EXPLORING CREATIVE DECISION-MAKING IN CHOREOGRAPHIC PRACTICE: A PHENOMENOLOGICAL STUDY OF SITUATED COGNITION

by

Kristin Carlson
BFA (Dance), The University of Illinois at Urbana (Champaign), 2005

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Name: **Kristin Carlson**

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Examining Committee:

Chair:

Dr. Marek Hatala
Associate Professor

Dr. Thecla Schiphorst
Associate Professor

Dr. Philippe Pasquier
Assistant Professor

Dr. Tom Calvert

External Examiner
Professor Emeritus

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ABSTRACT

This thesis explores creative decision-making in choreographic practice by studying phenomenological experience of choreographers. By using a digital tool named *Scuddle* that employs a genetic algorithm to introduce constraints for movement generation, we reveal creative decision-making processes in choreographic cognition. When a portion of the choreographic process is constrained to investigate tacit creative decision-making, the result is a heightened awareness of the process of making decisions. Constraining a choreographer's process challenges creative problem-solving skills, guides attention to the experience and facilitates verbal articulation of that experience.

In this research, the digital tool, *Scuddle,* generates 'catalysts' for movement, which are incomplete movement data that act as constraints to provoke movement development. As movement material and compositional structure is often intricately entwined, the incompleteness of this data facilitates creative exploration, enabling multiple solutions to be generated from such a catalyst. Phenomenological interview methods were used to aid choreographers ability to identify and articulate attention to decision-making throughout their compositional process.

Keywords: Choreographic Cognition; Dance; Evolutionary Computing; Phenomenology; Computer-Aided Choreography; Creativity

DEDICATION

To my parents for illustrating that reality is sometimes more exciting than dreams.

To my belay partner for all the challenges, the achievements and the constant support.

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Luc Vanier for bringing me onboard productions and discussions around dance, Alexander Technique, technology and life. You intrigued me with your own explorations in the poetics of choreography and challenged me to join in the debate.

Jeff Glassman for showing me that everything is a situated action. You taught me that I just needed to know which creative decision to make in order to be successfully different.

Thank you to all the choreographers and dancers I have worked with, both on the study in this thesis and those in the professional dance world.

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GLOSSARY

Choreographic Cognition	The mental and physical processes for constructing and organizing information towards movement craft
Choreography	The crafting of movement in space and time to create an abstract temporal experience for an audience
Cognition	The mental processes involving the construction and organization of information through perception, memory and language
Constraint	A method, task or tool that restrains options or choice
Creativity	A novel, surprising and valuable solution
Conceptual Knowledge	The codified understanding of the world, which extends beyond the body's physical experience. Compositional methods, structures, the understanding of narrative arc as including a beginning, middle and end are all forms of conceptual knowledge.
Kinesthetic Knowledge	What and how the *body* knows (manifest through experience) and is tacit, skill based expertise related to moving expressively and competently.
Phenomenological Interviews	Techniques to help focus on 're-living' experience, bringing attention to elements of experience that seem intuitive through open interviews
Scuddle	A digital tool that employs a genetic algorithm, Laban Effort Qualities and Bartenieff Fundamentals to introduce constraints for movement generation
Situated Awareness	Awareness of the self in the present moment in order to be influenced by present components

1: INTRODUCTION

> *'If embodied knowledge of dance techniques aids or (put more strongly) is necessary to understanding dances, then there is a reciprocal argument that analytic understanding of how choreography works (by, for example, looking at a variety of dance forms and, dare I say, 'the choreographic canon'), far from impeding creativity, can foster critical practice and encourage experiment.' (Rowell, 2009, p. 148)*

> *Of common concern to the writers [of this book] is the increased need for reflexivity and analysis, and the desire to investigate choreographic processes more thoroughly. This may have come about because of the growth of dance as a discipline in the university sector, but equally, because of the demands placed on dance artists to communicate their practice in languages other than dance.' (Butterworth & Wildschut, 2009, p. 2)*

1.1 Choreography and Process

This thesis explores creative decision-making in choreographic practice by studying phenomenological first-person experience of choreographers. By using a digital tool named *Scuddle* that employs a genetic algorithm to introduce constraints for movement generation, we are able to reveal creative decision-making processes in choreographic cognition. Contemporary Choreography is a creative practice based in extensive embodied knowledge and physical exploration. It has developed through a tradition of breaking boundaries: first with traditional ballet technique, then beyond the narrative structures of 'modern' dance forms and today extending post-modern explorations through creative uses of new technologies. Contemporary dance explores qualities of movement

and the mechanics of the human body through a historical understanding of the body in performance (Banes, 1987; Birringer, 2008; Blom, 1982; Burrows, 2010; Butterworth & Wildschut, 2009; Humphrey, 2003). Approaches to composition in contemporary dance often focus less on formulaic options and more on conceptual and experiential structures. While decision-making in the choreographic process is often described as intuitively driven and relying on one's practice based expertise, choreographic decisions are also situated in the current context and actions of the choreographer (Smith-Autard, 2000). Lucy Suchman, whose contribution to creativity in technology is based on social and cultural anthropology, describes actions as devised from a combination of knowledge and affordances of immediate experience (Suchman, 1987). Because dance relies heavily on kinesthetic knowledge, this thesis defines choreographic cognition as distributed[1] between kinesthetic knowledge, conceptual knowledge and situated awareness of the immediate context (Hollan, Hutchins, & Kirsh, 2000; Kirsh, 2010, 2011; Nardi, 1995; Risner, 2000)(see Figure 1).

[1] The term Distributed Cognition has emerged from psychology through the study of social organizations and interactions. It has become additionally relevant through the study of human-computer interaction by analyzing the way in which individual humans, objects, tools and environments interact with complex skills to collectively complete an action. I adapt this definition based on David Kirsh's work with Distributed Cognition and Choreography to explore the distribution of knowledge within the self and the immediate environment.

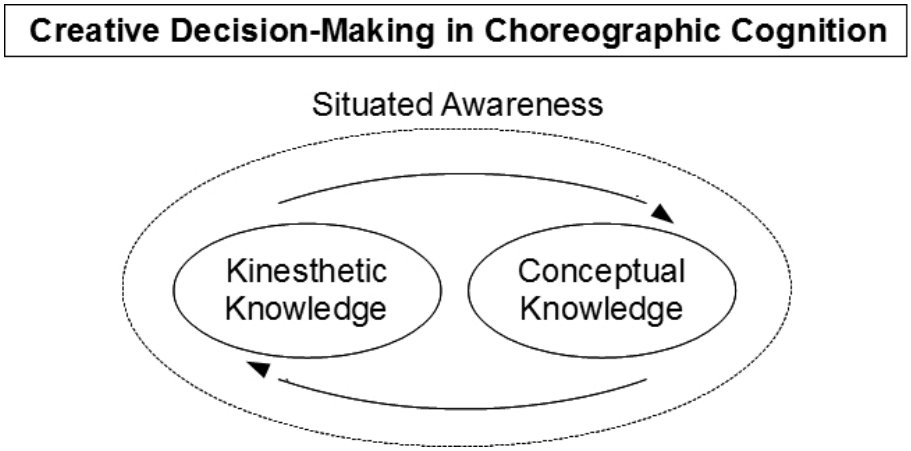

Figure 1. Choreographic Cognition is composed of Kinesthetic and Conceptual Knowledge that is interconnected with the current situated context

Cognition is the mental processes involving the construction and organization of information through perception, memory and language (Best, 1998). While cognition is often viewed as a strictly 'thinking' process, it also relies on the body's kinesthetic knowledge. Choreographic cognition could then be discussed as the mental process for constructing and organizing information towards movement craft (Bläsing, Puttke, & Schack, 2010). This process relies on an embodied interaction of kinesthetic and conceptual knowledge in the immediate situated context. Analysis of how these cognitive processes operate is important to constructing a deeper awareness of the interaction between kinesthetic and conceptual knowledge. I am interested in examining the choreographer's lived experience of their decision-making processes in order to understand how these operate in a creative problem-solving environment, This understanding may help me to develop creative support tools for novel movement generation.

Kinesthetic awareness is always experienced through the body (and in first-person). Conceptual knowledge is knowledge about the craft of choreography (that includes the knowledge of the world) that can also be considered as explicit knowledge (Bara, 1995). However in choreographic process, conceptual knowledge is *enacted* through the/a body. Situated knowledge is contextual, and describes conditions that influence choreographic decision-making. These conditions can include, the environment (outside, inside, architecture), props, technological systems and constraints, emotion, choreographic or administrative goals.

1.1.1 Kinesthetic Knowledge

Kinesthetic knowledge refers to what and how the *body* knows (manifest through experience) and is tacit, skill based expertise related to moving expressively and competently. Choreographers most frequently train as dancers first. Because the choreographer uses the medium of the dancer to create her compositions, choreography is a discipline that often embodies shared knowledge between the medium (the dancing body) and the creator (the choreographer). A dancer and a choreographer's kinesthetic knowledge is developed through an iterative cycle of physical experience in training, reflection and application of skills (Butterworth & Wildschut, 2009).

1.1.2 Conceptual Knowledge

Conceptual knowledge refers to codified understanding of the world, which extends beyond the body's physical experience. Examples in dance are

movement systems such as Laban Movement Analysis and codified dance techniques such as Graham or Limon techniques that have prescribed techniques and forms used by dancers and choreographers. Compositional methods, structures, the understanding of narrative arc (for example, the structural form of including beginning, middle and end) are all forms of conceptual choreographic knowledge.

1.1.3 Situated Awareness

Situated awareness refers to external sensory and contextual influences in the moment; for example, the goal of the choreography and the environmental affordances such as the architecture and site of the space..Based on Suchman's definition of action, we can say that choreographic action contains knowledge that is intertwined so tightly in the movement produced that it is very difficult to separate the action from the knowledge. Because of this tightly coupled aspect of tacit knowledge and action within choreography, it has been difficult to unpack details that occur in the decision-making processes within choreography. While there are many discussions on the nature of thinking and embodiment, in this research, I dissect choreographic knowledge into these 3 categories only to highlight the *dominant* aspects of an action and to provide an explanatory frame for my experimental process.

1.2 The Use of Constraint as a Form of Dehabituation

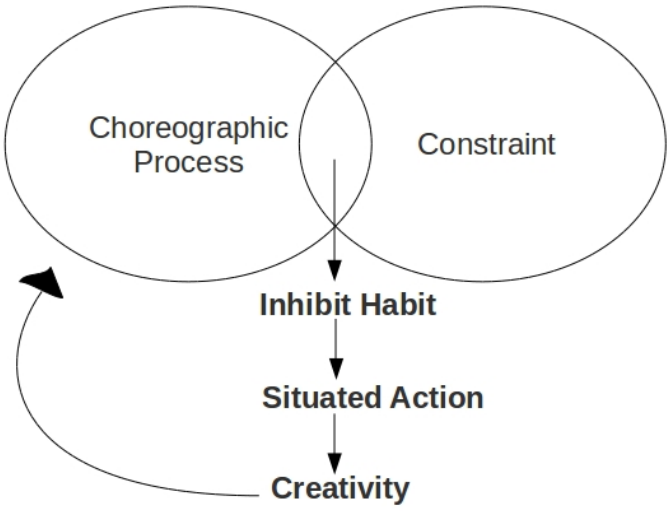

Figure 2. Using constraints in choreographic process inhibits choreographic habits, requiring choreographers to use situated actions that facilitate creativity in choreographic process

Throughout life experience, habits form to provide known successful solutions to new experience. While we rely on habits to address new experiences, it is also useful to have the freedom to assess additional, potentially creative, solutions. A method to create access to creative solutions is the use of constraints (Stokes, 2006). Well designed constraints inhibit the immediate, habitual response in order to prompt or bring awareness to alternate novel solutions (See Figure 2).

The body's knowledge allows us to act. Thinking processes enable reflection on actions, and this reflection in turn informs our kinesthetic knowledge and decisions to act. To be able to act 'on cue', as dancers are required to do,

kinesthetic knowledge develops movement pathways that become ingrained in the body and are therefore readily available and eventually habitual. Habits develop from a choreographer's physiology, personality, technical training, compositional training, and the experience of 'being in the world' as an everyday person (Alexander, 1970; Merleau-Ponty, 2002) (see Figure 3). Choreographic habits could be seen as 'exploitation' of decisions that are already known to be successful, while creativity is more about 'exploration' of other possible options that are unknown for success (Russell & Norvig, 2010). Choreography uses the combination of different forms of *knowledge* to make decisions through constant reflection-in-action, assessing decisions from multiple perspectives in the moment (Schon, 2000). Choreographic cognition supports a decision-making process that is distributed among these different forms of knowledge (body, mind, environment) and interacts between them. In this thesis, I investigate decision-making in choreographic process to better understand how choreographic cognition is distributed between forms of knowledge that result in varying degrees of habit, creativity, conceptual representation and current experience.

While our conceptual knowledge pushes our mind to imagine the impossible, our kinesthetic knowledge grounds us in the possible. Dance provides an opportunity to examine the interplay between the imagined potential, constrained by physical ability and the variables and affordances of context from which to create from. As the development of technology moves further into intelligent interfaces and digital tangible interaction, we are witnessing a

concurrent reinvigoration of the body's intelligence and its physical/tangible abilities. Deepening our understanding of how the body, mind and environment collaborate is valuable to the development and use of technology in our lives. While the investigation of cognition in experiential process is difficult (Dewey, 1925) because decisions are often made based on tacit experience, embodied knowledge and intuitive foresight, this research uses technology as a constraint in order to reveal and articulate the choreographic decision-making processes.

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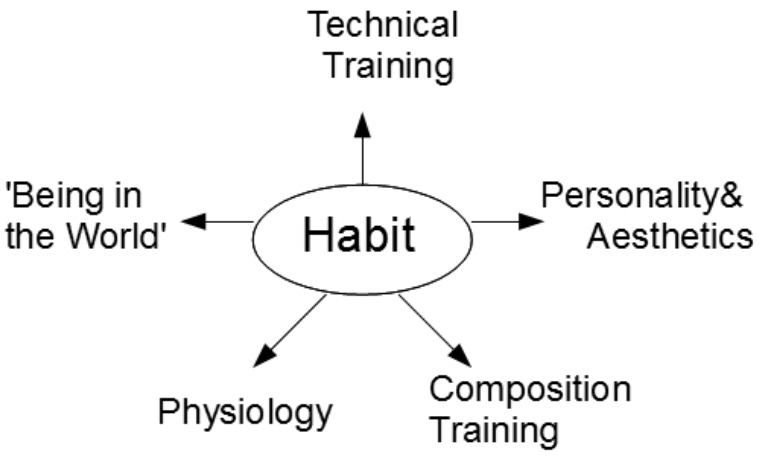


Figure 3. Sources that build habitual knowledge

Decisions are frequently experienced as a balance of habit, influence and inspiration that is difficult to observe or articulate verbally. To accurately explore the experience of decision-making, awareness needs to be brought to the act of making decisions in a way that aids the choreographer in identifying and verbalizing the different forms of knowledge they rely on. To develop awareness

in dance, somatic body-based practices are often employed as methods for working through and beyond habitual response (Alexander, 2001; Feldenkrais, 1991).

Somatics are the study of self-awareness and control to optimize available voluntary decisions (Johnson, 1995). They operate on a method of inhibiting habitual response to allow one to observe other possible responses and increase the potential choices to act upon in the most useful, efficient or creative way possible. This practice is an active one, often using constraints to facilitate a constant reflection-in-action, inhibiting the initial habitual response to consider all available responses (Gelb, 1987). The relationship between imposing constraints, developing awareness, and creating new patterns is paralleled in research on creativity. Exploring creative decisions in any discipline frequently relies on using constraints, strategic, sometimes self-imposed parameters, to inhibit habitual responses and generate novel, but controlled, responses (Stokes, 2006).

The use of constraints has also been termed ‘making strange’, ‘defamiliarization’, ‘forward provoking’, or using catalysts. By applying constraints to creative decision-making tasks, familiar practices are rendered unfamiliar or ‘strange’. Defamiliarizing engrained practice facilitates creativity and develops heightened awareness of that particular practice, making it easier to identify and verbally articulate (Butterworth & Wildschut, 2009; Crawford, 1984; Heidegger, 2008; Sheets-Johnstone, 1999). The application of constraints to familiar practices facilitates the inhibition of initial habitual responses, while

simultaneously supporting awareness of these initial responses and opening choice for broader stimuli and action. The ability to incite greater awareness results in the ability to evoke creative choices in exploring and building new, more useful, solutions (Alexander, 2001). In the process of becoming aware, the practitioner learns that their solid foundation of knowledge is not merely a single tacit response, but is a variety of facets between experience, training, sensory, aesthetic and conceptual influences. Constraint based techniques provoke awareness that can shift between these distributed forms of knowledge, cooperatively building greater capacity of choreographic cognition.

1.3 Technology as Constraint

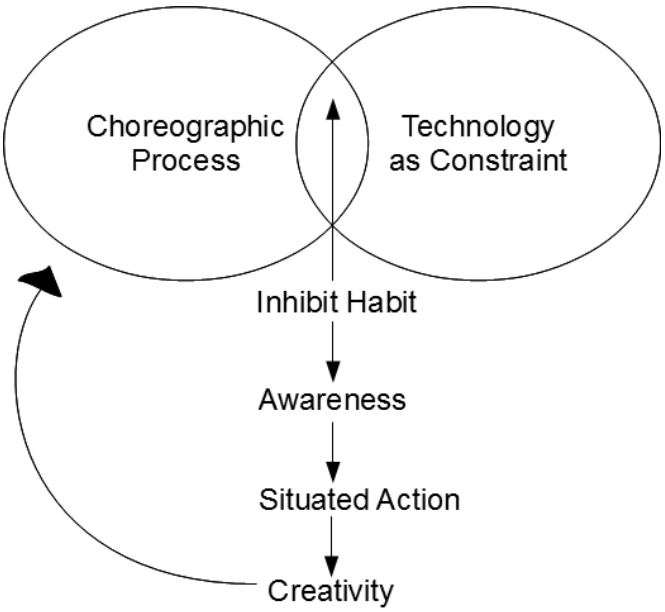


Figure 4. The process of using technology constraints to facilitate creativity in choreographic process

Digital technology can be a useful research tool to aid in ‘making strange’ (Sheets-Johnstone, 1999) provoking or creating constraints in physical practice to facilitate awareness of actions (See Figure 4). Digital technology can provide options for generating potential ‘solutions’ based on a series of factors that might not be available in the physical world. For example, Merce Cunningham used the software ‘LifeForms’ as a virtual provocation to explore movements that are not physically possible or practical on the human body (Schiphorst, 1993). In exploring how physical bodies might adapt to perform these motions he discovered new, creative movement possibilities from which to compose dances (Copeland, 2003). By analyzing choreographic process, an objective model can be constructed that enables reflection on actions and decisions (Blom, 1982). Technology easily lends itself to supporting analysis through video documentation, compositional software such as LifeForms and Whatever Dance Toolbox, and as design elements in performance through media, sound and interaction. Technology supports analysis and objectivity because the successful design of technology is due to appropriate implementation of constraints or limitation (Calvert et al., 1998; Candy, 2007, p. 2). This is relevant in choreographic process even when using more sophisticated choreographic software such as LifeForms: the constraint of working on a virtual human is vastly different from physical dancers who bring their tacit knowledge of movement into the studio.

Scuddle is a digital tool that I designed and developed to provide constraints for the initial stage of choreography: the generating movement stage

(Carlson, Schiphorst, & Pasquier, 2011). Scuddle was designed to provide the choreographer with incomplete movement data, specifically selected information to control specific components of creating movement. This use of constraint guides choreographic decisions towards certain identifiable aspects (body position, height of the movement, qualities of the movement) while allowing freedom for other decisions. The use of Scuddle in generating movement through choreographic decision-making is able to reveal habitual choices in situ, and guide the choreographer towards new choices. These new choices can often be viewed as creative because they rely on the choreographer's situated actions and increased level of awareness in those actions.

Through my personal experience of being a dancer and a choreographer who learned and developed movement expertise first-hand and through my own body, I have explored the questions of how I 'know' how to move and choreograph. Through my formal choreographic training, I have learned to make observations of my own and of others compositional process. One such observation is that as people continuously develop habits in the way they move, think and take action there develops an equal and corollary tendency of the search for creativity that can 'break' these habits. This parallel compositional trajectory develops into a tension, or serenade, between interactions of habit and creativity. To understand this process of interaction more deeply means the 'fostering of critical practice and encouraging of experimentation', as Bonnie Rowell states in the opening quote on page 1 of this Chapter. This can lead to new *artistic* explorations in the field of dance, and can also extend techniques for

teaching movement and composition. Further knowledge of how creative decisions are made and acted upon is useful to a variety of researchers including those in creativity, human computer interaction, communication, education, cognition, kinesiology and psychology.

1.4 Researching Choreographic Cognition

In this thesis, I explore the choreographic decision-making process by inhibiting a portion of choreographic process in order to bring awareness to the decision-making aspect of the process. This 'inhibition' facilitates the ability to identify and verbally articulate the choreographic process. Because I am explicitly exploring the choreographer's awareness of their *experience* of decision-making, I utilize phenomenological interview methods to gather data that enables me to analyze and research the process (See Figure 5).

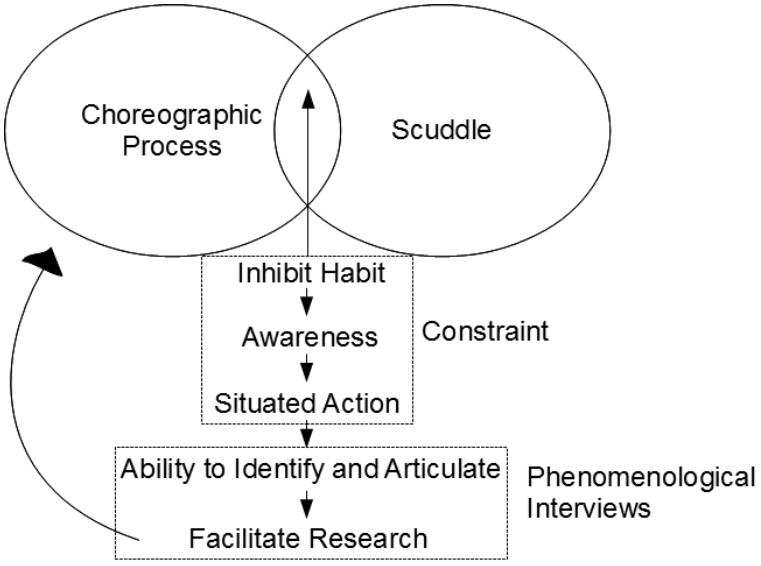


Figure 5. The process of using technology to understand decision-making in choreographic process in order to invoke greater creativity

Choreographic process can include habitual decision-making in the construction of movement. This can be inhibited by using a method of ‘making strange’, bringing a choreographer’s awareness to their own unique compositional decisions. I employ this mechanism by using a computational tool entitled Scuddle to generate 'catalysts' for movement that act as ‘incomplete movement data’; specific parameters used to provoke movement vocabulary development. As movement material and compositional structure is often intricately entwined, the incompleteness of data facilitates creative exploration, enabling multiple solutions to be generated from a catalyst. This process supports the exploration of decisions by making the decision between many visible solutions become equally visible. In Heideggarian terms decision-making becomes ‘present-at-hand’ (Heidegger, 2008).

In my research study, eight choreographers were asked to create a short work over the course of three studio sessions, using the movement vocabulary generated from Scuddle movement catalysts. In order to explore the process of 'becoming aware' through the inhibition of habitual choreographic responses, I used phenomenological interview methods to aid choreographers in identifying and articulating their attention focus throughout their compositional process. Data from interviews was analyzed by transcribing interviews and analyzing choreographer responses using a grounded theory-influenced approach to creating categories and to develop observable patterns and themes of interaction between choreographic forms of knowledge (body, mind, environment). The outcome of the resulting analysis is a model of choreographic cognition based on

the use of technology as constraint in order to invoke awareness of creative and cognitive decision-making.

1.5 Research Objectives and Questions

Research Objectives

1. To understand choreographic decision-making through the use of creative constraints modelled within a technological AI tool (Scuddle).
2. To apply phenomenological inquiry in order to access choreographers' experience with the use of technological constraints in choreographic process.
3. Develop an explanatory model that describes specific features of choreographic decision-making when using incomplete movement catalysts designed (extracted) from an AI based technological tool.

Research Questions

1. How can constraints, particularly technological constraints based on incomplete movement catalysts defined by an AI tool, Scuddle, support better understanding of choreographic decision-making in the creation of new and creative choices in three levels of choreographic process including movement generation, sequence generation and higher-level choreographic craft?

2. How can phenomenological inquiry support the description and analysis of experiential choreographic evidence that describes tacit knowledge embedded within choreographic decision-making processes that are normally not verbalized or extracted from choreographic process?
3. What are the attributes of a phenomenological model of choreographic decision-making process that have explanatory value within choreographic cognition and that can describe choreographer's creative process in movement generation, sequencing and choreographic craft?

1.6 Structure of Thesis Chapters

This thesis investigates creative decision-making in choreographic practice by using a digital tool named *Scuddle* that employs artificial intelligence to introduce constraints for movement generation. I study how this movement generation develops in choreographic process through a phenomenological first-person study of choreographers that have used *Scuddle*. Chapter 1 introduces the argument, background and research questions, which lays the foundation to define choreography and the forms of knowledge frequently discussed by practitioners. Chapter 2, Literature Review of Choreographic Process, provides a review of contemporary choreography literature including analysis about choreographic process, creative process literature, and a background of studies that describe how constraints are used to generate creative decision-making processes. Chapter 3, Literature Review of Choreographic Cognition and Technological Models for Choreography, continues the literature review by summarizing the current state of research in choreographic cognition and

reviews technologically based tools for choreography, analyzing how computational intelligence has supported choreographic process within the history of technological tools for movement.

Chapter 4, Methodology and Design of Scuddle, describes the methodology and research design used to gather data on choreographer's experience of their choreographic decision-making process based on their explorations with Scuddle. Chapter 5, Study Design and Exploring Phenomenological Data from Choreographic Decisions, summarises Phenomenological Inquiry and Data gathering methods including phenomenological interviewing techniques figure prominently into this research. Chapter 6, Results of Choreographic Decision-Making, describes the Results and Data Analysis of the Choreographer's Interviews, exploring a model of choreographic cognition in constraint-based experiences. This model includes participant beliefs and Expectations, choreographer's use of attention and attention shift, choreographers' assessment of decision-processes, the operation of Attention in constructing and sequencing movement, and in constructing higher level choreographic craft. Finally, Chapter 7, Conclusion, discusses implications of the model for data analysis and presents a conclusion and future work.

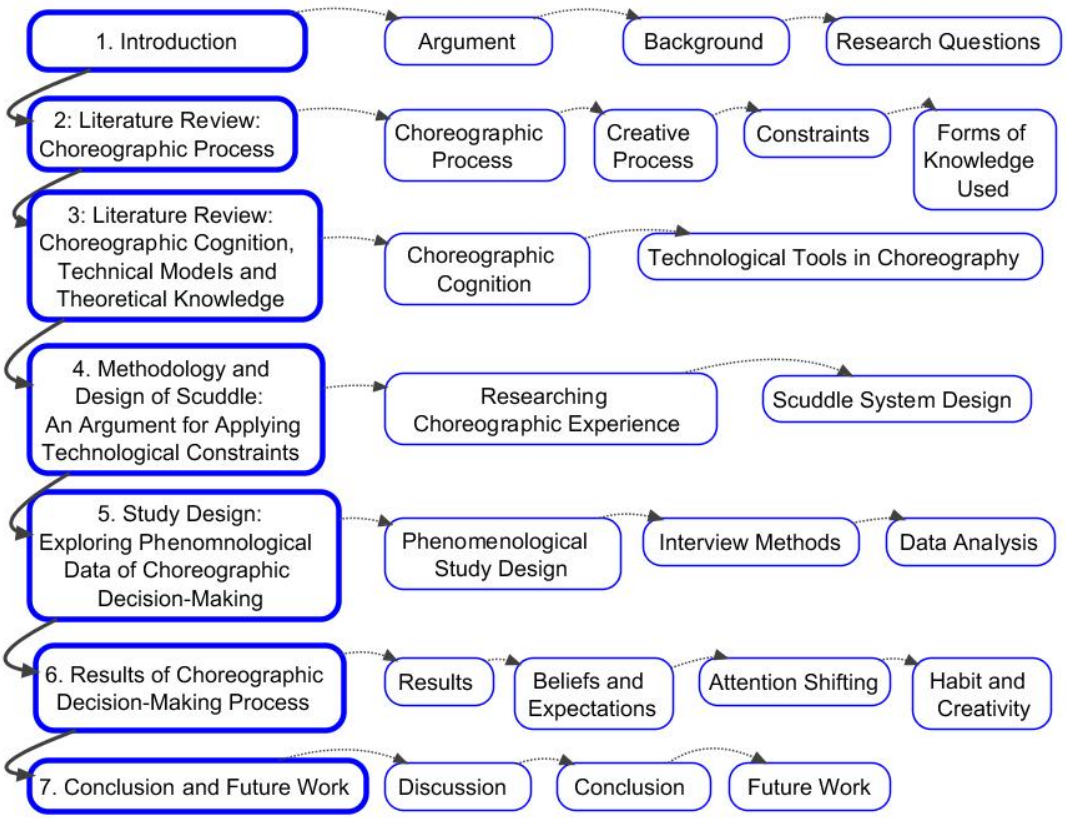


Figure 6. Summary of Thesis Structure which lays the foundation to define choreography and the forms of knowledge that is frequently discussed by practitioners

2: LITERATURE REVIEW: CHOREOGRAPHIC PROCESS

2.1 Introduction to Choreographic Process

The research in this thesis explores choreographic creativity through the use of technological constraints that can generate creative decision-making processes. In the following literature review, kinesthetic knowledge is discussed as tacit knowledge developed through technical training, physiology, personal preferences (based upon personality profiles), and somatic practices which expand movement awareness and agency through processes of dehabituation. Conceptual knowledge is described through the lens of dance history including choreographic techniques, the application of constraints to creative decision-making the understanding of the dancer's body mind connection. Situated knowledge is described as the ability to apply kinesthetic knowledge, conceptual knowledge and creativity together to invoke action. Situated knowledge can be dependent on the choreographer's internal or external immediate experience or an imposed internal or external immediate experience.

This literature review of Kinesthetic, Conceptual and Situated knowledge in Choreographic Process is outlined in Figure 7 below. The chapter begins with an introduction to choreographic process and the researcher/s personal experience to lay the foundation for discussing choreographic cognition. Choreographic cognition exists within kinesthetic experiential knowledge, which includes the tacit and physical knowledge of the researcher and the research

participants within the study. Choreographic cognition and the act of choreographic decision-making is based upon conceptual knowledge which includes models of analytical and theoretical choreographic knowledge. Choreographic Cognition includes knowledge that is kinesthetic, conceptual and situated.

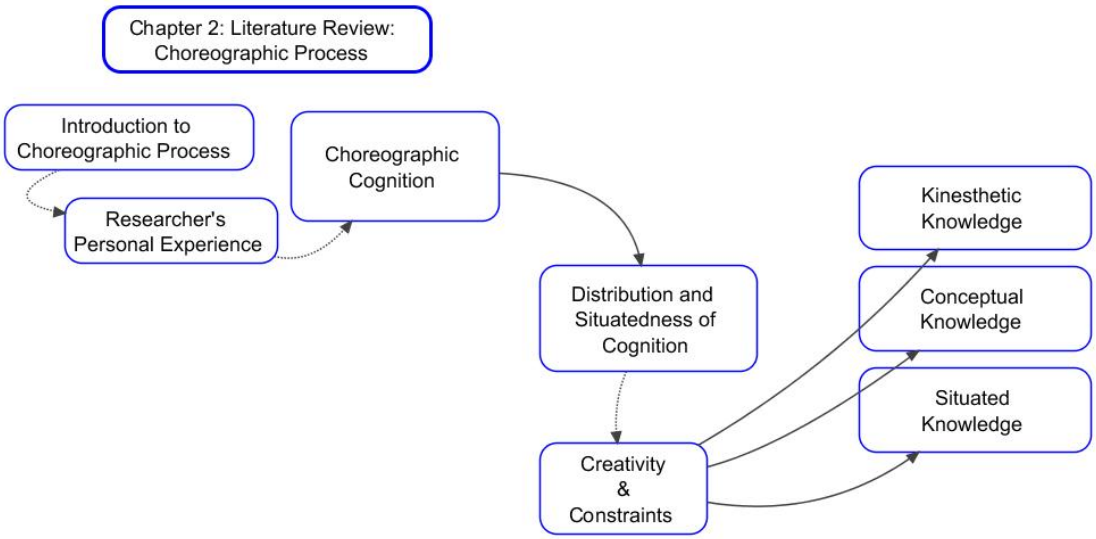


Figure 7. Diagram of Theoretical Framework for the First Literature Review Chapter

2.2 Choreographic Process: Definition

'You do not learn to choreograph by reading about it… You learn by getting your ideas out and into movement, onto a body, giving your dance an independent existence.' [Blom, 1982]

'I believe that we learn by practice. Whether it means to learn to dance by practicing dancing or to learn to live by practicing living, the principles are the same.' (Graham, 2010, p. 8)

Choreography is the crafting of movement in space and time to create an abstract temporal experience for an audience (Adshead, 1986; Banes, 1987; Blom, 1982; Humphrey, 2003; Smith-Autard, 2000). The choreographic process develops through a series of iterative cycles from creating a movement 'vocabulary' to sequencing or creating 'phrases' of movements to crafting phrases and movements into a finished work. Like other art forms, choreographic process may often begin with a blank canvas. Outside influences can be used to guide the process, but there is no required script, no score and no absolute direction imposed from the beginning. The process of choreographing, as with many art forms, explores a combination of kinesthetic knowledge, conceptual knowledge and the situated experience of the choreographer and their dancers. A dance work may explore a certain quality or limitation of movement, a conceptual idea, a social or cultural phenomena, an immediate kinesthetic response, the experience of the surrounding sounds, or any additional or combination of sense-based, metaphoric or other structural concepts. However, choreographic material is always explored through the body's individual experience of moving, regardless of the artistic concept or choreographic experience that is being explored.

2.3 Researcher's Background and Personal Choreographic Experience

The exploration into creative choreographic process and decision-making explored within this thesis stems from a combination of the background literature

and my own personal experience in the field of dance and choreography. My experience in dance is nuanced and rich. I have been a dance student for over 20 years, a professional dancer, choreographer, teacher and technician. In this professional history of training, experience and exploration, I have always had an interest in combining the practices of art and technology and exploring how the concepts of one domain support and deconstruct the other. I have been curious about how the practice of dance, and the emerging developments in technology can incite each other in creative decision-making. This interest became important to me while learning dance technique, exploring how to compose for movement and choreography, and learning to expand my awareness in movement and in cognitive choices in situ through somatic techniques. These personal experiences support my interest in the concept of choreographic cognition as knowledge that can be extracted to rely specifically on kinesthetic knowledge, conceptual knowledge and situated knowledge. My prior training and education has included the exploration of many movement and choreographic techniques, while I am most comfortable and more ‘at home in my body’ in contemporary dance, improvisation and ballet. My formal training evolved to include teaching skills as well as performing, choreographing and producing performances. In dance production I have played many roles including stage manager, lighting supervisor, lighting designer and general technician.

Through these multiple personal experiences, and aided by the research literature and prior work, I am aware that there is a tremendous archive of prior compositional knowledge in the field of choreography for creating a movement

vocabulary and supporting form or sequence in choreography. My own experience and knowledge has been developed through dance education, composition classes and improvisation techniques. Yes, within this large body of work, there is very little research as evidenced in the literature that explains or illustrates how a choreographers' knowledge, acquired through training, exposure and experience, is put to use in the moment of a choreographic 'problem'.

The exploration of artistic ideas in physical form frequently relies on association and metaphor as a way to convey meaning in an inter-subjective context (Hanna, 1987; Johnson, 1990). These metaphors often reference cultural, experiential and sensory knowledge to present an idea, story, environment or experience to the audience. Research has been undertaken to explore these associative and affective results of a performance (Grove, Stevens, & McKechnie, 2004; Hanna, 1987). An emerging area of research has recently been exploring the physical methods that connect audience members to their perception of the performance and performer (Calvo-Merino, 2010). This ability to experience and become engaged in choreography is built upon our individual understanding of the world, ourselves and our social interactions (Argyle, 1978; Heidegger, 2008; Merleau-Ponty, 2002). Our ability to craft choreography is also based on our individual understanding of the world, ourselves and our social interactions. Even my ability to craft this thesis is therefore based in my individual understanding of the world, myself and my social interactions.

In this research and as evidenced by the results of the study with choreographers, the affective, social and cultural implications of choreography are viewed as beliefs and expectations that the choreographer holds. While these components affect the decisions that a choreographer makes, they are also implicit directives that are situated in the global time and place of creation. This research explores a choreographer's explicit decision-making process through the concept of distributed and situated cognition. This includes the distribution of local, immediate attentions as well as various learned components, including: physical training, compositional training, creativity potential and capacity for analysis (See Figure 8). The choreographer's Distributed Cognition results in actions taken by choreographers that are situated in the habitual, environmental, sensory and conceptual constraints of the moment.

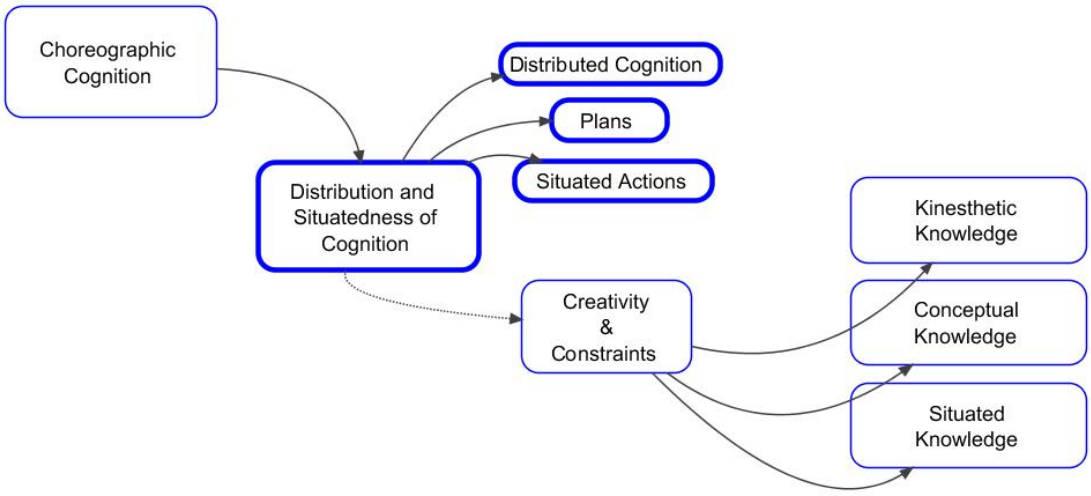


Figure 8. Choreographic Cognition is Distributed and Situated Which Leads to Creative Choices

2.4 Distributed and Situated Cognition as it Relates to Choreography

The term Distributed Cognition has emerged from psychology through the study of social organizations and interactions (Hollan et al., 2000). Within human-computer interaction distributed cognition has been utilized to analyze the way in which individual humans, objects, tools and environments interact with complex skills in order to collectively complete an action (Gill, 2007; Hollan et al., 2000). The term Distributed Cognition explores the backgrounds, skills, goals, the location of knowledge storage and direction of attention that affect how decisions are made between people and systems. Intelligence can be distributed by placing memories, facts or knowledge on the objects and individuals in the collaboration to facilitate the prioritizing of actions. For example, an airline captain relies on first and second officers to fly a plane along with the flight controls, gauges and the radio to the control towers. Though there is a hierarchy to the system, this distribution of cognition ensures a safe flight (Engeström & Middleton, 1998). These components work together, to create a social intelligence that can respond to most situations in an efficient nature.

In choreography, an artistic composition depends on the distribution of cognition within the choreographer's kinesthetic knowledge and conceptual knowledge, as well as their situated awareness that includes elements such as the present environment, artistic concept and creative intention to enable a creative process. Choreographic decision-making is distributed between many components. These include the choreographer's individual (historical) physical abilities and training, the (historical) physical abilities and training of the dancers,

their compositional training, their cultural, social and aesthetic influences, their personality, and their background and life experiences (to name a few). This distribution of knowledge (between individuals and cultural and learned influences) and ability to make connections between different types of knowledge (whether arbitrary or meaningful) makes up creative craft (Gabora, 2000).

Choreography often uses both plans and improvisation in order to develop movement material. Nardi and Suchman suggest that improvised decisions form the basis of Situated Actions even in the context of plans. Situated actions are based in prior knowledge combined with a current contextual situation. Situated Actions can, but do not necessarily, follow a path defined by prior Plans (Nardi, 1995; Suchman, 1987). Plans require goals towards which one executes actions. Yet, obstacles and new directions arising from improvisation constantly adjust the current work process based on the original goals. This description of situated actions parallels choreographic process. Choreographers define goals for their choreographic works, and these goals are executed through movement expressed through dancers. Although not all choreographers ask their dancer to improvise choreographic process, the implementations and execution of movement is fulfilled and enriched through improvisational expression, both in the choreographic process itself, and in the performance of the choreography. In Nardi and Suchman's terms, situated environments often require responsive thinking and quick actions in order to continually progress, which often results in unprecedented decisions.

Situated actions are defined as improvisatory actions that emphasize human action as constantly constructed and reconstructed from dynamic interactions with the environment, tools and other individuals. Gaining knowledge through experience helps to design actions *intelligently* towards the execution of a plan. Experience includes the current environment and circumstances as well as one's background, skills and resources. One's experience helps to create intelligent plans by refining communication with others and prioritizing between actions. Although Nardi and Suchman's construct of situated actions is often confined to workplace and computationally supported environments, these constructs apply equally well to choreographic situations. Improvising on a concept or action is a common method for developing movement material and collaborative movement communication both within the body (between various body parts or body and cognitive decision-making processes) and between the choreographer and dancers. While Plans refer to the loose goals or structures that are designed in a choreographic design, the improvised responses of performers is similar to the term Situated Action, or actions taken in response to a developing situation. Every action made by a choreographer is situated in the context, experiences of the choreographer and the dancers and the goals of the group and the choreography.

2.5 Creativity and Constraints in Creative Process

> *'The traditional role of the artist, composer or writer is thus called into question; it may no longer be necessary to assume that he is a specialist in art-rather he is a catalyst of creative activity.'*
> *(Cornock & Edmonds, 1973)*

While many people assume every action in the arts to be creative, the current use of the term ‘creativity’ often reflects Margaret Boden’s definition: a novel, surprising and valuable solution (Boden, 1998). Many choreographic actions could be considered valuable, as serving the guiding authority of the dance, however only some could truly be considered novel or surprising. So how much creativity is in the craft of choreography? Can habit be considered creative?

Boden discusses creativity as being either *Exploratory Creativity* or *Transformational Creativity.* Exploratory creativity is an exploration of all available ideas within existing parameters (or constraints) that result in a selection from within those parameters, while Transformational Creativity is an action that generates ideas well outside of existing parameters (Boden, 1998). Even within a creative process such as choreography, we can assume that from the nature of prior knowledge, experience and habits, most actions are taken within the realm of *Exploratory Creativity*. Gabora extends this boundary by suggesting that cognition operates through an iterative cycle of spontaneous shifting between associative, de-focused attention and analytical, focused attention (Gabora, 2007). How attention is focused towards a creative decision, however, is highly dependent on the existing constraints.

According to Patricia Stokes, a psychologist and artist, the type of constraints utilized in creative-decision making affects the types of solutions generated (2006). The chosen constraint defines the search space, defining the potential solutions available at that time. Stokes suggests that creative

constraints have to work in pairs (the first to inhibit habit, the second to induce new creative choice) in order to restructure an existing problem space; routine or habitual results need to be restrained while new and ‘creative’ results need to be provoked (Stokes, 2006). Creative process has been discussed as an iterative process that explores local concepts that eventually chunk to expand into global concepts (Yokochi & Okada, 2004). Working locally often relies on the creator following patterns, in which case their habits and prior knowledge both support and make the decisions. Within artistic creative decision-making, the addition of constraints requires the artist to work around, through and outside of the imposed parameters to adjust their local ideas (Yokochi & Okada, 2004). Catalysts for creativity, the concept of using a consciously imposed constraint to provoke situated and creative possibilities, have been used extensively by artists throughout history. Creative catalysts are often used to explore ideas in new ways and to push the artist’s choices and actions beyond known answers. Artists often create their own constraints to explore new possibilities for change, such as Monet’s repeated paintings of the same row of poplar trees (24 times) with the goal of discovering new ways of seeing the same trees (Stokes, 2006). Another example describes the shift from Abstract Expressionism to Pop Art and is illustrated in Figure 9. In this example the use of *creative constraints pairs* inhibit a routine and established ‘expressionist’ action while simultaneously provoking new creative choices by guiding awareness to developing another ‘pop art’ act.

Paired Constraints for Pop Art

Problem Stages	Description
Initial state	Current "hot" painting style, Abstract Expressionism
Constraint pairs	1. Preclude emotional impact → Promote intellectual distance (irony)
	2. Preclude improvisation → Promote pre-planning
	3. Preclude abstraction as motif → Promote ordinary, real objects as motifs
	4. Preclude complex forms → Promote simplified forms (hard-edged)
	5. Preclude modulated colors → Promote primary, unmixed hues
	6. Preclude virtuoso brushwork → Promote flat paint application
Goal state:	New "cool" painting style, Pop Art

Figure 9. Paired Constraints for Pop Art Generation (Stokes, 2007, p. 110)

2.6 Kinesthetic Knowledge in Creative Process

'… it seems that in life a person uses his own wide range of movement patterns, both subtle and crude, in gestures and "shadow" movements, in order to try to balance his own inner vibrations and attitudes." (North, 1984, p. 9)

'…we would rarely confuse a sleeping man with a thinking one, however relaxed the body appeared in the thinker, and usually there are intermittent shadow movements or body adjustments which indicate mental activity. It is a mistake to conclude that the mind and body are separate, because of such definable movements of seeming separations; they are relatively infrequent'. (North, 1984, p. 11)

Body knowledge and conceptual knowledge are difficult, if not impossible to separate. I begin this discussion with the highest level of generality in order to assess the concept of *'initiation of action'*. Every movement that is physically learned is accompanied (during the learning process) by the conceptual knowledge of how to do it, the perception of what it feels like and looks like and the assumption of how it should operate to complete a movement goal. Dancers and choreographers create with and through the body, which in body-based

practices is referred to as the '*knowing body'* (Wilde, T Schiphorst, & Klooster, 2011). The 'knowing body' interacts with the world and gains knowledge from its interactions which are both functional and aesthetic. How a person's body is used in the everyday world is based on its biomechanical structure and learned ability to function, as well as the person's perception of themselves, including their personality. It is with this *particular* body, and everyday knowledge, that dancers investigate movement through technical dance training, by testing the rules of biomechanics and physics and by deepening their attention to their everyday constructed knowledge of understanding how to move.

A dancer's physical training includes learned understanding of body shaping, spatial intent and movement qualities (Laban, 1976). This knowledge is attained through studying various codified techniques, somatics principles and 'learning by doing' (Anzai & Simon, 1979). Though all dancers learn by doing, in this thesis, the definition of learning is focused primarily on *choreographic learning* that occurs during a studio rehearsal session in situ through the direct application of techniques that invoke creative process in order to create 1) new movement, 2) new movement sequencing or 3) higher level choreographic crafting. Choreographic learning is distinguished from a dancer learning dance technique intended to develop greater physical expertise in moving the body as an instrument of expression.

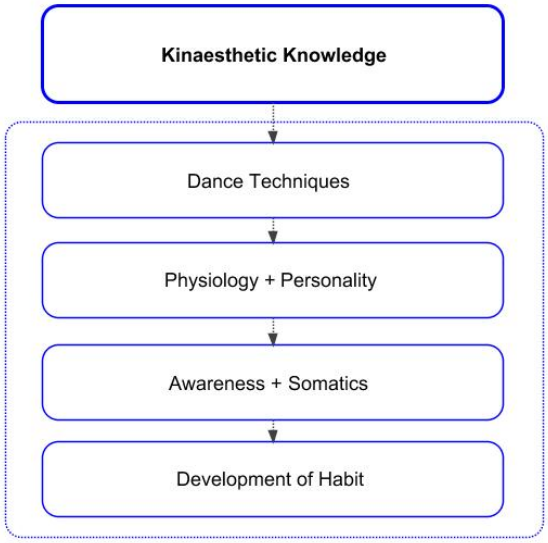


Figure 10. Outline of Kinesthetic Knowledge Review

To summarize this section, kinesthetic knowledge is comprised of dance technique (codified techniques the support fluid and expressive movement), physiology and personality of the dancer, the application of awareness and somatic techniques of attention to learning, and the development of habit which supports the reduction of cognitive load while simultaneously reducing the number of conscious choices available for action (See Figure 10).

2.6.1 Dance Techniques

A multitude of techniques have evolved historically through the development of a variety of dance forms. Dance techniques function to teach a dancer's body to articulate movement that supports specific styles, historical preferences, and political and artistic ideals. Classical techniques often refer to ballet styles such as Ceccheti (Italian), Vaganova (Russian), and Royal Academy

of Dance (RAD) that focus on the body's elongated relation to space in a proscenium arch environment (Foster, 1998). Each dance technique emphasizes different aspects of dance; for example Ceccheti focuses on constantly flowing arm movements (port de bras) while Vaganova emphasizes technical precision that looks effortless. In the late 1900's and early twentieth century, the free period, or American Expressionist dance, including artists such as Isadora Duncan, saw a rejection of precision and rigidity in movement to focus on the freedom of the human body and as a return to 'her conception of the Greeks' ideas about the soul and the body' (Foster, 1986). The modern period of the 1930's through 1960's reined in the developed freedom of movement to explore more drama-based movement styles such as Martha Graham's tension-filled contractions and releases (Foster, 1986). Expressionism developed in Germany during the 1930's with Mary Wigman and Kurt Jooss (students of Rudolf Laban) and was extended into the form, Tanztheatre, with Jooss' student, Pina Bausch. Expressionism turned more towards dance theatre, exploring effort qualities and emotion to dramatic lengths (Manning, 1998). The post-modern period that developed in the United States in the 1960's and 1970's reinvented dance again to explore everyday and pedestrian movement as both performative and improvisational (Au, 2002a; Banes, 1987, 1994; Ross, 2007). Contact improvisation emerged through the post-modern period to explore the capability of the body to compose in the moment, situated in the environmental, temporal and social aspects in the present moment. Contemporary technique classes taught by choreographers such as Ohad Naharin (Batsheva Dance Company),

David Dorfman and Anne Theresa De Keersmaeker, as well as many forms of current training, focus on a combination of previous era's techniques and styles to explore different approaches to gaining awareness and control of one's body. Contemporary dancers often study multiple techniques in order to increase expressiveness, strength and flexibility. Many contemporary dancers today will study ballet, contemporary and other body-based release practices in order to fulfil their ability to treat their bodies as a medium of movement. A professional dancer "takes class" everyday in order to keep the body aligned and ready to move.

2.6.2 Physiology and Personality

> '*We know that words can be used in many ways: to say what we mean, what we think we mean, what we think we ought to mean, what we deliberately do not mean and so on. Movement, as revealed in our gestures, unconscious movements ("shadow" movements), body carriage and our working actions, is always "ourselves". It always speaks honestly, or by its counter-actions of superimposed phrases reveals that an act (conscious or unconscious) is being put on. The assessor of movement recognizes the difference between habitual and temporary actions, for it should be remembered that even these "acquired" momentary actions still belong to the person.' (North, 1984, p. 6)*

A dancer's physiology affects how they interact with the world as well as how they approach their dancing (Fitt, 1996). While bodies are anatomically similar, every body is also anatomically unique and it is these personal differences that produce slightly different functioning for each unique body. Within dance and body-practices there are many systems that classify these differences in order to provide explanatory value to differences in function,

movement and learning. *Somatyping* is an attempt at classifying body types that can reflect anatomical abilities and limitations, though few people truly fit precisely into the classifications. For example, ectomorph bodies are slender, have a fragile bone structure and don't build muscle quickly, often have loose ligaments and very flexible joints. A highly efficient nervous system supports a preference for small, quick movement. Mesomorph bodies are more athletic and as a result often stronger and less flexible. An efficient cardiovascular system results in high endurance and strength to support large full body movements. Endormorph bodies build more fatty tissue, resulting in a rounder appearance though these fall between ectomorph and mesomorph capabilities. Endormorph bodies can be the most versatile at controlling strength, flexibility and endurance well. While most dancers focus training in similar ways, coordinating smaller muscle groups to avoid the overuse of large muscle groups (such as the quadriceps) to attain similar physical ability, there are still components that are specific to the individual. The strength, flexibility and control of each muscle fibre, affects the available range, control and habitual patterns of every body (Fitt, 1996; Laws, 1986, 2008). We move in ways that make functional and physical sense as well as feel good and are pain free; we develop personal styles and habits as preferences to the way we chose to move and are aesthetically interested in moving. Aesthetic interests in movement are reflected by cultural, social and personality influences. Even personality traits have been assessed from movement habits using Laban Movement Analysis, through a belief that movement and personality directly reflect and influence each other (North, 1984).

Through specialized training, dancers embed particular movement patterns into their muscle memory. These patterns are as much a result of the shapes dictated by particular techniques as the body's physiology in reaction to them (Blom, 1982).

2.6.3 Awareness and Somatics

Somatics are methods developed to bring awareness to the body and body-mind integration (Johnson & Hanna, 1995). Somatics practice develops conscious control and understanding of physicality as a method for therapy, self-awareness and is often used to support physically based disciplines such as music, dance and theatre. Somatics techniques often function by directing the participant's focus and attention to very specific physical processes, exploring these in depth over many lessons using attention to reveal detrimental patterns in order to build and develop more fluid, free and less constrained patterns of movement. Dancers frequently study a combination of somatic techniques to gain additional awareness and understanding of movement beyond the traditionally taught dance technique forms. Techniques such as Feldenkrais, Alexander, Body-Mind Centering and Authentic Movement focus on the experience of the participant and the effort quality while techniques such as Pilates, Yoga, Gyrotonics and Bartenieff Fundamentals focus on the body's ability to express shape and spatial intent with a full range of actively chosen movement.

2.6.4 Development of Habit

As codified methods of movement become ingrained, dancers learn to rely upon them as much as their everyday pedestrian movement. Bodies are constantly devising and revising how they interact with the world. The body prefers to interact with the world in the most efficient way possible. This includes moving in a stable, balanced, upright manner that exerts minimal strain on the muscular system (Knudson, 2002). Many people connect this idea to posture (Alexander Technique focuses on posture while affecting many other components of movement), but it is also apparent in the directness of a motion and the gracefulness of motion. These qualities may also lead one to perceive other high level semantic attributes such as the confidence of a person's carriage and person's outlook, evidenced in the way the body's physical state supports or filters their viewpoint and perceptions of the world, in order to interact with it. Mark Johnson discusses the body schema of 'balance' to transfer meaning from the personal physical experience to the perception of the outside world (Alexander, 2001; Johnson, 1990). Though we can develop these methods of interaction into habits, such as actions that we know will be successful in most predicaments; we also try to create new pathways and directly oppose our habitual intentions.

The Alexander Technique directly addresses movement habits through a study of the inhibition process (Alexander, 1970; Alexander, 2001; Gelb, 1987). Habits develop as movement patterns throughout one's process of interacting with their environment over their lifetime. Alexander devised a method to simply

‘stop’ performing the habitual pathway as an alternative technique to attempting to force a new pathway through a habit. Throughout the process of working with Alexander technique, the participant gains heightened awareness of the embodied process behind executing a movement, which includes both the physical and the cognitive processes. Alexander has termed this process ’the use of the self’ and this process of examining the details of movement habit has enabled many people to change their movement patterns as well as facilitate research into physicality and experience (Alexander, 2001). John Dewey was an extensive student of Alexander’s and incorporated his experiences of assessing and changing habits into both his theoretical and educational work (Dewey, 1925; Schiphorst, 2008).

2.7 Conceptual and Theoretical Knowledge of Choreography

> *‘I suspect that the advent of movement improvisation as an artistic dance practice in the downtown New York 1960s and 1970s is closely related to the explanatory success of the communicational and information theory paradigms in science, particularly in the psychology of perception, biology and kinesiology. I agree with Scott deLahunta when he speculates that the focus on Robert Dunn’s very influential workshops in the 1960’s, which focused on the use of chance, indeterminacy rules and constraints for the generation of choreographic structures, were perhaps influenced by the developments in computation and information theory. Therefore, it is possible that many present day dance practices belong to the same lineage as digital computers. In that sense computation became a model for algorithmic generative compositional strategies, but the main shift happened – I propose – in how improvisers conceived the ontology of movement within the continuum of mind, body and environment.’*
> *(Barrios Solano, 2005, p. 283)*

Choreography as a creative process can be discussed, not as a magical phenomena, but as an organization of movement in a non-deterministic, open way (Klien, 2007). Choreographic knowledge is learned and implemented through experiential structures, just as the Body Knowledge discussed in the previous section/chapter is known through doing. Like body knowledge, choreographic knowledge includes our situated perception of the world, how we decide to interact with it, as well as how our personalities, aesthetic tastes and interests develop and are brought into play in creative process. This section will focus on a review of the compositional and historical theories and models developed to explain and generalize [dance] knowledge in order to describe how a choreographer structures and develops compositional material through knowledge gained outside of their subjective physical experiential knowledge (See Figure 11).

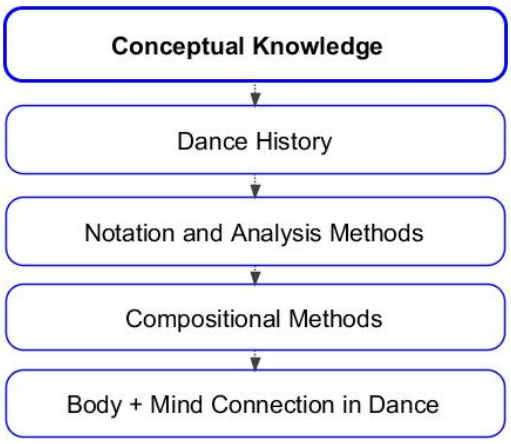


Figure 11. Outline of Conceptual Knowledge Review

2.7.1 Dance History

Dance history, like many artistic histories, has been a radical process that has responded to the historical, cultural, social and political shifts in the world in which it is a part. Doris Humphrey, a modern dance choreographer and educator, discussed the transitions of dance as a sleeping beauty. The initially sweet, obedient and sleeping girl awoke at the turn of the century 20th to a 'devouring desire' to explore the world, enamoured with industrial and social revolutions, war and nature (Humphrey, 2003). The developments in choreographic compositional approaches have expanded along with the shifting world in the last century. The history of choreographic process is influenced by the context it is situated in, yet its shape and power is still a vivid component of current contemporary dance. In this section of the literature review, I review compositional strategies used in the making of dances, starting from classical ballet techniques and working through the various forms of contemporary dance techniques.

Classical ballets are traditionally developed around a strong narrative structure and some classical dance techniques augment the storyline and character traits through the use of pantomime to make the storyline and character traits more explicit (Foster, 1998). In contrast, avante-garde ballet companies such as the Ballet Russe (1909-1920) focused on the development of a single theme in a performance akin to the sound poem in musical composition, and in contrast to a narrative or story structure (Au, 2002b). Free dance choreography (sometimes referred to as American Expressionism), explored by

practitioners such as Isadora Duncan and Loie Fuller (1900), developing ‘pure’ movement into improvisations and compositions that evoked references to Greek classicism. American Expressionism positioned itself in contrast to classical ballet, valuing loose clothing, bare feet and physical expression that extended the nineteenth century corsets and constraining representations of the female body.

In America, Ruth St. Denis and Ted Shawn exploited symbolism of culture and particularly pagan religion during this historical time period, exploring the strong, physical, rhythmic and culturally contextual movements of exotic cultures and locations that expressed physical expression in ways that could critique middle-class bourgeoisie understanding of movement. Rejecting the narrative storylines of ballet, free dance perpetrated an experience of beauty and truth that linked it to cultural expression and a critique of the industrial body (Foster, 1986). Modern dance eventually re-invented the narrative as both abstract and narrative through Martha Graham, Doris Humphrey and Charles Weidman (Foster, 1986). Form and content became highly stylized for the choreographer and often representational of ideas, natural processes and political ideals. During this time in America, choreography represented a mechanism to communicate the changing social status. Simultaneously, in the European continent, the highly theatrical nature of German Expressionism again combined Free and Modern dance compositional styles, exploring narrative structures through experience and emotion more than through the development of a stylized movement vocabulary(Manning, 1998). While this differed in representation from the

American style, its goals were linked in expressing cultural and social experience, albeit in a more directly emotional and theatrical form.

The cultural, social and political revolution of the 1960's and 1970's did not escape contemporary choreographic techniques. Post-modern dance not only explored everyday and pedestrian movement vocabularies but also everyday composition and performative ideals (Au, 2002a; Banes, 1994). Yvonne Ranier's work 'Trio A' explored the use of space as though there was no audience; there is no eye contact, spatial 'front' or acknowledgement of the audience at all. Merce Cunningham explored the use of 'Chance Procedure', using the I-Ching and rolling dice to determine choreographic choices (Copeland, 2003). Contemporary choreographic work was built upon the many facets of the history of dance composition and now integrates and selects elements from many or all compositional methods, sometimes within a single dance choreography.

2.7.2 Notation and Analysis Methods

While it is a common practice in the field of music to analyze scores and imitate the musical compositional structure, it is rare to analyze, deconstruct or model choreographic compositional forms in the attempt to analyze, understand or teach choreographic composition. Multiple notation methods exist which could, theoretically, provide a basis for analysis of dance, however it is well understood that the complexities of movement extend beyond the representation of music notation (Adshead, 1988). The codified notation systems of Labanotation, Benesh and Eshkol-Wachman provide a defined set of movement data that would be very useful for analyzing choreographic structure (Adshead,

2000; Guest, 1998, 2005; Laban, 1966). Rudolph Laban was one of the key dance-practitioner's to explore the deconstruction and analysis of movement (Guest, 1998; Laban, 1974; Newlove & Dalby, 2003). Laban's notation scores contain the largest amount of movement-related information, yet it is well understood that the notation scores are difficult to attain and read, yet the information provided is focused on the reproducibility of the movement (Jordan, 1993; Loke, Larssen, & Robertson, 2005). While there are other notation forms such as Benesh and Eshkol-Wachman, there have been few attempts to explore ways of further understanding real-time structural, contextual or content in contemporary dance outside of archival notation systems. According to Jackson, a dance scholar and writer, two forms of dance analysis have evolved, analysis of detailed physical movement information and analysis based in the contextual and often affective situation of the time (Jackson, 1994). Janet Adshead's work explores the development and use of analysis to better understand, critique and teach dance (Adshead, 1986, 2000). She was the initiator for the Report on the Fourth Study of Dance Conference, on Choreography: Principals and Practice, and wrote the book 'Dance Analysis' (Adshead, 1986, 2000). Little work has followed in response to Alstead. Susan Foster explored the affective side of analysis, examining the cultural, social and empathetic qualities of performance. This historical and cultural research has caught on widely in the dance world, although it does not closely examine the decision-making actions made in a work.

The analytical view provided by an investigation of choreography is valuable because it illustrates actions or decisions taken by the choreographer, which are difficult to deconstruct or 'tease out' of contemporary practice. Because analytical systems that assess choreography are difficult to find outside of notation systems, I am exploring the choreographic decisions and actions as they are enacted in a studio. By exploring the choreographic decisions and actions of choreographers in real-time, I can better understand the cognitive processes behind their actions. This can better support the understanding of creative problem solving in choreographic process. As choreography *is* a series of creative problems to be solved, that rely on one's prior knowledge, habits and creativity, choreographic cognition supporting choreographic action are transferable to other fields where creative problem solving in real-time has value in terms of design process or human experience. This perspective on-'distributed cognition' explores how physical and conceptual knowledge combine within a real-time decision-making process. This combination is difficult to locate and to research in other, often less physical, disciplines. This research explores a choreographer's decision-making process through the distribution of cognitive decision-making over various learned components, including: physical training, compositional training, creativity potential and capacity for analysis. Distributed Cognition results in actions taken by choreographers that are situated in the habitual, environmental, sensory and conceptual constraints of the moment.

2.7.3 Contemporary Compositional Methods

Viewpoints is a composition framework that has purposefully analyzed, described and integrated many compositional approaches and tactics (Bogart & Landau, 2005). All of these 'viewpoints', as they are called, are identifiable in any dance composition and are iterations of tactics developed by many choreographers including Rudolf Laban, Doris Humphrey, Martha Graham, Steve Paxton and Nancy Stark-Smith (Graham, 2010; Humphrey, 2003; Koteen & Stark, 2008; Laban, 1976, 1974; Newlove & Dalby, 2003; Pallant, 2006). Entire contemporary choreographic techniques can be, and often are, constructed out of a single viewpoint. For example, a technique developed by the company Batsheva in Israel, entitled '*Gaga'* explores movement for choreography almost strictly through what is referred to as *Kinesthetic Response*. Within the Viewpoints systems the 9 viewpoints are named: Spatial Relationship, Kinesthetic Response, Shape, Gesture, Repetition, Architecture, Tempo, Duration and Topography.

Spatial relationships are the distance between things and may connect people, props, design elements and architecture. *Kinesthetic response* allows the body to respond to physical sensation, whether ~~of~~ this describes your own body or the body of an outside experience. *Shape* refers to the shape or position of the body. *Gesture* is an action that can stand on its own, for example a task such as waving for a taxi or demonstrating a feeling of being lost. *Repetition* is the repeated parsed movement phrase in any of the frames listed above. *Architecture* as a viewpoint explores and responds to the environment or spatial

context of the dance: architecture could be a stage set, the interior room or exterior environment the dance is performed within or the environment that can be seen elsewhere (as in through a window or in a video). *Tempo* is the speed of a movement. *Duration* is how long a movement extends for. And lastly, *Topography* is the floor pattern or spatial pathway the movement or sequence takes.

How a work is structured is an important compositional aspect of choreographic process, yet is the least codified or defined aspect of choreographic craft. While there are tactics/techniques and methods to generate and explore movement there are fewer codified methods for piecing a movement choreography work together. Choreographic history has seen the back-and-forth shift from representation, narrative to improvisation and everything in between. Marlon Barrios-Solano's opening quote at the top of this section may suggest a relevant perspective. Choreographic craft is always situated in a historical frame, and in the contemporary ideas of creativity that are an aspect of compositional craft. As art, (including choreography) is always situated within the context in which it was made, it follows that art and choreography use and are influenced by contemporary Information theories including those of complexity and artificial intelligence and that contemporary information theories can also be used to explore concepts of structure and connection in dance (Hagendoorn, 2008).

2.7.4 Body/ Mind Connection (In Dance)

Merce Cunningham is a historically important choreographer of post-modern and contemporary dance because of the particular creative methods he

applied in his interest in exploring choreographic composition. His choreographic explorations moved beyond previous historical techniques, habits and styles. Cunningham was interested in accessing new ways of understanding movement. He is often seen as the choreographic marker that divides the modern dance era and the post-modern revolution that became contemporary dance. He continued to create cutting-edge work from his early career in the 1950's until his death in 2010. Cunningham, along with his partner John Cage, was interested in the concept of the relationship of the mind with regard to the body.

> *'One of the many differences between pre-Cunningham and post-Cunningham modern dance is the attitude that each displays toward intelligence: the value of possessing it, the strategies for displaying it – above all, the manner of defining it. In the rhetoric of pre-Cunningham modern dance, we hear references galore to the "thinking body" and the "whole" person. But in practice, this holistic philosophy all too often translates into the triumph of the body over the mind.' (Copeland pg 206)*

> *'The "intelligence" of his movement is, first and foremost, a quality inherent in the movement itself. And yet- I hasten to add- Cunningham's mode of bodily intelligence remains comfortable with (rather than suspicious of) the verbal dimensions of thought.' (Copeland pg. 210)*

While Cunningham's philosophy integrated body and mind, he also actively explored the influence of situation or context in creating his works. His historical use of 'Chance Procedures', a method of rolling dice (or coins), using the IChing, relied upon a situated-ness that supplanted a choreographer's direct control in order to create new and unforeseen opportunities to devise movement and structure. Cunningham exploited the choreographic concept of 'dancing from

the present moment' by simultaneously combining what the body knows and what the mind knows, Cunningham's approach can be viewed as incorporating the three types of knowledge relied upon when building and constructing choreography, namely: kinesthetic, conceptual and situational knowledge. In Cunningham's choreographic process, creativity becomes an act of 'situated problem solving' (Leclerc & Gosselin, 2004). While the interaction of kinesthetic, conceptual and situated knowledge is not frequently discussed in the literature, this phenomena is explored in Human Computer Interaction under the title of 'Distributed Cognition'.

2.8 Situated Awareness In Creative Practice

Situated awareness relates to how an action is made, in the moment, influenced by all components present in that moment. Present components can include the choreographer's internal state (such as emotions, intentions, curiosities, goals or sensations) or the external state of the environment (such as affordances of architecture, structure, sound, other people or objects, gravity or light). Making a choreographic decision is situated within the choreographer's awareness of the present moment (See Figure 12).

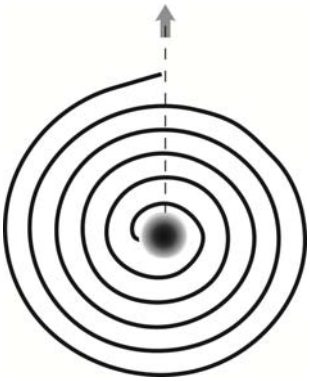


Figure 12. Attention is Situated in the Current Time and Place, which expands with Awareness

A choreographer's awareness is situated within its own kinesthetic and conceptual knowledge. However awareness is also situated in a specific location, at a certain time, with certain people or things and with the choreographer's own internal state (Pallant, 2006). For example when dancers are improvising movement they are concurrently aware of their internal state (affective), their body's proprioceptive feedback, the architecture of the space they are in, sound, light and temperature within the space. While dancers are aware of their physical proximity to other dancers, walls, floors and objects (through as many senses as possible), they are also attune to the internal state of other dancers in order to anticipate their actions.

The application of focussing awareness in improvisational dance, especially in dancers working with contact improvisation (improvising in weight-bearing contact with others), is trained to be attuned to many corresponding elements of the present moment. Applying this awareness throughout the action of movement allows a dancer's attention to be constantly shifting to the most

important or dominant element while continuously keeping a subdominant attention on everything else that is present. This method of utilizing attention as a skill (Schiphorst, 2011) informs the dancer regarding the decision to act or respond, safety issues (such as saving yourself from falling on your head) and compositional elements (how to apply the awareness of all actions that have taken place toward the goal of constructing a composition in the moment).

3: LITERATURE REVIEW: CHOREOGRAPHIC COGNITION, AND TECHNOLOGICAL MODELS FOR CHOREOGRAPHY

3.1 Introduction

Chapter 3 reviews the literature in choreographic cognition (See Figure 13) and technological models for choreography. The research presented in this thesis studies choreographic cognition from the perspective of problem-solving and is based on the concept of applying constraints to creative decision-making. I introduce the use of a technological tool (called Scuddle) to present movement catalysts that provide choreographic constraints in the

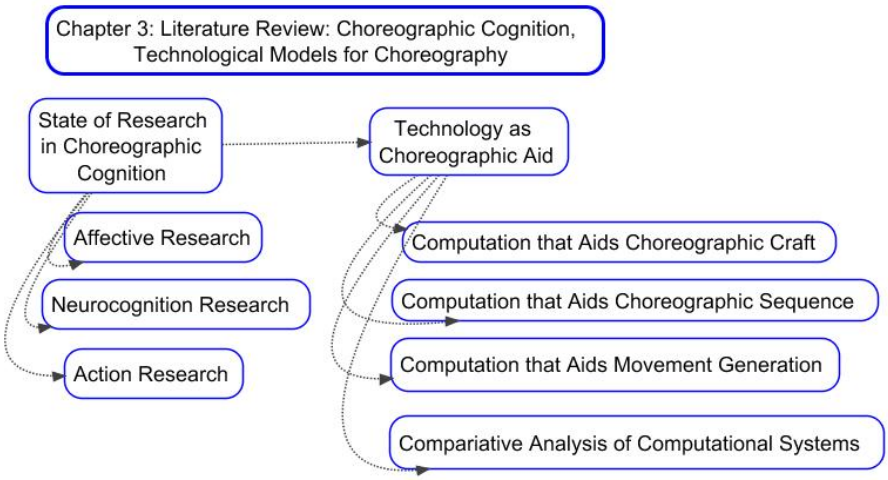


Figure 13. Chapter 3 Literature Review: Research in Choreographic Cognition and Technological Models for Choreography

form of incomplete movement suggestions. The second half of this chapter reviews the literature in technology designed to support choreography, analyzing different forms of technological support for the choreographic tasks of movement generation, movement sequencing and higher level choreographic crafting. Because choreographic crafting is implemented through the body, I also review literature in the areas of Phenomenological inquiry, focussing on extracting data that describes experience and the use of attention through phenomenological interviewing techniques.

3.2 Choreographic Cognition

The intersection of research in creativity, cognition and choreographic process has resulted in a number of recent research projects that explore various aspects of choreographic process. These projects can be categorized into three broad research areas: affective, neurocognition and action research. The table below compares recent choreographic research projects by the name of the project and researchers working on it, the research area it falls under, the aims and focuses of the research projects, the methods used to gather the data, whether the research investigated a fully choreographed work or a short experimental study, and the stages of choreographic process that were explored or alternately the use of improvisation outside of the context of the 3 choreographic states (As described previously, stage 1 is movement material generation, stage 2 is sequencing movement material and stage 3 is crafting the pieces into a final work.) Improvisation is movement exploration through

expertise of connoisseurship. These projects are categorized and compared to describe how research is currently being enacted in choreography.

Researcher	Name of Project	Type of Research	Research Aims/ Focus	Methods Used	Full Choreographic Work or Study	Stages
Grove, McKechnie, Stevens 1999-2001 2002-2005	'Unspoken Knowledges' & 'Conceiving Connections'	Affective	Affective Perception of Creative Process + Audience Engagement	Questionaires, Likert Scale, Interviews, Observation, Journalling	Full Work	All 1,2,3
Popat + Palmer 2004	'Projecting Performance'	Affective	Affective Connection with Projection	Questionaires, Interviews, Observation	Study	Improvisation Of All
Calvo-Merino 2005	'Neural Mechanisms for Seeing Dance'	Neuro-Cognition	Kinesthetic Empathy	Quantitative Analysis of fMRI brain activity	Study	All
Jola 2005	'Mental Imagery Processes in Dance'	Neuro-Cognition	Effects of Imagery	Quantitative Analysis of Task Completion	Study	All
deLahunta 2003	'Choreography and Cognition'	Action	Understanding of 'Phrase'	Interviews, Tagging Video	Full Work + Study	Sequence 2
Kirsh 2009	'Creative Cognition in Choreography'	Action	Learning and Memory	Ethnography, Video Tagging	Full Work + Study	Generation 1
Popat + Palmer 2003	'Performance Robotics'	Action	Creativity with Constraints: Not Product Driven	Observation, Interviews	Study	Improvisation
Carlson 2010-2011	'Scuddle: Decision-Making in Choreographic Process	Action	Cognition-Making Process	Phenomenological Interviews, Observation, Journalling	Study	All 1,2,3

Table 1. Choreographic Cognition Research Aims and Methods

3.2.1 Affective Research

In the table above, Affective Research is a category in the third column, which categorizes ***Type of Research***. Affective research explores the conceptual knowledge of choreography and is often focused on audience reception of performance, including the audience's affective reaction. In the table listed above, there are 2 examples of Affective research on audience reception. Grove et al explore affective perception of creative process and audience engagement in two projects entitled 'Unspoken Knowledges' (1999-2001) and 'Conceiving Connections' (2002-2005). One study in these projects explicitly tested audience response to performance through 3 factors: the choreographic intention, the expertise of he audience, and how much information was presented to the audience before seeing the performance (S McKechnie & C. Stevens, 2009). Audiences viewed a full length choreographic work and then participated in an interview process (to investigate cognitive, emotional and affective reactions), a series of Likert scales to assess responses and a questionnaire about their personal background and knowledge including demographics.

The second affective example in the table by Popat & Palmer called the 'Projecting Performance' (2004) project explores how an audience participant perceives their connection to a digital animated image by physically interacting through drawing the trajectory of the animated image on a WACOM tablet and interacting with the projection physically (Popat & Palmer, 2009). 'Projecting Performance' interviewed two categories of participants: 1) participants drawing the sprite's trajectory and 2) participants dancing with the projections. The project

explored the process of connection as a short study working with improvisation (as opposed to a full length choreographic work) and used questionnaires, observation and interviews to gather data from participants.

3.2.2 Neurocognition Research

In the table above, Neurocognition Research is the second ***Type of Research*** described by the Research Category in the third column***.*** Neurocognition research explores how the brain functions in creative and physical acts. In the table listed above, there are 2 examples of Neurocognition Research in dance and choreography. The first example focuses on the concept of kinesthetic empathy. Neurocognition has recently introduced the concept of mirror neuron theory which provides an explanation for kinesthetic empathy in humans and primates. Mirror neuron theory has shown that the same set of motor neurons fire in the brain when viewing an action as when performing an action, while still debatable, it is often believed to be goal-oriented actions (Calvo-Merino, 2010). This research has generated interest in the effect of mirror neurons in watching dance. In these experiments, the activity of mirror neurons has been tested by imaging which areas in the brain are most activated when dancers watch movement in their own expert technique as compared to a technique they are not an expert in. Results of the study using fMRI showed that the action observation system is highly attuned and aware of our own motor expertise and experience (Calvo-Merino, Glaser, Grezes, Passingham, & Haggard, 2005). This project used short sequences of movement in a study

environment that worked through all stages of the choreographic process, including movement generation, sequence and craft.

The second example of Neurocognition research in dance is Jola & Mast's exploration of how the use of imagery to guide movements can affect the motor response (Jola & Mast, 2005). This project explores mental rotation of objects and bodies and references the somatic practice of ideokinesis, a practice that uses extensive mental imagery to physically change musculature. The hypothesis was that if motor processes support the execution of mental rotation tasks that dancers, having specific expertise in motor processes, should complete tasks better than non-dancers. However, the response times for dancers were longer than non-dancers which was unexpected. As this project explored a task-based process it is categorized as a study that required knowledge from all stages of choreographic process (because the project relied upon the dancer's whole expertise).

3.2.3 Action Research

Action research, the third category within ***Type of Research*** explores the process of creating actions and making decisions as they happen in choreography. This research does not explore the affective considerations or the biological processes in the brain, but simply what the choreographer does with movement, situated in the moment. Wayne McGregor and his company 'Random Dance' have become the main pursuers of this type of research. Working with Scott deLahunta, they have created many works in collaborations with cognitive scientists and neuroscientists to explore and better understand the processes

they work through on a daily basis in the studio. With one collaborator in the UK they investigated how a dancer viewed a phrase, for every dancer in the company. Every dancer watched a video of the current state of the piece and tagged where they thought a movement phrase began and ended. Dancers were interviewed about their experience learning and performing the phrase of movement throughout the process of developing a full-length choreographic work. Interestingly this was very different for every performer, including the choreographer (deLahunta, Barnard, & McGregor, 2009). The research in this project focuses on the process of sequence generation and developing sequences of ‘phrases’ of movement.

Another collaboration at UC San Diego resulted in the exploration of how a dancer learns – whether through imagery, physical execution or through ‘marking’ (a common dance practice of half-performing the movement and visualizing it at the same time) (Kirsh, 2011). Both of these studies followed the creation of a full-length work in the moment while running short studies regarding the learning procedure of dancers concurrently. This project used ethnographic methods to observe and interview the dance company while also tagging and analyzing video of the entire process. The research in this project focused on the process of movement generation and learning movement.

Another intriguing form of ‘action research’ involves a project that solely wanted to spend time in the studio to explore how a common language could be developed. To do this, the project focused on play and experimentation in order to see what could happen when no common goal to make anything was present.

The project brought together a combination of robots, engineers and dancers to explore each other's movement and develop ways of communicating between seemingly different disciplines (Popat & Palmer, 2005). Observation and interviews were used to explore the actions made by the dancer and robot participants as well as the thoughts of the engineers. This 'study' environment required that there was no focus on a full length choreographic work and relied upon improvisation and situated decisions of the participants to explore the actions made under the immediate constraints of the project.

This thesis explores action research through the study of 8 choreographers' experience of the decision-making process when using technological constraints as movement catalysts produced by the system 'Scuddle'. The study environment is designed to provoke creative decisions by completing a situated task (creating a short choreography using Scuddle) that explores all 3 stages of choreography (including movement generation, sequence generation and craft). The study environment used studio sessions to physically explore and develop creative decisions from movement catalysts. Data was extracted from the process of making decision by using phenomenological interviewing techniques to guide awareness to the process, enabling the choreographer's verbal articulation of decisions.

Studies utilizing action research to adapt choreographic events into experimental research events are becoming more prevalent. Corinne Jola, a cognitive neuroscientist and choreographer, discusses the development of 'experimental choreographies' as a way of designing a study based on or within a

choreographic process (Jola, 2010). Wayne McGregor's work with both Phil Barnhard and David Kirsh has resulted in these types of 'experimental studies' alongside the process of creating a larger work (deLahunta et al., 2009; Kirsh, 2010, 2011). In these projects a dance company has held a residency where they developed a full-length work while the researchers have concurrently run short experimental studies examining the creative process along the way.

3.3 Technology-Supported Choreography: Computational Tools

'Computers are useless. They can only give you answers.'
Picasso (Pickover, 2001, p. 10)

'Technology is great for constraints because of its inherent characteristics already being limited.'(Candy, 2007)

This section reviews constraints in choreography from a historical perspective and also applies choreographic constraints to their potential implementation in choreographic technology. Constraints are present in many different forms, including kinaesthetic and conceptual, which define a problem (a situation) that needs to be solved. The design of the constraints directly defines and confines the search space, thereby provoking creative explorations around the edges of the search space. By directing decision-making through constraints, awareness is brought to the process and highlights decisions (Lavender, 2009). When the choreographer's attention is brought to the decision-making process

they are better able to verbally articulate decisions, allowing study of those decisions.

In dance, the use of constraint as a movement-catalyst has existed long before the use of technological support tools for choreography. The concept of creative catalysts has been used by artists throughout history, including its use in dance and choreography. Constraints are often used to generate new ideas and to push the artist beyond known answers. Figure 14 illustrates the use of constraints within creative process, prompting exploration around the borders of the search space that is defined by the constraints. Creative problem solving decisions are often explored on either the habitual side of the constraints (using solutions known to be successful) or the creative side of the constraint (using new solutions unknown to be successful), which inhibits habitual choice. However, within this process there requires a

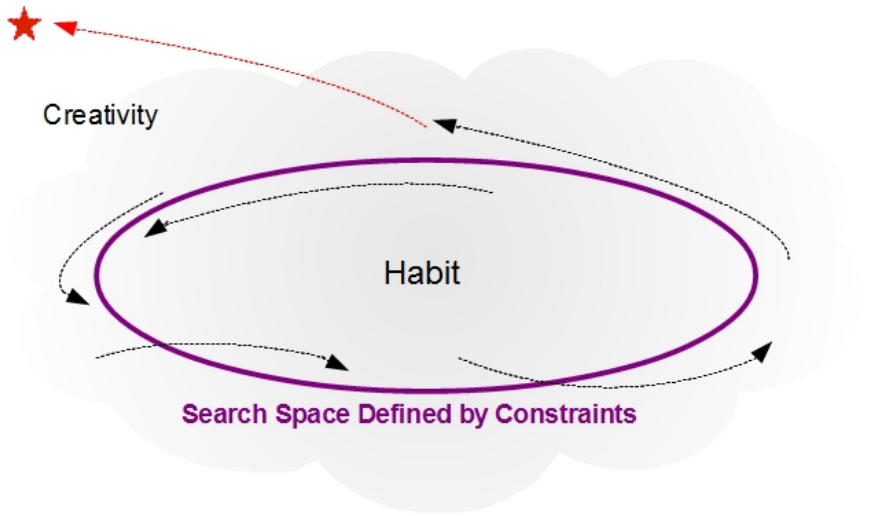


Figure 14. Constraints Define the Creative Search Space by Dividing Known, Habitual Solutions from Unknown, Potentially Creative Solutions

certain special ‘something’ to push an exploration beyond the definition of constraints. There are a number of historical examples that illustrate how choreographers have applied constraints in the creation of dances. For example, in 1930 Martha Graham used costume as constraint in her work ‘Lamentations’ to generate movement from the limitations imposed by the garment itself (See Figure 15) (Foulkes, 2002). The costume, a tube of stretch fabric, obscured Graham’s physical form and often her face. These kinesthetic constraints provoked Graham to examine shape and quality of movement as expressive qualities beyond the traditional narrative dance.

Richard Move as *Martha*
Photo by: Josef Astor

Figure 15. Richard Move as Martha in Lamentation. (Schwartz, 2010, p. 79)

Merce Cunningham used the IChing and utilized Chance Procedures as ways of exploring new movement ideas, creating constraints suggested by the

outcome of the IChing hexagrams which were assigned to structural movement choices (See Figure 16). Cunnhingham created his own ‘mappings’ or algorithmic connections between the IChing outcome and the movement strategy. For example a hexagram might be mapped to an arm movement, or to a position of the stage, or to a kind of phrase, or to rhythmic pattern. This is not a physical constraint but a conceptual or algorithmic constraint, even though at this stage these mappings were not in a digital form (Copeland, 2003; Schiphorst, 1993).

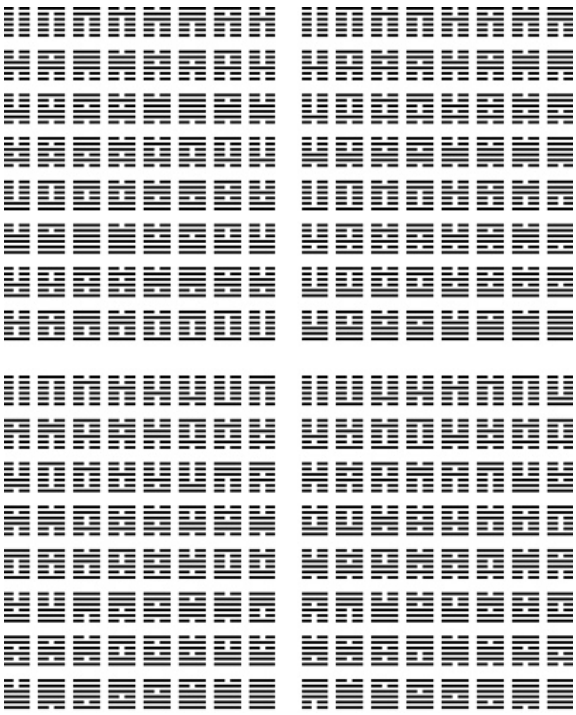


Figure 16. Hexagrams from the I Ching. (McDonald, 2010) Retrieved from http://www.flickr.com/photos/kylemcdonald/4482560669/

Alvin Nikolais designed dances, costumes, props and lighting to constrain the perception of the human body and the audiences-made associations of the

dancers from the 1950's to the 1980's (Mazo, 2000). In the 1965 Nikolais' work 'Tower' the dancers balance on freestanding posts (similar in form to ballet barres), so neither the dancer nor the post can balance upright without the other (See Figure 17). This posed both a kinesthetic and a conceptual constraint on the choreography. The dancers were only able to perform certain movements without falling down, while the sequence and craft of the choreography was highly dependent on creativity found in movement generation.

Figure 17. Nikolais Dance Company Performing 'Tower', 1965

In the 1960's and 1970's Steve Paxton, a pioneer of contact improvisation and the post-modern era, began exploring the body's relationship to other bodies as well as to "the physical laws that govern their motion – gravity, momentum, inertia" (See Figure 18) (Koteen & Stark, 2008, p. xiv). Working improvisationally

requires the dancer to heighten their awareness of movement choices at the same time as being open to whatever ongoing changes are occurring within the situated environment. In contact improvisation, the dancer simultaneously is required to have at least four levels of awareness. The first is an internal or close awareness of their own body, how it feels, what choices it is making, how to keep itself safe. The second is a near awareness of the environment (floor, walls) and their dance partner's body. This near awareness includes anticipating their partner's actions while being aware of their partner's safety. The third is a far awareness of the environment and bodies on the other side of the room that may need to be responded to. The fourth level of awareness is a compositional awareness: the dancers performing together are aware of what actions, what sequence of actions and what patterns or motifs are being developed and how they are contributing to this as a whole. This compositional awareness allows the dancer to assess all components of the situation to make decisions based on how a choreography is being structured in the moment. While this contact improvisation as a dance form may seem simple to perform, a well-structured or choreographed improvisation relies heavily on the skill of the performers. For example, Cheryl Pallant describes a task of 'global partnering':

> *Travel through the space while doing a solo dance. Orbit everyone. Consider your partner, but do not make physical contact with them. Partner by either dancing across the room from them or in their vicinity. Place them in your focus without intending to influence them. Let your body respond to theirs. Mirror their rhythm, a stretch, a chosen part of the body, their tone, an energy. Alter the quality of your movement so it becomes something distinctively different from the original. Make it your own.(Pallant, 2006, p. 149)*

Figure 18. Contact Improvisation Jam (Olivari, 2008)

Though I explore technology as a medium for introducing creative constraints, it can also be applied as a creative design tool for dance and choreography. Technology has been used extensively in performance as a design element in a theatrical set or in lighting design. As early as the 1890's, Loie Fuller designed and patented dimmers and coloured gels to create lighting effects for her dance performances. Fuller used lighting design to colour her costume, which was also considered a technology. This costume technology is evidenced not only in her highly designed performances, but also in the patent Fuller held for the costume design (See Figure 19) (Fuller, 1894). Fuller also applied for and holds patents for chemical salt dimmers and coloured lighting gels. Fuller's use of costume and lighting constrained and therefore provoked the

movement she performed, which accentuated and explored her designed lighting elements, as well as the spectacle her shows became.

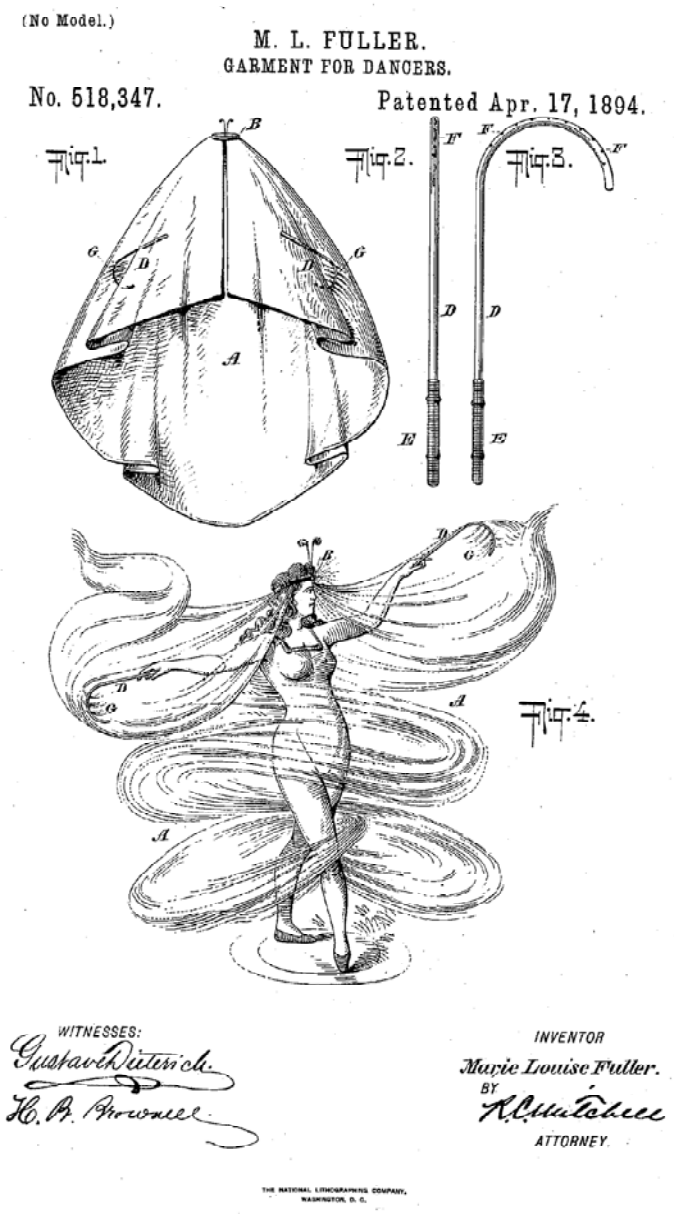


Figure 19. Loie Fuller Costume Patent (Fuller, 1894)

Currently, interactive performance with digital projection has become the default standard for cutting-edge performance with accessible software such as

Isadora, Eyesweb and programming environments such as Max/ MSP/ Jitter. Audience or performer-triggered video, lighting and sound is commonplace. Robots and physical computing is now simpler to build (e.g. kits and arduino boards) than in the past. Performers are able to learn the skills to design and program themselves or easily find collaborative partners with the skills. Though this technology is widely available it continues to be used as a design element or conceptual constraint, to affect the architecture of the stage space. Technology as an intentional kinesthetic constraint within choreographic process is rarely used, due to its physical limitations. Computer-aided choreography has existed for decades, though it has not directly targeted the use of constrained decision-making in order to produce novel movement outcomes.

The term ‘artificial intelligence’ was coined by John McCarthy in 1956 (Russell & Norvig, 2010). Russell and Norvig’s textbook on Artificial Intelligence (AI) discusses many definitions of AI that address two key topics: human performance and rationality (2010). Human performance focuses on how humans think and act while rationality is explored by focusing on logic and ideal intelligence. AI, alongside the field of Cognitive Science, have examined these topics in order to model cognitive processes computationally using a vast variety of approaches such as genetic algorithms, neural networks, self-organizing maps and agents. While AI techniques are often used to solve utilitarian problems, they eventually gained notice by artistic fields such as music composition and visual arts (Paul, 2003).

Several software systems have been designed to computationally support choreographic process through a combination of choreographer input and artificial intelligence techniques. While many of these systems could function as catalysts (Merce Cunningham also used DanceForms as a catalyst for movement and to develop sequences) they were designed for different goals, often to simulate the process of making a dance. While novel and useful for conceptually based choreographers, the simulation of dance composition has limited applications to choreographers who focus on their embodied experience in the studio.

Scuddle was designed to function solely as a movement catalyst, in order to provoke creative movement decisions in the studio. By provoking creative choreographic decisions, Scuddle is used within the creative process to explore choreographic actions with a ‘bottom up’ approach by designing initial movement possibilities the way a choreographer would when they begin to explore in the studio. This approach is different from many other software systems, which often take a ‘top down’ approach, providing the choreographer with the tools to create all the higher level, main actions of choreographic process such as sequencing pre-made movements.

To provide a general understanding of choreographic process I divide it into 3 stages:

1) the investigation of movement itself as source material, 2) the development of movement material into phrases or sections and 3) the composition of the movement phrases into a final structure. Literature on

choreographic process often focuses more on the creation of movement material (stage 1) and sequencing of material (stage 2) than the crafting of material into a finished work (stage 3). However, many computer based attempts at creating choreography limit focus to the sequencing of predefined movement material (stage 2) (Calvert, Welman, Gaudet, Schiphorst, & Lee, 1991; Lapointe & Époque, 2005; Nakazawa & Paezold-Ruehl, 2009; Soga, Umino, Yasuda, & Yokoi, 2007; Yu & P. Johnson, 2003). Movement sequencing (stage 2) can be the most systematic stage of choreography, hence the easiest to model computationally. Effort qualities or performativity of movement is rarely addressed in computational systems, leaving a focus on high-level choreographic actions such as sequencing. The select focus on algorithmic sequencing of codified movement can also reduce creative possibilities in composition instead of supporting them.

The following sections discuss an exhaustive survey of 10 computational support systems for choreography. These systems are identified and categorized by the highest level stage of the choreographic process that it addresses. Stages are viewed as developing in compositional complexity from the beginning of movement creation (starting to assemble movements), through to sequencing (ordering movements) and finally to the crafting of choreography (developing performativity and dynamics through sequences). The following systems described begin with DanceForms, a system that addresses all 3 stages of choreographic process and end with Scuddle, my system that solely addresses the first stage, movement generation.

3.3.1 Computation that Aids Choreographic Craft

Choreographic Craft refers to the process of composition at the highest level of abstraction and based upon the other two stages or developing movements and sequences. Craft explores the higher-level construction of time, space and performativity that connects a choreography to any intended or implied meaning or expression that makes up the experience of watching choreography. This is the most difficult choreographic stage to simulate or provoke computationally because it embeds the most complex performative qualities of all the stages. Only 2 systems are capable of helping to developing choreographic craft, DANCING and DanceForms/Lifeforms.

The first system to explore all three stages of choreography is Dancing (See Figure 20) (Nakazawa & Paezold-Ruehl, 2009). Dancing used a series of music related parameters, stage use rules and a predefined library of traditional movements to generate Waltz choreography using a Genetic Algorithm. By connecting the correct, predefined, ‘steps’ in a domain-specific sequence that provides stage directions and orientations, this system generates syntactically correct movements in a complete choreography that are presented as ASCII symbols on a bird’s eye view of the stage. This system is used to simulate syntactically correct waltz sequences based on the rule system provided by the dance form. The dance form itself is initially quite restricted and relies heavily upon the rule system. While there may be room for creativity in the expression and performativity of waltz choreographies there is very little room for creativity within the movement and sequence generation. The precision of movement

description to the choreographer is minimal, requiring them to understand the mappings for steps to ASCII symbols. This system could be quite useful for reproduction purposes that might explore historic court dances, however it is not a useful tool for helping a contemporary choreographer explore a creative problem in the studio.

Figure 20. Dancing System Output (Nakazawa & Paezold-Ruehl, 2009)

The second system that focuses on all three stages (movement creation, sequencing and crafting of movement) of the choreographic process, allowing complex movement to be designed and viewed with a high level of detail, is DanceForms (formerly LifeForms). DanceForms (Calvert et al., 1991; Calvert, Bruderlin, Mah, Schiphorst, & Welman, 1993) is a compositional tool and software system that uses graphical animation for designing and visualizing

dance movement based on user input or library selection. Libraries have been developed from motion capture data, key-frame animation, and movement vocabularies such as Cecchetti ballet (Ryman, 1997) and Cunningham Technique (Schiphorst, 1993). The system has three views, space, time and body-position. The timeline allows the choreographer to design sequences and timings of movement. DanceForms supports choreography of multiple figures, spatial patterns and orientation. Merce Cunningham used DanceForms to design movement on avatars, transposing the movement decisions onto live dancers. This process allowed him to explore movement options that he may not have otherwise considered while facilitating his use of chance operations (Schiphorst, 1993). DanceForms, aside from the provided libraries, relies on the user's input to the system to create choreography. The system uses movement positions in order to aid the choreographer in producing sequences or crafted compositions, similar to the choreographic process that is necessary for a dancer in the studio.

3.3.2 Computation that Aids Choreographic Sequencing of Movement

The second stage of choreographic process is the sequencing of movement, which happens (in some form) before craft. Choreographers often explore many different ways of piecing together the movement vocabulary in order to explore dynamics of body positions, speed, momentum and timing. Sequencing movement could be considered the pattern designing stage of choreography, as it finds the common elements of movements and arranges them to create a theme. Because sequencing lends itself to patterns, this is the most suitable stage of choreography to computationally simulate. AI offers set of

excellent tools for exploring and acting on patterns, making the sequencing stage the most frequently used for choreographic support systems.

Computer choreographic systems that address sequence specifically often focus on the linear arrangement of movement to create formulaic phrases. Four systems focus on sequence as the most complex choreographic stage; Tour, Jete, Pirouette, Web3D Composer, The Dancing Genome Project and John Lansdown's work. Yu and Johnson explored autonomous sequence generation through the use of a Swarm technique (an AI method) within DanceForms on the project titled Tour, Jete, Pirouette (2003). This project used the existing libraries of movement within DanceForms to autonomously generate sequences of movements. These sequences were shown to professional choreographers to test for similarity to a studio-crafted choreography and were found to be novel but not always physically possible. While this attempt at simulating novel sequences of codified movement seemed successful, it could have a different view of success if the system was viewed as a constraint as opposed to an exact replica of a choreography. This use of novelty in choreography, especially without comfortable or habitual sequencing, could be an interesting creativity support tool if pitched to the correct choreographer. If this tool was presented to a very broad-minded choreographer with a high level of kinesthetic and conceptual awareness, they may find the experience of figuring out how to make the sequence work highly creative.

Web3D Composer creates sequences of ballet movements based on a predefined library of movement material (Soga, Umino, Yasuda, & Yokoi, 2006).

The library of movement material was collected through motion capture data from a live professional dancer. The system allows the user to select movements from a pool of possibilities, which shift based on structural ballet syntax. Structural ballet syntax references the historic formulas of movement sequencing that have been developed over the last 200 years. This interactive process allows the choreographer to select movements based on the possibilities presented by the system while presenting nearly complete graphic movement information The Web3D Composer system generates syntactically correct movement phrases for up to a second year ballet course and was designed with intentions as a tutoring system for students. This system focuses on the studio-learned technique for dancers that relies on syntax and simulation of the syntax. The uses of this tool for creative sequencing of movement is limited due to the reliance on the developed syntax of sequence that hinders creative actions.

The Dancing Genome Project (Lapointe, 2005; Lapointe & Époque, 2005) developed a genetic programming model to explore sequences of movement in performance. The movement material was created by gathering motion capture data extracted from a dancer performing a movement sequence in a studio. The motion capture (mocap) data was used as input to the genetic programming model to shift the location of dance movements, creating a ‘mutated’ sequence. The final ‘mutated’ sequence is performed by virtual avatars alongside the original sequence performed by live dancers to create a mixed-reality duet. This process is similar to exploring themes and variations in the studio choreographic

process, where the structure of a work may separate into individual (though similar) sequences and reconvene in unity.

As early as the 1970's computers were being used to explore creative movement and choreography. One such system designed by John Lansdown (a computer graphics pioneer) uses markovian algorithms to create body outlines that provide a body position with text for stage directions and orientation in a sequence (Gray, 1984; Lansdown, 1978). This system is special because it generated unique movements along with placing them into a specific sequence with minimal precision of movement information. This system is closer to simulating the studio creative process that choreographers explore by devising movements, layering on orientation and stage directions to finally sequence those movements. Lansdown continued to develop this system and used it in collaboration with the One Extra Dance Company in Sydney to create a performance titled A/C/S/H/O in 1990 (Schedel & Rootberg, 2009).

Figure 21. Lansdown System for Choreography (Lansdown, 1978)

3.3.3 Computation that Aids Movement Generation

The first stage of the choreographic process is to create and decide upon the movements that will be used to develop the composition. In the dance field this is described as ‘generating a movement vocabulary’. Though a choreographer may start their process by exploring a concept (for example, how to make a dance about the rain in Vancouver), they still need to create a movement vocabulary before they can create sequences of movement or craft it into a composition. Many defining choices are made in this stage of the choreographic process which can provoke or inhibit creative decisions depending on what the overall intent for the work might be.

While traditional forms of dance such as classical ballet rely on a codified movement vocabulary, contemporary choreography relies on creative,

choreographer-generated movement to develop the vocabulary. Innovative movement choices can then define innovative compositional choices throughout the process if they are used well. The nature of technology is better suited to algorithmically sequence a library of codified movements, leading to few explorations in computationally generated creative movement.

Early computer choreography systems explored innovative approaches to creative movement material through a low precision of movement description such as simple 2 dimensional images and text for body positions and stage directions. Joseph Menosky in 1982 created a computer system that used an interactive silhouette image on the screen that could be altered with the choreographer's light pen by touching a body part in the image. The touch of the light pen then reconfigured the body position or opened a menu of the movement possibilities for that body part (Gray, 1984). This interactive silhouette could be used to generate body positions and store them in the sequence chosen to later retrieval. This process could be viewed as similar to a studio choreographic act of deconstructing a movement to change one component of the movement or initiation of movement, which could be considered a constraint for habitual movement generation.

James Bradford and Paulette Cote-Laurence used AI techniques in 1995 to design a choreographic system titled CorX (See Figure 22) (1995). CorX facilitates dance improvisation through textual instructions for spatial direction and orientation to generate rules for guiding dance quality and movement generation (Bradford & Côté-Laurence, 1995). This approach focused on the

generation of movement sequences that is similar to the way tasks are assigned in contact improvisation performances. The instructions are used to change the immediate action of the performer and bring their awareness to a spatial change in the moment.

Figure 22. CorX System for Choreographic Directions (Bradford & Côté-Laurence, 1995)

Currently available contemporary computer choreographic systems that address and allow the creation of movement material include DanceForms (as discussed in section 3.3.1), Dance Evolution and Scuddle. DanceForm's movement options include the choreographer's design decisions or the available libraries of codified movement vocabularies. The interactive feature of the system allows the choreographer to design intricate body positions and movements by interacting with a 3 dimensional highly detailed avatar(s) (although this does not occur in real-time, unless one is importing motion-capture data (which is a multiple step process)). The avatar's body has minimal limitations in joint

flexibility which provides the choreographer with any movement option they can imagine. However, by providing so many options the choreographer has to make a strong commitment to the system in order to explore creative movement options on a screen, rather than just in the studio. This freedom also inherently limits the choreographer's options by making them scramble to design movement that they know, movement that is not physically possible or accidental movements that shifts some creative agency to the system (developing from minimal intention of the choreographer or an accidental mouse click).

Dance Evolution animates avatars by 'teaching' them to dance to music through the use of an interactive evolutionary algorithm. Avatar movement is generated by using rhythm analysis to control the energy an avatar uses to execute a position in connection to the music (Dubbin & Stanley, 2010). The amount of energy used by the avatar controls the vigor of the dancing, slightly altering the performed movement. Every component of the movement produced by this system relies heavily on the music that is inputted, which strictly controls the creativity of movement generation. This system would be equivalent to dancing at a party as opposed to creative movement for choreographic or performative purposes.

Scuddle was developed as a choreographic support tool to constrain the possibilities for movement generation while provoking creative movement decisions simultaneously. The system generates unique movement catalysts without the input of the user, through the use of a genetic algorithm. Scuddle is designed to explore and inhibit the habitual body positions, heights and effort

qualities typically performed by dancers in the studio, in order to bring awareness to additional, new, movement options. Scuddle provides the choreographer with specific guidelines for movement execution that are controlled by the system, yet require the choreographer's creativity to individually interpret them. This is the only current system that is designed specifically as a catalyst for creative movement material. Scuddle is used in the creative process, in the studio, the same way a choreographer would explore creative movement options without technology. However, the addition of technology helps to guide movement decisions towards unusual choices, that may not be addressed otherwise, that both create unique movements and make the decision-making process more apparent to the choreographer. These design choices support Scuddle's use as both a creativity support tool as well as a research tool.

3.3.4 Comparative Analysis of Computational Systems that Support Choreography

These computation support systems for choreography are compared in order to evaluate their goals, function, and compositional techniques or anything else you can think of here. The table includes the following categories: the computer aided choreographic systems to be compared, the stage of choreographic process, movement generation, sequence generation, the final selection method, the representation of choreographic data and the precision of the movement description to the choreographer. Every system that is compared simulates at least one stage of the choreographic process: movement generation, movement sequencing and choreographic craft. The column for

Movement Generation explores how the movement data is generated and selected (usually either by the choreographer/ user or the system itself). This Movement Generation column simulates the process a choreographer explores initially in the studio, developing movement material. The column for Sequence Generation explores how the movement data is sequenced (usually either in the order it was generated or through AI techniques). This Sequence Generation column simulates the process a choreographer explores when searching for and constructing patterns from the movement material generated in the previous stage. The only system that comes close to facilitating the crafting stage of choreographic process is DanceForms, so craft is not explored as its own column.

The Final Selection Method addresses the last decisions made in the system before the output is generated (which is either by the choreographer/ user making the last decision or the AI technique/ Fitness Function). The Representation of Choreographic Data column describes how movement data is presented to the dancer. The complexity of movement data can range from single 2D figures to multiple 3D figures with space and orientation directions. The Precision of Movement Description ranks the representation of choreographic data to describe how much information is provided to the choreographer. For instance, the multiple 3D figures with space and orientation directions of DanceForms is a very high level of information that can direct exactly how a dancer is to move. However, the single 2D figure with height and effort quality information requires the dancer to fill in the gaps of information in order to enact

the movement. This is similar in the studio to learning a dance from video (high level of movement information) vs. learning a dance from another choreographer's personal, handmade notes.

All the systems compared in the table below, aside from DanceForms and Scuddle, simulate a stage of the choreographic process in the studio. These tools are useful as tutoring tools or demonstrations of choreographic strategies, though their use in the studio by a choreographer is debatable. DanceForms is the only system that is useful to a choreographer in every stage of their process, but it requires a reliance on conceptual knowledge to develop choreographic material. DanceForms supports the choreographer's actions with a high level of movement data and precision, though its only constraints on the process are inherent to the nature of computer systems and software.

Scuddle was designed through the search for a tool to help the choreographer work creatively in the studio. The use of constraints have historically aided choreographers in exploring new artistic territory, and technology (as seen below) has typically attempted to simulate creative process rather than support it.

Table 2. Computational Support Systems for Choreography

Computer Aided Choreo. Systems:	Stage of Choreo. Process	Movement Generat. (stage 1)	Sequence Generat. (stage 2 +2)	Final Selection Method	Rep. of Choreo. Data	Precision of Movement Description
DanceForm (LifeForms)	Movement, Sequence, Craft	User or Library	User	User	Multiple Figures, Space and Orientation in 3D	High
Tour Jete, Pirouette	Sequence	User or Library	Swarm Technique	User	Multiple Figures, Space and Orientation in 3D	High
Web3D Composer	Sequence	Library	User/ Interactive Possibilities	User	Single Figure, Space in 3D	High
Dancing Genome	Sequence	User/ Motion Capture	Genetic Algorithm	Fitness Function	Single Figure, Orientation in 3D	Medium
Dancing	Sequence, Craft	Library	Genetic Algorithm and Music	Fitness Function	Two Figures, Space, Orientation in ASCII	Medium
Dance Evolution	Movement/ Animation of	Neural Net and Music	In Order of Creation	User	Multiple Figures, Orientation in 3D	Medium
Lansdown System	Movement, Sequence	System	System	System	Shapes,Text	Low
Scuddle	Movement	Genetic Algorithm	In Order of Creation	Fitness Function	Single Figure in 2D	Low
Menosky System	Movement	User	N/A	User	Shapes	Low
CorX	Sequence	N/A	System	System	Text	Low

Scuddle challenges choreographers to use technology to invigorate the exploration of kinesthetic knowledge alongside conceptual knowledge to act and think creatively. By reinforcing the reliance on both kinesthetic and conceptual knowledge in a situated environment, research into choreographic cognition is facilitated by the heightening and shifting of awareness.

Of the systems compared above (See Table 2); 3 systems focus on the generation of movement as the most complex choreographic stage, 5 systems focus on sequence generations as the most complex stage and 2 systems focus on choreographic craft as the most complex stage. DanceForms is the only system that is versatile in all stages, while Dancing's focus on choreographic craft is reliant on historical syntax and does not easily support creative choices. Systems that generate movement use a variety of operations: 4 systems use pre-defined libraries, 4 systems rely on choreographer/ user input and 3 systems generate movement themselves (1 from a neural net's translation of music, 1 using a Genetic Algorithm and 1 using an unknown AI technique). Only the 3 systems generating movement themselves have the potential to produce movement as constraint.

There are 5 systems that generate sequences of movement themselves, 2 systems that output movement information in a sequence that is not assessed by the system and 2 systems that give choice to the choreographer/ user. The final selection of movement and sequence data to create the final output of the system is made by the user for 5 systems, while 5 systems rely on the material generated by their process to create a product. Of the 5 system-dependent programs, only 3 use a fitness function to assess its own product. This means that while 5 systems require the choreographer to make decisions, and 2 systems generate predictable results, only 3 systems generate potential constraint material.

The representation of choreographic data column is connected to the precision of movement description column, as the complexity of data directly reflects the amount of movement description provided to the choreographer/ user. Of the 3 systems with a high precision of movement data, all image representations are 3D with spatial options. These systems provide the most information to the choreographer for reproduction or simulation. Medium precision of movement description systems have orientation in common, though the Dancing Genome system does not use space, the Dancing system does not have figure images (only ASCII symbols) and Dance Evolution does not have space or really generate artistic movement. Low movement description system (4 systems) may provide a single figure and/ or text for directions. Three of these systems were designed before 1990, which reflect the limitations in computer graphics of the time period. Scuddle was designed specifically to have a low precision of movement information in order to provoke choreographic action. By generating system-developed movement material with a low precision of movement information, this design supports choreographers in the studio to explore new, creative movement decisions in multiple stages of the choreographic process.

4: METHODOLOGY AND DESIGN OF SCUDDLE: AN ARGUMENT FOR APPLYING TECHNOLOGICAL CONSTRAINTS

4.1 Researching Choreographic Experience

> *'Calling attention to ourselves in movement in this way [by performing free variations on our own habitual movement patterns to appreciate first-hand what is kinetically there], we have the possibility of discovering what is invariantly there in any felt experience of movement. This is because whatever the habitual movement, it now feels strange, even uncomfortable. Just such oddness jars us into an awareness of what we qualitatively marginalize in our habitual ways of doing things. By making the familiar strange, we familiarize ourselves anew with the familiar.'*
> *(Sheets-Johnstone, 1999, p. 143)*

Chapters 2 and 3 have reviewed key theoretical concepts in dance, choreography, creativity and constraint theory while situating this study in contemporary choreographic research and choreographic support software. This chapter examines the methodology and design of Scuddle. Particular focus is given to the rationale of employing technological constraints to invoke creative decision-making and phenomenological methods to collect data that describes the choreographer's experience of that creative decision-making. This chapter describes the motivation and design of the research instrument which includes the design of the choreographic software tool, Scuddle, as well as the phenomenological study of choreographic decision-making (See Figure 23).

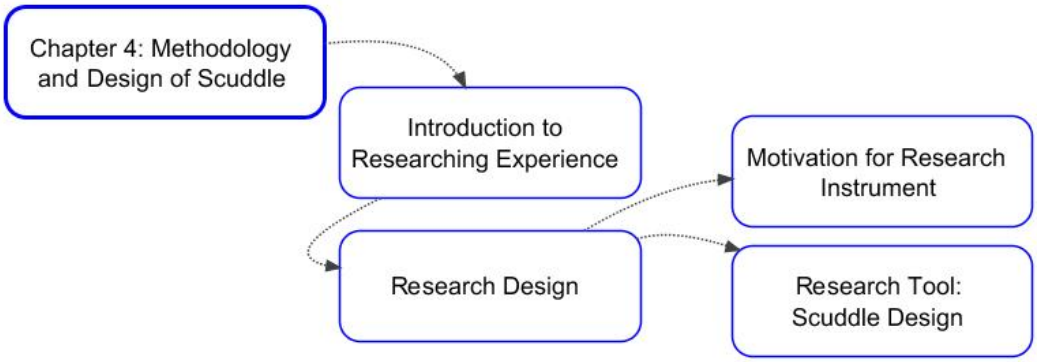


Figure 23. Methodology Chapter Map Illustrating Research Design and Study Design

The choreographic software tool, Scuddle, was designed to bring awareness to the creative experience of choreographic decision-making (See Figure 24). Scuddle utilizes choreographic knowledge in the form of Laban and Bartinieff movement principles to generate movement catalysts as constraints for provoking creative movement. The rehearsal studio in situ process of working with Scuddle generated movement constraints that enables the choreographer to bring awareness to their decision-making experience, which is then verbally elicited with the aid of the researcher's guidance through phenomenological interview techniques. Phenomenological interview techniques help focus the choreographer on 're-living' their experience, bringing attention to decision-making elements of that experience that may seem tacit, non-verbal or intuitive. Data from these open interviews was then coded, categorized and analyzed through a grounded-theory influenced method.

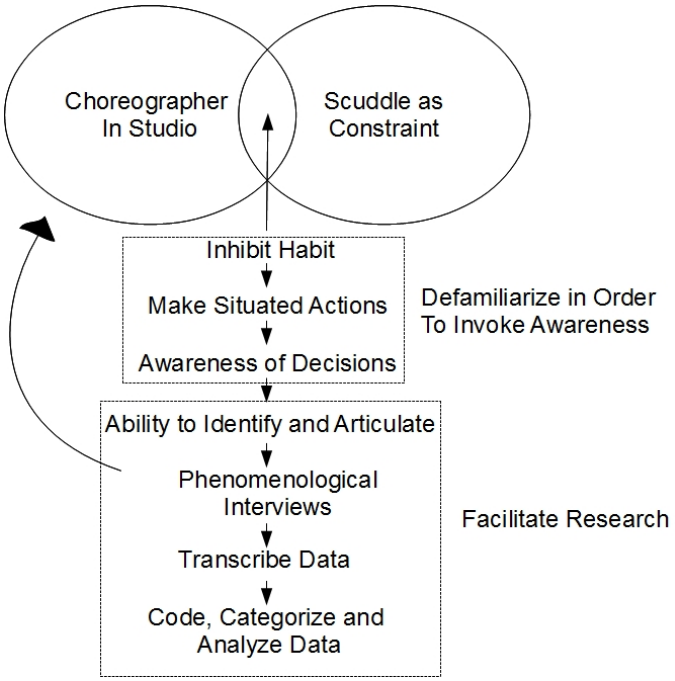


Figure 24. The Research Instrument: The Process of Defamiliarizing the Choreographic Process to Invoke Awareness and Facilitate Research

Each choreographer has a unique experience of their creative process. Therefore, it is important that the research methodology that explains and describes creative process support an individual investigation of experience, particularly when that experience is difficult to access or verbalize. Cognitive Science literature in phenomenological methods outlined by Varela, Depraz and Vermersch (2003) include techniques that describe the process of 'becoming aware', a set of procedures for shifting or deepening attention towards an experience. This has been explored rigorously by cognitive scientists including Francisco Varela, Natalie Depraz, Pierre Vermesch, Evan Thompson, Eleanor Rosch and Claire Petitmengin (Depraz, Varela, & Vermersch, 2003; Petitmengin, 2006; Thompson, 2007; Varela, 1993). These techniques incorporate specific

procedures that guide attention is and these procedures are similar to and often referenced in the practice of somatics. Guiding attention in order to focus more clearly on cognitive activity or intuitive decisions just below the threshold of awareness, results in emerging awareness regarding both habitual and alternative choices that were previously hidden below the surface of conscious activity. Heidegger explains this process as taking something that is ready-to-hand (functioning with you without the need for your conscious attention), and breaking this tacit and unconscious relationship to make it present-at-hand (not functioning adequately and therefore requiring your attention in order to ameliorate the breakage) (Heidegger, 2008). When framing the use of a tool like a hammer, the process of shifting awareness to the tool is seamlessly unified with the goal of hammering a nail. It is not intentionally directed toward the tool itself but to the goal. Because it is tacit the connection with the tool may seem unintentional. However, in somatics practice, and particularly in the introduction of creative constraints, this process becomes intentional, uncovering habitual processes that have been hidden beneath the threshold of awareness requires a 'breakage' in order to enable new choices and actions.

Choreography is an example of many practice-based skills sets including art practices that rely upon tacit expertise, which renders analysis or investigation difficult. Practitioners who have developed skill over a long period of time are often unable to verbalize their actions. In order to research creative process there are certain steps that need to be addressed: defining what is an action, how to identify an action, how to deconstruct an action and how that deconstruction

might be explored. For example, in the evolution of art history, the process of deconstructing prior rules and assumptions is frequently explored as a mechanism for developing new styles, statements and forms of representation. As rules and perspectives of a current period or artistic era become habitual, artists try to push the boundaries and deepen explorations to break the rules and create new styles. A prominent example of this could be the Dada period, where artists defiantly looked to everyday and mundane constraints to reflect their current experience in a war-torn continent (Prevots, 1985; Richter, 1978). Because the artist's home environment appeared completely senseless, artists pushed the senseless as far as possible, with the overriding rule being not to follow any known rule. This period in art history resulted in works such as Marcel Duchamp's 'Fountain' (1917) and 'L.H.O.O.Q.', (1919).

In this research I bring awareness to cognition in choreographic creative process through the development of a tool (Scuddle) that extracts decision-making processes in choreographic experience and extracts that experience through facilitated phenomenological interviews in order to uncover embodied data. In this case the researcher has to understand the nature of the process at hand in order to design and guide the study. The researcher needs to be capable of identifying key elements of choreographic process being explored in order to make decisions about how to guide the process. This requires understanding through prior knowledge and expertise that can guide the interview process: what determines the cognition decision and actions of the choreographer in the studio, and how might creative constraints be used to guide awareness to those

decisions resulting in choreographic action. In designing, implementing and testing a computational research tool the researcher needs to select appropriate 'constraint-pairs' (Stokes, 2006) that 1) have the potential to make room for creative-decision making choices that 2) result in novel movement choices and novel choreographic decision-making in sequencing and craft.

The researcher's ability to guide attention within this methodology is dependent upon their experience, expertise and understanding of the process. The system design and implementation of the Scuddle choreographic tool is based in personal choreographic expertise in the fields of choreography, dance and somatic practices, particularly with regard to designing functional constraints that could induce potentially novel movement vocabulary choices. The movement catalysts generated by Scuddle constrain the choreographer's habitual process, thereby bringing awareness to the decision-making that acts on the habit, as well as the alternate decision-making that produces novel choices outside of habitual decisions. Once the choreographer becomes aware of these processes through the use of Scuddle, the researcher can elicit verbal descriptions of these processes through phenomenological interviewing techniques by guiding the choreographer's attention to relevant areas of their experience, facilitating the choreographer's verbal articulation of the experience.

4.2 Scuddle System Design

To illustrate how the design of the technological tool Scuddle applied choreographic constraints in the form of movement catalysts, I begin by discussing the motivation for using a constraint-based model to explore

choreographic decision-making and also the motivation to computationally model movement generation in choreographic process (See Figure 25). I describe the application of Laban Effort and Bartenieff fundamentals descriptors as an outcome of genetic algorithm movement catalyst generation. Scuddle was implemented by applying a genetic algorithm (GA) that included a fitness function, selection and breeding components. I link this technological system design to its grounding in choreographic expertise and knowledge of movement generation.

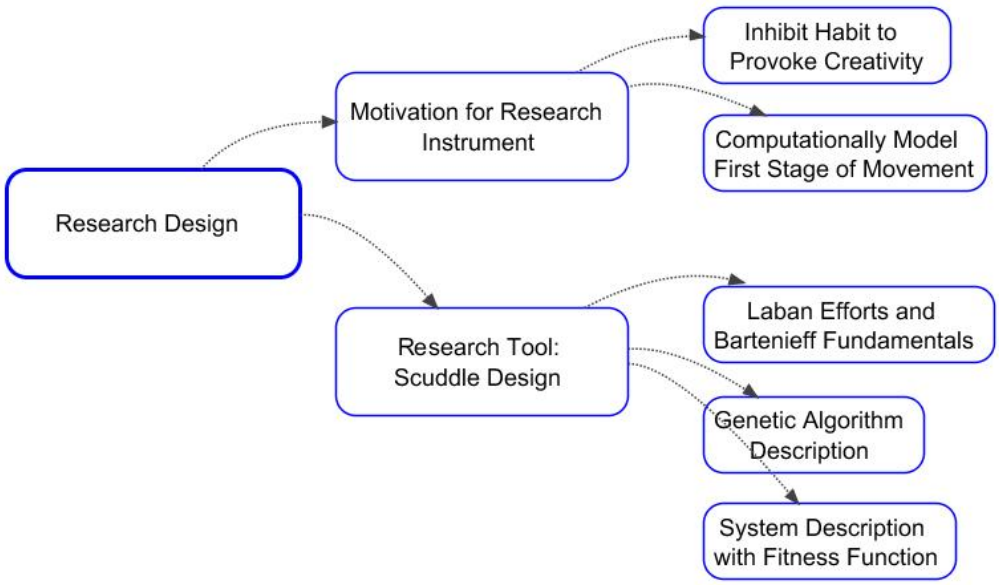


Figure 25. Map of Research and System Design Section

4.2.1 Design Motivation: Designing Constraints

> *'In producing outcomes whose value may be ascertained only through hindsight logic, choreographic provocation gives choreographers a powerful hands-on rehearsal tool for invention within the parameters of their existing material. It is often tempting for choreographers to lean heavily on foresight logic –that is, the logic of looking ahead, planning and preparing. Important as these capacities of mind are, they are not always the best for searching out or developing novel ideas. By offering fresh, and even deliberately outlandish, options for the choreographer to consider, provocations invigorate the creative process.'(Lavender, 2009, p. 93).*

I have always been interested in the potential of fully computer generated, contemporary choreographies. Through my university dance experience while I was also taking courses in Computing Science, I was aware of my habitual movement patterns and wanted to gain the control to change them at will. However, I did not want to change them in order to move in a more technically 'correct' way. I wanted to move in a highly original way, that could lead to novel choreographies and a uniquely creative yet functionally desirable, style. However, the process of changing habits and learning to move in a particular way does not come easily. Many body-based practices that explore dehabituation techniques take years of full-time study to master. For example, Alexander Technique teacher training takes 3 years of full time practice. A common aphorism among dance professionals is the statement that "it takes 10 years to make a dancer." This shared common domain knowledge alludes to the length of study required to master the knowledge and practice of movement and to develop sufficient and versatile embodied knowledge to become a dancer

(Blom, 1982). The process of altering movement patterns developed over years of practice is not simple to identify, consistent among various styles of dancers or easily taught.

During the research that developed from this thesis, I began to concurrently study computational techniques available within Computer Science, and specifically a branch of Artificial Intelligence, which provided ideas for potential approaches to finding solutions, which could alter my physical habits, with the goal of creating novel movement. I became interested in using computer programs that would generate unusual movements on 2D avatars or stick figures with realistic anatomical limitations in order to use these movements to choreograph dances. The system would create a catalogue of every possible joint movement 5 degrees apart and algorithmically combine individual joint locations into a whole body position (See Figure 26). Body positions could then be algorithmically sequenced into movement phrases that could be used compositionally and that the live physical dancer could learn.

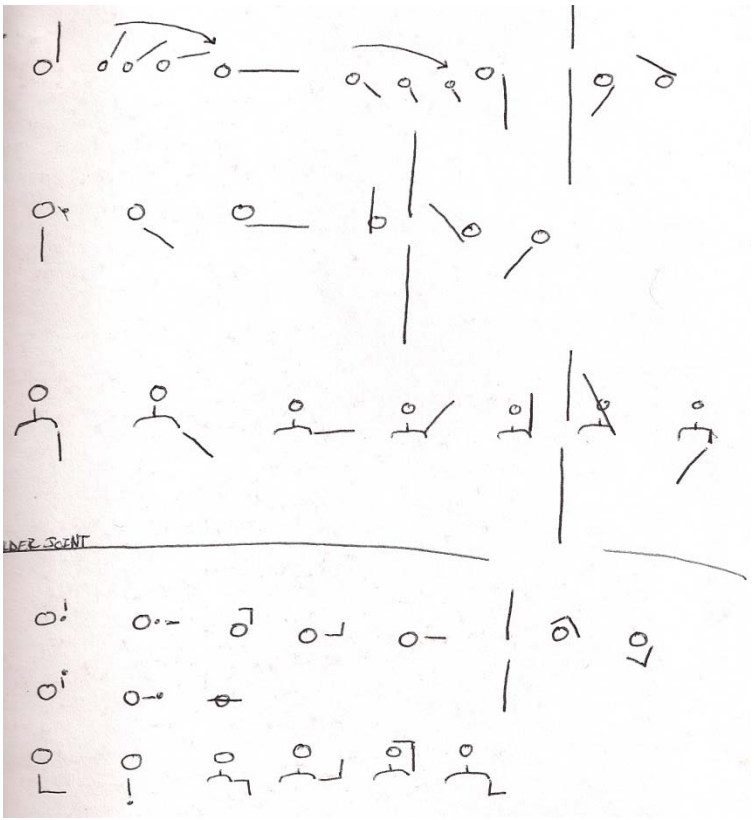


Figure 26. Original Ideas for Computationally Cataloguing Motion

This initial idea for computer-generated choreography prompted a preliminary programming sketch. However, as a first draft, instead of creating a catalogue, positions were randomly generated without including anatomical limitations (see Figure 27). When exploring the resulting movement images in the studio I discovered unusual movements that I would never have explored otherwise. I also found that I relied strongly upon my habitual learned tendencies for survival (for example to move without getting hurt), as a mechanism by which to realistically explore the images that appeared nearly impossible to execute. It was during this stage that I was able to recognize certain habits more strongly

than others and could begin to describe the experience verbally. As this was an intriguing process that met my goals of invoking highly original movement, while uncovering habits and decision-making processes that enables me to understand my choreographic process and develop new strategies for movement, I began to revise the system to explore additional movement qualities.

Figure 27. Original Scuddle Body Position Generator

As the first iteration of the system contained only body positions, I still had a lot of freedom to rely on my movement habits. The second iteration of the system added Laban Effort Qualities and Height (the level the movement is performed at) to further constrain movement possibilities. These additions required me to dynamically move through the provided body position, transforming the position into movement. However, only certain movement catalysts challenged me to move past my habits, while other catalysts enabled

me to easily transform the movement into my typical movement patterns. I began exploring novel movement but still relied on my habitual survival skills to an extent that did not only keep me ‘physically’ safe but also was keeping me ‘creatively’ safe. There was more design work that was required in order to analyse what kinds of movement catalysts were more effective in generating novel movement, and what kind of algorithmic model I could use to generate these qualities in movement catalysts.

Figure 28. Author Exploring Scuddle Catalyst

The final version of Scuddle presented in this thesis, needed to dramatically shift my habitual movement choices. To do this I built a Genetic Algorithm to generate ‘preferred’ catalysts, weighting and selecting desirable elements to further constrain positions, height, body symmetry and Effort Qualities. The selected catalysts became very difficult to physically explore but created very interesting, highly novel and unusual movements. Though movements may feel foreign, trained dancers often continue to execute difficult movement with ease, which can appear to the observer as aesthetically

reasonable decisions to select and execute (for instance ballet movements may look light and easy but are very difficult for a body to perform taking years of physical training to execute correctly). To the dancer, there is a lot of time spent solving both kinesthetic and conceptual problems (See Figure 28). The process of kinesthetically performing Scuddle movement catalysts heightened the choreographer's awareness of the problem-solving process, and enabled verbal articulation and discussion.

4.2.2 Design Motivation: Modelling the Creation of a Movement Vocabulary

> *'We may initially define cognitive science as that set of subjects which study the human mind, accepting simulation as their unifying method, a method which is typical of artificial intelligence.'*
> *(Bara, 1995)*

Another aspect to the design of Scuddle includes the need to model the initial creative, choreographic decisions that generate movement ideas. A choreographer begins working in the studio by finding some concept, movement or goal to explore. Scuddle provides the choreographer with a creative movement goal to focus on kinesthetically exploring unusual catalyst components and enables the choreographer to find a way to develop the components into a movement vocabulary. The incompleteness of data in Scuddle movement catalysts facilitates 'open' exploration by the choreographer, enabling multiple solutions to be generated. The design of Scuddle movement constraints takes into account the creative cognitive process and typical actions resulting from choreographic decision-making in a studio, This ensures that when a choreographer uses Scuddle to generate movement, they incorporate the

motivation to explore creative movement towards a specific goal, which is the first step of studio exploration in choreography. Body position, body symmetry, height of the action and effort qualities are initial creative design choices for movement in the studio that are modelled in Scuddle. Scuddle's suggested movement catalyst is incomplete by definition, enabling the choreographer to make creative choices about the movement execution, which transforms an incomplete movement catalyst into a fully physical executed movement or movement phrase.

The field of Cognitive Science frequently examines cognitive processes by computationally modelling them, to 'test' what is known (Bara, 1995). However, in order to simulate a component of human cognition, we have to understand the 'known' cognitive component with enough detail to model it computationally. In order to validate what has been understood, we attempt to replicate or simulate cognitive processes computationally. After such an attempt at computationally modelling improvised theatre, Magerko and Riedl recognized that the current understanding of cognition in that discipline required a much more refined level of knowledge representation in order to develop a successful model (Magerko & Riedl, 2008). Subsequently they explored the cognitive processes of improvised theatre in real physical life and have yet to attempt second iteration of its representation in a computational model. Some processes are inherently complex, and require subsequent chunking into understandable component parts to successfully explore and validate cognitive decision-making features (Johnson, 1970). For example, Scuddle uses a *limited selection* of movement

data in order to provide opportunities for the choreographer to examine their choreographic process which simultaneously engaging in creative decision-making tasks that result in action.

4.2.3 Laban Efforts and Bartenieff Fundamentals

The design of Scuddle's incomplete movement data is based on studies in movement patterns and effort qualities by Laban and Bartenieff (Laban, 1947; Hackney, 1998). Rudolf Laban developed a method of categorization to analyze, notate and create movement. One property of movement that Laban explores is 'effort', the quality used to execute a movement. He emphasized that every movement possesses effort qualities as forerunners of the movement execution, describing Effort as an *inner attitude* that results in movement execution. He describes four quality components (See Figure 29): weight (light to strong), time (sudden to sustained), space (direct to indirect) and flow (bound to free). For example, "Movements performed with a high degree of *bound flow* reveal the readiness of the moving person to stop at any moment in order to readjust the effort if it proves to be wrong, or endangers success. In movements done with *fluent flow*, a total lack of control or abandon becomes visible, in which the ability to stop is considered inessential" (Laban, 1947). Scuddle uses all four effort quality components as 'instructions' for executing a position. The combinations of qualities are designed to create unusual or novel yet complex physical patterns for the body to execute.

Bartenieff Fundamentals are a further development of Laban's research to the moving body (Hackney, 1998). Irmgard Bartenieff was a student of Rudolf

Laban and that built upon Laban's movement descriptions. Bartenieff uses anatomical body planes to deconstruct movement into categories such as pathways of movement, movement patterning, spatial intent and core support. The body planes (see Figure 30) sagittal, coronal and transverse help to illustrate the paths and planes that movement patterns are executed within. For example: homologous positions (same limb positions for one side of the transverse plane), homo-lateral positions (same limb positions for one side of the sagittal plane), and contra-lateral positions (same limb position for one opposing limb on each side of the sagittal plane). Additional movement pathways include distal positions (all limbs fully extended) and medial positions (all limbs fully contracted). Bartenieff Principals are used in Scuddle to explore and inhibit habitual movement patterns.

The body prefers to interact with the world in the most efficient and fluent way possible (Laban, 1974). This includes moving in a stable, balanced, upright manner that exerts minimal strain on the muscular system (Knudson, 2002). As choreography requires extensive endurance to perform for long periods of time, the human body needs to work efficiently even in dance. Habitual movement patterns often prefer comfortable, symmetrical and stable actions to maintain safety and efficiency of the body. These elements suggest that most people prefer to function in an efficient, stable and upright manner. For instance, unless a choreographer is actively creating a work about falling down, they will not intentionally fall down. On the other hand, if a choreographer is exploring *how* to

fall down, they will be exploring how to do so in a comfortable and stable way that keeps them safe and able to react quickly when needed.

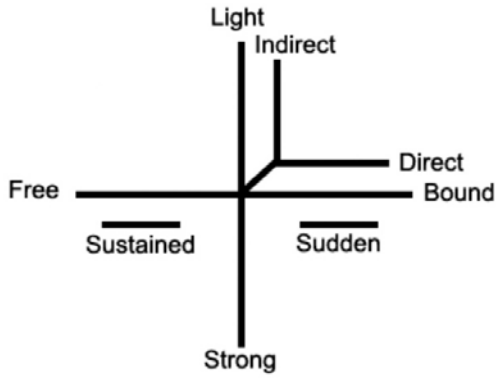


Figure 29. Rudolf Laban's Effort Quality Graph (Newlove and Dalby, 2003)

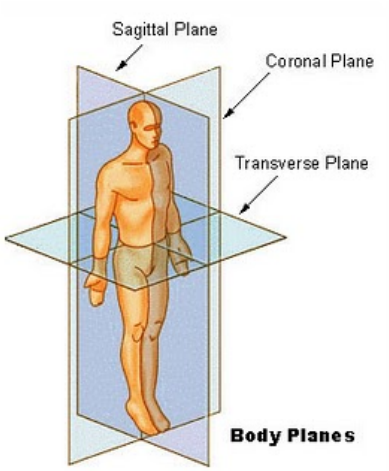


Figure 30. Bartenieff Separation of Bodily Planes (Hackney, 1998)

4.2.4 Movement Habits and Scuddle Design

George Birkhoff, a mathematician who studied the mathematics of art, music and poetry, describes aesthetic beauty as being illustrated (in part) through forms of asymmetry and complex variation (Birkhoff, 1956). Asymmetrical body positions are more difficult to safely explore kinaesthetically, because they require a continual reassessment of stability. In Scuddle non-stable limb joint angles (shoulders, elbows, hips and knees) are explored and favoured to generate body positions that are asymmetrical, non-habitual and unique. The combinations of various and differing joint angles creates more detail for the

choreographer to attend to, which requires more attention, more effort to execute and more creative exploration to find successful executions of the position.

By using complex variations of joint angles, habitual movement decisions are inhibited and attention is brought to the decision-making process, enabling verbal articulation of the decisions. By combining unique unusual body positions (through complex joint angles) with asymmetry, the choreographer has to manipulate their attention through both the unusual body position and the position's stability. By including Laban Effort Qualities to constrain *how* the instability is managed, the choreographer has to make decisions about where their attention will be, bringing additional awareness to the decision-making process. By creating complex catalysts, emphasis on inhibiting habitual movements is designed through the use of asymmetry and complex variations between joint angles on a position (Birkhoff, 1956).

4.2.5 Scuddle Constraints

Scuddle uses body position, height and effort qualities to constrain the choreographer's choices for creating movement. Laban Efforts and Bartenieff Fundamentals are utilized to support constraint choices. Body position is constrained to generate asymmetrical positions with joints that are neither fully extended nor fully contracted. Habitual and codified body positions are more difficult to access, hence creative and unique movement choices must be made. The physical height at which a movement catalysts is executed is constrained to support unstable heights (such as crouching or balancing on the toes) to promote movement and exploration. Stable positions such as laying down, sitting and

standing, become a rare and unusual movement catalysts selection within Scuddle because these are easy to execute and are linked with common body positions. Basic Laban Effort combinations are avoided by using all four Effort Qualities, weight, space, time and flow. Effort Qualities are constrained by promoting unusual and complex combinations to explore unique qualities of movement. Figure 31 illustrates the paired constraints utilized within Scuddle that support the shift from codified or habitual movement to creative and unusual movement. Based on Stokes model of creative constraint pairs (described in Chapter 2) I designed a set of paired constraints to shift choreographic creative-decision making from habitual choices to novel or creative choices. Scuddle was designed to limit codified and balanced body positions to invoke new and unique body positions. Stable heights are limited to invoke movement and instability. Basic effort quality combinations are limited to invoke interesting combinations of effort qualities, promoting new ways of moving. This model is one of the contributions of this research.

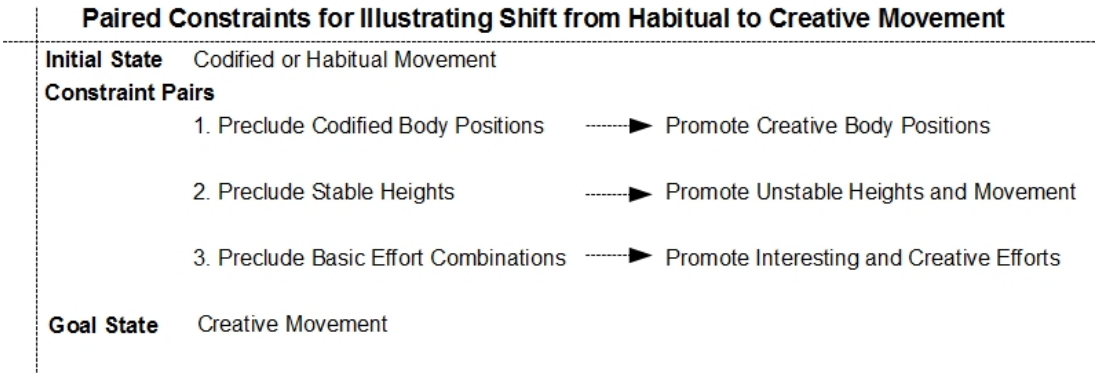


Figure 31. Paired Constraints in Scuddle Using Stoke's Model (Stokes, 2007).

4.2.6 Genetic Algorithm

A Genetic Algorithm is used to evolve the ‘creative’ movement catalysts (the right side of the constrained pair) as indicated in ***Paired Constraints in Scuddle using Stoke’s Model*** above. This allows the system to control fundamental components that problematize the dancer’s process of generating movement. Genetic Algorithms are typically used to explore a wider range of potential solutions than other search algorithms can (Holland, 1992). Initially a large population of random individuals are generated and given a score for their fitness against the prescribed goals for success. This initial population is then subjected to an iterative cycle of selection and breeding. Once a cycle is complete the new population is judged on its fitness once again and the process continues for a fixed number of iterations or until a certain fitness threshold is reached (Floreano and Mattiussi 2008; Russell and Norvig 2010).

4.2.7 System Description

A movement catalyst consists of movement data that is graphically represented as a 2 dimensional figure with text for height and effort quality instruction (See Figure 32). The 2D figure represents body position through the use of straight lines as limb positions with curves to suggest torso positions. This allows the 3 dimensional orientation and limb position to be determined by the choreographer. The interface has five button options that have the functions of Start (to run the algorithm), Watch (to view the 6 catalysts in order), Pause (to pause the playback), Back (to view the previous catalysts) and Clear (to erase

the values to re-start the algorithm cleanly). Still images of the generated catalysts are saved every time the algorithm is run (See Figure 32).

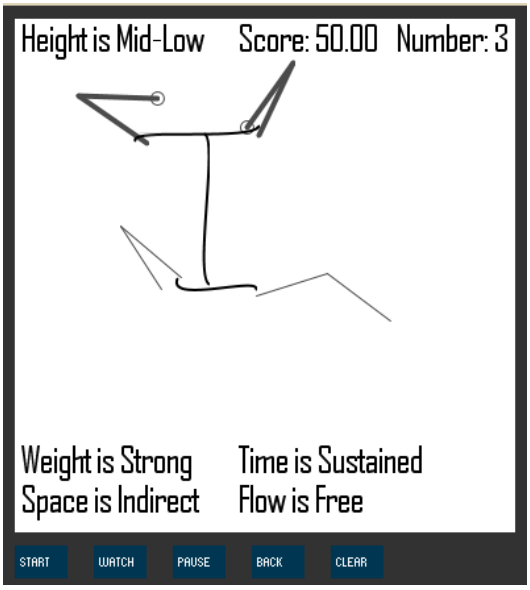


Figure 32. Scuddle Interface in 'Watch' Mode to View Movement Catalysts

The system begins by generating an initial population of 200 random ‘catalysts’. Body positions are designed to allow unlimited possibilities for positions in eight major joints; the shoulders, elbows, hips and knees. Positions are initially generated by calculating random angles between 0 - 360 degrees for each joint to alter the configuration of the position’s limbs. Effort qualities are randomly generated as 1 or 2 (for fighting or indulging as later explained) and height as a random level from low to high. Therefore, a catalyst is composed of 13 values: 8 joint angles, 1 height level and 4 effort qualities. An example of the values from Figure 33, showing height and effort qualities are:

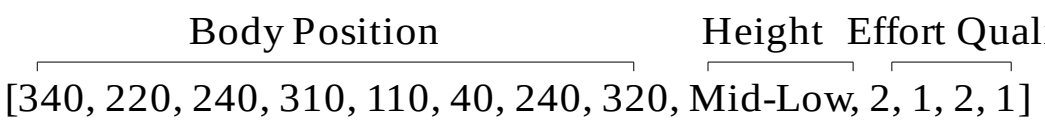


Figure 33. Values for Creating Movement Catalysts

4.2.7.1 Fitness Function

A rule based system is used to evaluate the fitness of each movement catalyst. We have developed heuristic rules based on movement patterns discussed in Bartenieff Fundamentals and the author's expertise in contemporary dance practice to inhibit traditional habits when creating movement. The fitness function evaluates each catalyst component separately (body position, height, effort qualities and Bartenieff) and then calculates the overall score. To compare the catalyst components we map each value separately. Each of the 8 joint angles are weighted based on their location within quadrants. For example, angles between 0-90 degrees are placed in one quadrant and 90-180 degrees in another. The orientations of quadrants are based on their location from the center of the body (See Figure 34). This weighting is designed to lower the score for fully outstretched or contracted limbs by placing all joint angles on diagonals that score 1, creating an overall body position score of 8 (1 x 8 joints). For example, the bent arms in Figure 2 have scores as follows: the left shoulder is 340 degrees which is mapped to 4 and the left elbow is 220 degrees to map to 1. This sum of these mappings gives Figure 2 a body position score of 14. Height is the level at which the body position is to be executed. These values are used to

emphasize more unstable positions such as balancing in crouches and on the toes (See Table 3).

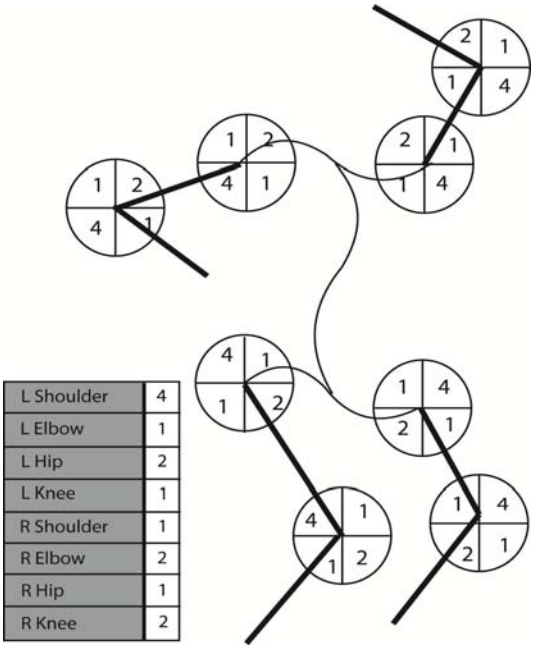


Figure 34. Weighting of Quadrants for Body Position

Effort Qualities refer to the effort used to execute a body position and height. Fighting efforts are direct, strong, sudden and bound. Indulging efforts are indirect, light, sustained and free. A combination of four fighting or indulging efforts results in modifying the sum of the position and height by -60%. Combinations of two fighting and two indulging efforts modify the sum of the position and height by +20%. Three fighting efforts and one indulging effort or three indulging efforts and one fighting effort modify the sum of the position and height by +40%.

Height Weighting		
Jump	High	2
Raised	Mid-High	3
Stand	Middle	1
Crouch	Mid-Low	3
Floor	Low	2

Table 3. Height Weighting to Adjust Scuddle Score

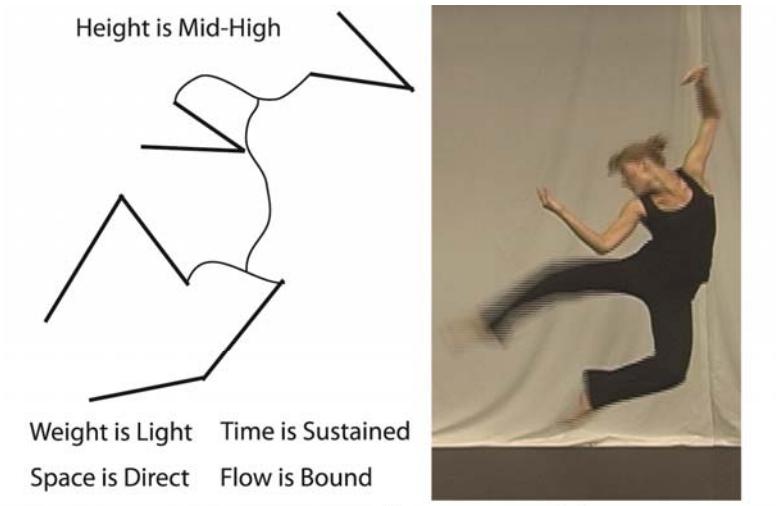
Bartenieff Modifiers	
Contralateral	+30%
Homologous	-40%
Homolateral	-50%
Distal	-60%
Medial	-50%

Table 4. Bartenieff Modifiers to Adjust Scuddle Score

Symmetry of body position is analyzed as movement patterns (based in Bartenieff Fundamentals). Contra-lateral motions explore the diagonals made across the body. In homologous motions the relationship of the top half of the body is compared to the lower half. Homo-lateral motions compare the limb position of one side of the body. All limbs fully extended are considered distal and all limbs fully contracted as medial. To address habit inhibition, heuristic rules are designed to favor contra-lateral motion (asymmetry) while hindering homologous and homo-lateral motion (a tendency of codified dance techniques). See Table 4 for the assigned modifier that is applied.

The fitness for a movement catalyst is calculated as the sum of body position and height that is modified based on the combination of Laban effort qualities and Bartenieff movement patterns. See Figure 36 for an example of mappings and fitness score. The equation for the score is:

$$\mathbf{Fitness(mc)} = BP_{mc} + \mathrm{Height_{mc}} \times (1.0 + Bartenieff_{mc} + Laban_{mc})$$



L Shoulder	1	R Shoulder	4	Weight	1	Position +	20
L Elbow	1	R Elbow	2	Time	1	Height	3
L Hip	4	R Hip	2	Space	2	*	1.00 +
L Knee	1	R Knee	2	Flow	2	Laban +	0.20
Height	3	**Total**	**20**	**Laban**	**0.20**	Bartenieff	0.30
						Score	**34.5**

Figure 35. Example of Scoring for Fitness Function

4.2.7.2 Selection, Cross Over and Mutation

The system selects 20 percent of the movement catalyst population by Roulette Wheel to be parents for the next generation of offspring. The Roulette Wheel process selects individuals with likelihood proportional to their fitness. Two individuals at a time are bred through two-point cross over, chosen from the pool of parents. The breeding takes place by selecting two random placeholders from the two individual's values and switching the values between placeholders (See Table 4). The offspring are added into the new pool of individuals. The breeding process continues until the population has grown back to the original size. Once the size of the population has regenerated, ten percent of the individuals are randomly selected to mutate. The mutation occurs by choosing a random

placeholder in the values of the individual and generating a new value for that place (See Table 5).

Individual 1 [4, 1, 2, ||1, 1, 2, 1, 2||, 3, 2, 1, 2, 2]

Individual 2 [1, 1, 2, ||2, 4, 2, 3, 1||, 3, 1, 1, 2, 2]

New Individual 1 [4, 1, 2, ||2, 4, 2, 3, 1||, 3, 2, 1, 2, 2]

New Individual 2 [1, 1, 2, ||1, 1, 2, 1, 2||, 3, 1, 1, 2, 2]

Table 5. Example of Cross Over

Individual 1 [4, 1, 2, 1, 1, 2, 1, ||4||, 3, 2, 1, 2, 2]

Mutated 1 [4, 1, 2, 1, 1, 2, 1, ||2||, 3, 2, 1, 2, 2]

Table 6. Example of Mutation

The cycle of Selection, Cross Over and Mutation repeats until the termination criteria has been fulfilled. This has been set at 6 generations to retain diversity in the population. For the final selection of individuals, Roulette Wheel selection is used to choose 5 individuals from the population to be presented in sequence to the choreographer. The system is available online at:

http://www.metacreation.net/kcarlson/Scuddle/applet/

5: STUDY DESIGN: EXPLORING PHENOMENOLOGICAL DATA OF CHOREOGRAPHIC DECISION-MAKING PROCESSES

Art practice – both the art object and the creative process – embodies situated, tacit knowledge that can be revealed and articulated by means of experimentation and interpretation. (Henk Borgdoff, pg 18)

5.1 Phenomenological Study Design

This chapter describes the design of the formal phenomenological study that explored creative decision-making in choreographic practice (See Figure 39). Choreographer's experience was investigated using technologically-generated movement constraints in Scuddle. The study was conducted with eight choreographers, including the researcher, utilizing phenomenological interview methods. Data Analysis of transcribed interviews used open-coding techniques, which formed the basis for developing initial categories based on choreographers response, and was influenced by a grounded theory approach. Data categories were used to construct a model based on choreographer's reported experience in a technologically supported constraint-based model of choreographic creative decision-making process.

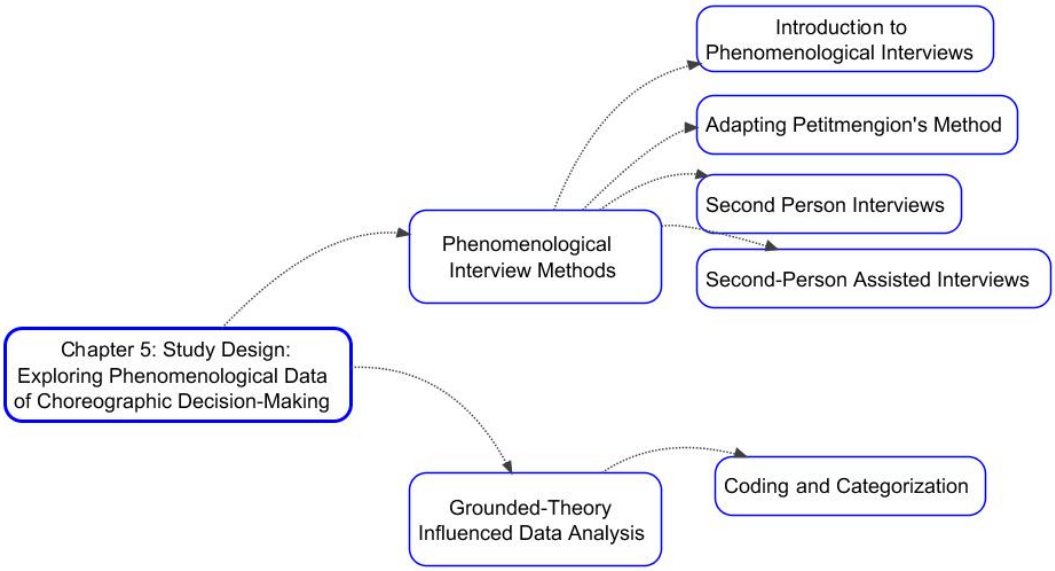


Figure 36. Map of Study Design, Interview Methods and Data Analysis

The Study participants consisted of eight local Vancouver-based contemporary choreographers. The formal study and data collection took place at Simon Fraser University, School of Interactive Arts and Technology Black Box Theatre Studio[2] from March 2011 to June 2011. Four choreographers were undergraduate dance students, one a graduate dance student, one a young professional choreographer and one an experienced professional. All were female between the ages of 20 and 39. Three forms of data were collected through this study: first-person data of the researcher through journaling, second-person interview data of the choreography study participants, and second-person *assisted* interview data of the researcher (when interviewed by an experienced external researcher) (See Figure 40).

[2] All studies with Scuddle were held in the Black Box Theatre Studio. The space can be viewed in any photograph including dancers.

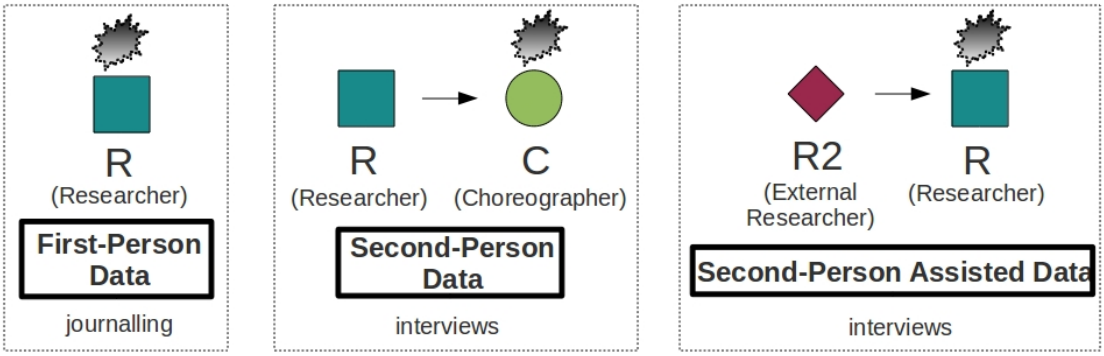


Figure 37. Interview Methods Used to Acquire Data

5.1.1 Design and Study Progression

Four stages of data were collected through the Scuddle research project (See Figure 38). The first stage was the first-person data of the researcher collected to inform the iterative design process of Scuddle. The second stage was the pilot study of choreographer's use of the beta version of Scuddle in order to collect second-person data about the Scuddle system, and to inform the study design for the formal Scuddle study. The third stage was the formal study, conducted with 8 Vancouver choreographers, to explore the main research questions described on page 15 of this thesis. And finally, the fourth stage was implemented as a part of the formal study, with the goal of triangulating researcher experience by incorporating the researcher's experience of the Scuddle system through an interview process conducted by an external researcher with the author to acquire the researcher/author's experience of Scuddle in order to reflect upon the main research questions. This fourth stage method is described as a second-person *assisted* interview, focusing on

extracting the researcher's experience of choreographing with Scuddle. The following bullet points discuss each stage in detail.

1. Stage 1: The Scuddle design process was iterative, relying on the researcher's background and experience with the tool in the studio to inform design decisions. This was a first-person method of gathering data based on journaling the experience. The main goals of the design process were to inhibit habitual movement decisions and provoke creative movement decisions. (Example statements from the first-person journal can be found in the Appendix in First-Person Journal Excerpts)

2. Stage 2: The Scuddle system was tested with student choreographers in a Pilot Study. The pilot study required that choreographers explore Scuddle movement catalysts in the studio while the researcher observed their actions. The researcher's observation of the choreographers informed the interview questions that were later posed to choreographers in an open-ended interview. The pilot study also gathered second-person data of the choreographer experiencing the Scuddle system. Results from the pilot study informed the design of the formal study including interview questions: ***what*** would be asked and ***how*** they would be asked. The main goals of the pilot study was to test how Scuddle provoked creativity in choreographers, if and how the choreographers were able to create a connection to the movement

created as a response to the Scuddle movement catalysts and if choreographers were better able to verbalize their experience.

3. The formal study (1) explored the choreographic process of 7 choreographers over 6 hours of studio time while using Scuddle. The researcher observed the choreographers through their studio process and used these observations to inform how the choreographers were interviewed. The formal study utilized second-person data collection by the researcher to access choreographer's experience of the Scuddle system. The main goals of the formal study (1) were to explore choreographer's creative decision-making processes in order to identify and model the higher-level cognitive processes that describe creative process particularly when presented with technological constraints.

4. The formal study (2) explored the choreographic process of the researcher (R) over 6 hours of studio time while using Scuddle. In order to extract and document the researcher's first-person experience of the creative process, an external researcher (R2) was brought in to interview the researcher. The external researcher (R2) is familiar with the proposed phenomenological interview technique and has an experienced performance background. The external researcher also reviewed videos of the first formal study. The external researcher (R2) then observed the researcher's(R) experience in the studio with

Scuddle and used it to inform his interview questions to the researcher (R).

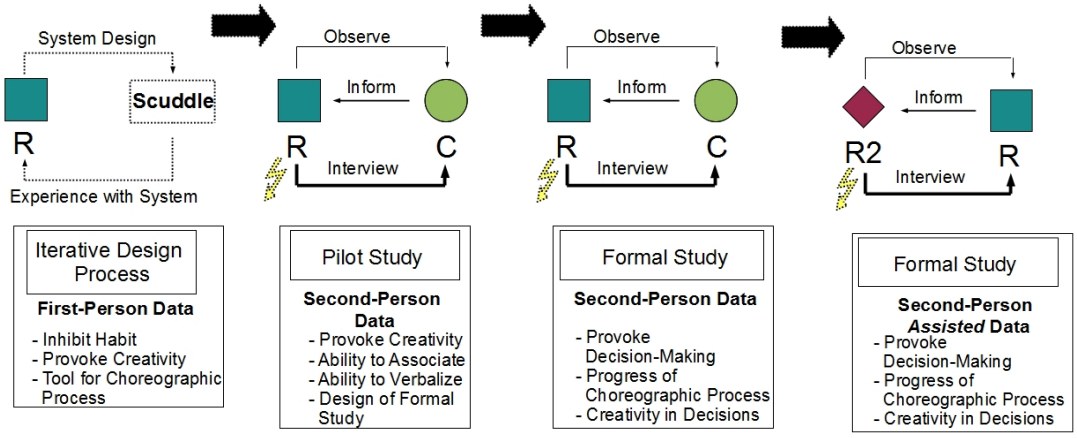


Figure 38. Forms of Data for Phenomenological Interviews

5.1.2 Formal Study Procedure

This section describes the procedure of the formal study for both the second-person interviews of 8 choreographer participants which include the researcher (R2)'s interview of the researcher (R) (See Figure 42). Seven choreographers were found to participate in the formal Scuddle study through the Canadian Association of Dance Artists union (an email list) and the School for the Contemporary Arts Dance Department at Simon Fraser University (an email list). The study took place in both the School for Contemporary Arts Dance studios and the School of Interactive Arts and Technology Interactivity Black Box space. Scheduling was based on the choreographer's availability. Each choreographer explored and composed movement developed from Scuddle's movement catalysts for three, two-hour long sessions.

Choreographers were first introduced to the space, the study and asked to sign an ethic's consent form that stated that they would not be harmed, misled or identified by name. Choreographers consented to using the visual material (photos and video) as visual evidence in this thesis and in the thesis publications. The sessions consisted of a short independent warm-up (often taking 30 minutes), the exploration period (often taking 1 hour) and a 20-40 minute interview about their choreographic experience. Each interview was structured with a set opening and then shifted to open-ended questioning to facilitate the choreographer's description of their experience. When the choreographers' descriptions became short or the choreographer repeated what they had said before, the research judged whether the interview should be drawn to a close. To ensure that nothing was being left underexamined the choreographer was asked if the discussion had missed any other part of the experience that they wanted to talk about. Each of the 3 studio sessions roughly followed the same structure: 1) first session explored and generated a movement vocabulary, 2) the second session developed the movement vocabulary into sequences and 3) the third session developed the sequences and movement vocabulary into a short, crafted composition.

Figure 39. Formal Study Progression of Studio Sessions

5.2 Interview Methods

> *'Dance lies at the point at which reflection and embodiment meet, at which doing and anticipation are intertwined'. (Martin, 1998, p. 1)*

5.2.1 Phenomenological Interviews

The phenomenological interview techniques used in this study were based on a pilot study for a research project entitled 'The Illusion of Togetherness' (Corness, Carlson, & Schiphorst, 2011). 'The Illusion of Togetherness' explored audience experience of a digitally mediated performance in a mixed-reality environment, situated in a research setting. The contribution of this study was the development of phenomenological interview techniques designed to explore the specific experience of performance. This approach is consistent with research on experience undertaken in Cognitive Science by Depraz, Varela and Petitmengin, Design for Interactive Art within Human-Computer Interaction by Schiphorst and in Dance by Kozel and Fraleigh (Depraz et al., 2003; Fraleigh & Hanstein, 1999; Kozel, 2008; Petitmengin, 2006; Schiphorst, 2009).

Petitmengin's cognitive research has been designed to focus on short task oriented experiences or critical moments within longer general experiences (Corness et al., 2011; Petitmengin, 2006). In the work done by Petitmengin (2006), markers in the form of statements by the researcher or environmental elements were used to help guide subjects back into a state of *re-living* the experience. Markers are devised points of reference that are used to 'mark' a section of the experience for the participant to make the moment 'present-at-hand' (similar to the defamiliarization created when using Scuddle constraints in

order to provoke verbal articulation) (Crawford, 1984; Heidegger, 2008). This brings the moment of experience to the choreographer/ participant's awareness, allowing them to return to the moment again later, facilitating 're-living' of the experience through the interview process.

Within 'The Illusion of Togetherness' project, potential markers were designed into a performance environment with the expectation of receiving participant awareness and articulation similar to those described by Petitmengin. However in a temporal experience such as performance, the assumption of what might constitute a 'marker' did not return the expected results. Instead, creating more openness regarding the participants selection of markers by 'defamiliarizing' the process itself provided the greatest results. By making this process 'present-at-hand' in Scuddle, the decision making process was also apparent, facilitating the choreographer's verbal articulation of the process. To 're-live' a decision while being interviewed and to articulate it with verbal clarity, choreographers often physically illustrated the decision-making process. An example of this was when one choreographer was describing how she chose to execute a movement catalyst and she grabbed catalyst printout while standing up to show me all the options she remembered thinking through, trying and deciding upon.

The individual experiences of audience members in the 'Illusion of Togetherness' study were coded and categorized, leading to the construction of a general model that described audience awareness in mediated performance. Based on the resulting explanatory properties of the general model for describing

audience awareness in performance, I applied the same procedure to develop a model for choreographic awareness during the decision-making process with a constraint-based technology tool such as Scuddle. In the approach taken in this thesis, there is an assumption that choreographic experience also contains uniquely individual elements, which can be analyzed to explore phenomenological data of choreographic experience, and that this experience can be coded, analyzed and compared for common features.

5.2.2 Second Person Interviews

The focus of this research is the decision-making process that occurs through the development of choreography. Because this is a personal embodied and physical experience, considerations need to be made to support the data collection that can enable research into the phenomena of choreography, a non-verbal and tacit creative skill set. For example, in researching experience there is the potential challenge that subjects may not have the practiced skills of self-reflection to inwardly articulate their process (Depraz, Varela, Vermersch, 2002) or the vocabulary (Glass, 2005) to adequately articulate the choreographic experience outwardly. Methods have been developed in the domain of cognitive science that attempt to address this difficulty. In these methods the researcher acts as a facilitator to help the subject articulate their experience. As facilitator, the researcher uses their own experience and knowledge of the phenomena to help the subject fully explore their somatic connoisseurship (Schiphorst, 2011). Additionally, care is taken to construct questions using the subject's own words so as to not lead or influence their answers.

The researcher/interviewer helps the choreographer achieve a mental state of re-living the experience. This is implemented in part by focusing questions on the physical sensations and state of curiosity being experienced during a particular moment. The interviewer can then focus questions on *how* the choreographer/interviewee perceives sensations in this re-lived moment, encouraging a focused and contemplative reflection on their experience. This reflection facilitates direct *descriptions* of their process and avoids overly conceptualized *interpretations* of their experience from an objective stance (Petitmengin, 2006). This is described by somatics practitioners as the difference between talking 'from' an experience, our favoured stance, and in talking 'about' an experience, a stance that distances the speaker from the 'feeling' and presence of the experience itself. Such interviewing techniques aim to support the participant's ability to achieve an authentic reflection that mimics the practiced reflection achieved in first person phenomenological description (Depraz, Varela, Vermersch, 2002; Kozel, 2007, Schiphorst, 2008). The research presented in this thesis combines the researcher's first person experience and expertise as a choreographer (their somatic connoisseurship) alongside their observation of the research subject/choreographers' process in the studio (Schiphorst, 2011). The combined observation of research subjects with the expertise and connoisseurship developed through the researcher's own practice helps to facilitate interviews.

The phenomenological interviews begin with a procedural explanation of how the interviewer/research would conduct the interview and ask questions. It would then open with a general question.

Researcher: So what we want to do is help you place yourself back into that experience and tease apart how you were making a decision.

Was there a moment where you had to explore many different movement options to find a suitable action?

From this opening general question, the interviewer follows the lead of the choreographer. Care was taken to phrase new questions using words used by the choreographer. These questions were focused on encouraging the choreographer to re-examine their description and see if there was any more to the experience then they first described. If the choreographer is relying on surface explanations, the interviewer guides their attention more directly to verbal indications of their experience, or to resonating moments in the interviewer's observation.

Researcher: When you're testing out things, when does it get to a place that it has become interesting enough to want to keep it?

P1: I don't know – it's a hard thing to answer. With the last shape, I stared at it a long time and the first or second thing I did was it. It

just felt right and I thought 'this is weird', I've never done anything like this before.

Researcher: How did it feel physically?

P1: I like it because it's a little bit of a challenge - I'm balancing on one arm, walking on my tippy toes.

Researcher: When you think about how interesting it is, are you thinking specifically about just how it feels? Thoughts about how it might look?

P1: I'm always thinking about the shape. About the audience's view of it for sure and also, I guess just to have a technical element to it, I really like dance where (I don't want to say this the wrong way - I do like pedestrian movement), but I like there to be at least a few elements of the choreography where the audience is like, 'Wow, I've never seen anything like that before', or it looks like it's challenging. Because, you know, we've trained for a long time and we'd like to show it off a little bit. So I keep that in mind and I want to be challenged or otherwise I'll get bored.

In the example above, the researcher helps the choreographer clarify their sensory approach to selecting movement choices: that the choreographer is not just exploring how a movement feels but also what it might look like to an audience. This example also illustrates the use of "how" questioning, where questions are phrased to focus on the choreographer's perceived or sensed experience. In this specific example, through the questioning the choreographer is able to 'reflect-in-action' and articulate that there was a choice between habit

and creativity to make. This form of questioning focuses the choreographer on describing physical sensations and mental processes of the experience (speaking ‘from’ the experience), avoiding rational explanations for the experience (speaking ‘about’ the experience).

5.2.3 Second Person *Assisted* Interviews with Researcher’s Use of Scuddle

In this research study, the researcher’s personal experience of decision-making in choreography is also captured as data. The rationale for including the researcher’s *experience of the system* as data helps triangulate the system design of Scuddle and the study design for choreographers using the system. Researcher’s experience is utilized as a gauge for the design success of the technological tool **Scuddle.** The researcher designs, tests and iterates the functionality of Scuddle in order to assess its reliability and success in applying constraint-based approaches to choreographic decision-making.

In order to gather data about researcher’s experience with using Scuddle, the researcher/author was also interviewed using the phenomenological technique described above in order to triangulate research experience with choreographer/subject experience. The combined interview transcripts were used in analyzing the data (described in the next chapter). In this case a graduate student researcher, who is experienced in phenomenological

interviewing techniques for performance, was asked to familiarize himself with the study and act as interviewer to the primary researcher[3].

5.3 Data Analysis

The method for analyzing the phenomenological data is inspired by Grounded Theory. Grounded Theory is a social science methodology that extracts the resulting theory from the data (Denzin, Lincoln, 2005). This procedure differs from traditional research that initially identifies a theory to evaluate the theory based on the chosen theoretical framework. Interview data in this thesis was coded, then concepts were developed from the codes that informed broad categories from which the final model was extracted (Denzin, Lincoln, 2005). The codes, concepts and categories used in the analysis were derived from the data itself. The interview of each choreographer was transcribed, coded and analyzed to construct a model of the choreographer's experience using Scuddle as a 'technological constraint'. In the first stage, each choreographer's interview transcript was coded and analyzed to create a detailed, unique 'individual choreographer' model. In the second stage choreographer models were compared and were used to generate a single high-level model based on similarities and differences of the individual processes**.** The third stage returned to the details of all the choreographer models to compare low-level events to more deeply examine experiences and create detailed

[3] This researcher familiarized himself first by participating in the study himself, exploring movement catalysts produced by the Scuddle system. He then reviewed videos of the primary researcher interviewing other participants ensure understanding of the research trajectory. The author then explored the choreographic task in the same way as other participants, and was interviewed about the experience by the outside researcher.

models of beliefs and expectation, the shifting of attention and the shifts between habit and creativity. This process is described in detail in Chapter 6.

Data from the researcher's first-person experience of working with the system (as journaling), the formal second person study (as interviewing) and the formal second person assisted study (as interviewing) are triangulated to develop the models of choreographic decision-making experience.

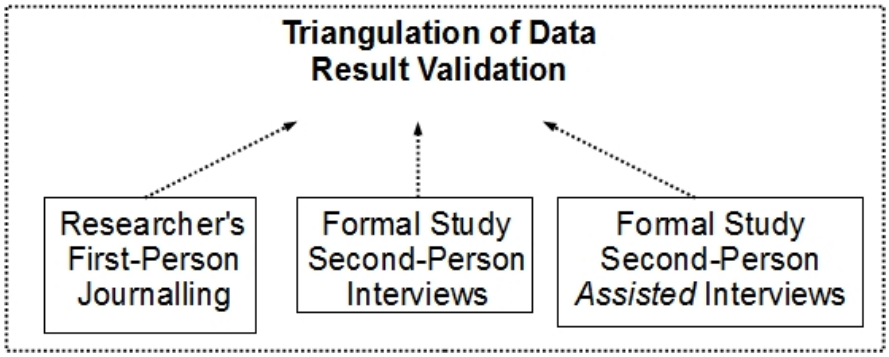


Figure 40. Triangulation of 3 Forms of Data to Form Results

We began the analysis by separating the descriptions into decisions. Each comment was flagged with the decision it referenced.

Researcher: The phrase has a lot of changing efforts and jumping into the floor - do you usually work with that range of effort or levels?

P1: I guess no is the short answer. I think I made a conscious effort to try and shift between things because I have a habit of getting into one thing and doing it for a long time. The last solo I did was one thing, one level, only floor work, head down the whole time, 5 minutes of just that. So I tried to not get too into one thing - and having the original images with the

> levels also helped that to happen. Also when I originally put the images in an order I intentionally made sure that one of the floor ones was in between 2 of the high ones - so I couldn't just jam out on the floor because I like to do that and I don't want every solo piece to be me on the floor.

The above example was flagged as a comment on decision about sequence due to the reference to making order. In the case that choreographers used ambiguous terms such as *shift*, the context of the comment and the researcher's personal experience was used to derive a flag. This process was used to distinguish between statements of physical movement and cognitive decision-making.

The intention of each comment was also considered. In general, comments can be divided into two types of intentions: descriptive and explanatory. With descriptive comments the choreographer had the intention to describe the experience in terms of an action or state. In the above example the descriptive flag of "I made a conscious effort to try and shift between things" was used since there is a reference to explore multiple movement options as opposed to a previous work that explore one movement option in depth. This is an example of an action statement. Other descriptive statements might comment on a state of confusion or curiosity.

The second intention, explanatory, often focused on providing explanations of assumption or beliefs. As Petitmengin suggests (1999, 2006), we found that these statements provided little insight to the choreographer's

experience but were valuable in determining a context for the experience that they provided through their more descriptive comments. The reference to ‘a habit’ is often explanatory and used as a blanket statement to cover embodied, intuitive decisions. Because it is still a decision, however, it is useful to examine which habitual components were utilized in that particular decision.

Analysis used an iterative process involving categorization, comparison and reassessment of experience descriptions. This allowed the individual models and general model to be developed concurrently while being compared for validity. Initially, each individual was analyzed separately. First, key phrases and words were highlighted. Then groups of consecutive key phrases were assessed and the main concept or topic was identified. Topics were then assessed for their temporal location within the process, similarity to other topics and reference to concepts from the literature.

An individual model was made for each participant based on the temporality of the topics and their qualities, including relevant key words or phrases. Once individual models were made they were compared simultaneously to assess for patterns. As individual topics were compared, the original sentences around key phrases were assessed to ensure that phrases were concurrent across choreographers. The development of models arose by following a similar pathway to the documented process; habitual and novel phrases were identified to explore detailed assessments, then larger temporal aspects were assessed, then the connection between detail and larger aspects were assessed.

6: ANALYSIS AND RESULTS OF CHOREOGRAPHIC DECISION-MAKING PROCESS

The previous two chapters (4 and 5) of this thesis discussed research design and methodology for studying choreographic decision-making in creative process. Chapter 4 described the motivation and design of Scuddle, a digital tool for imposing creative constraints on choreographic process by heightening awareness of decision-making. Chapter 5 described the phenomenological interview techniques utilizing an interviewer/research protocol to guide choreographers' attention to their decision-making experience. Chapter 5 also described the procedure for analyzing interview data. This analysis is the basis for the findings in this chapter, which describe and model results of creative decision-making in choreographic process. This chapter describes ~~the~~ results from 1) the pilot study of choreographers exploring creative movement with Scuddle and 2) the formal study exploring the choreographic process over time utilizing the 3 stages of the choreographic process: movement generation, sequence development, and compositional structuring and craft. The outcome is a model that describes choreographic decision-making in creative process in the context of technological constraints introduced by a choreographic support tool.

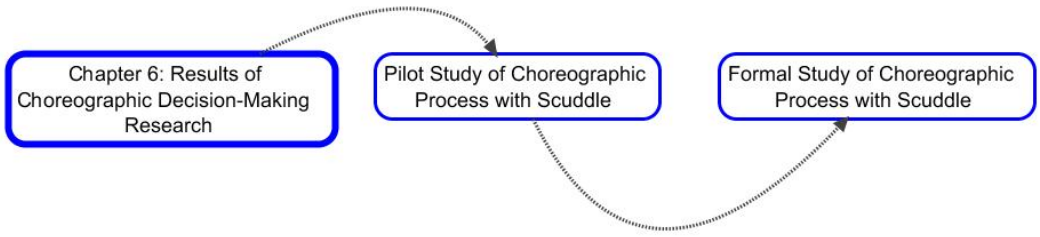


Figure 41. Map of Chapter 6, Results of Choreographic Decision-Making with Pilot and Formal Studies

6.1 Pilot Study

The pilot study explored how choreographers, created movement using Scuddle. The pilot study followed the initial design phase of Scuddle and was utilized to assess the ability for Scuddle to generate sufficiently complex movement catalysts to invoke creative movement decisions. This section describes the pilot study, the research design and the results (See Figure 45). Seven choreographers worked with Suddle: all participants were student choreographers. In the study analysis each participant is referred to as a participant (P) and their number.

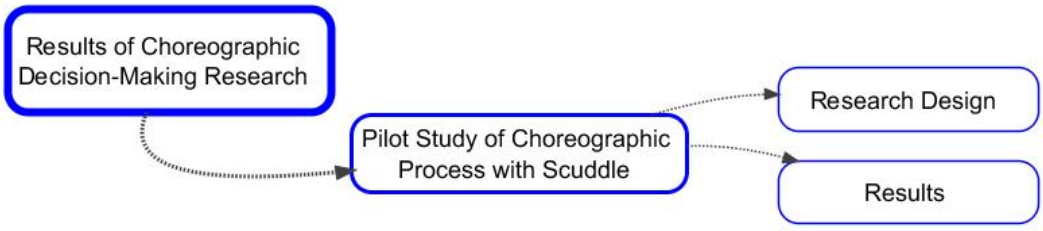


Figure 42. Map of Pilot Study Research Design and Results

6.1.1 Research Design

The pilot study was performed with 7 choreographers, 6 were local Vancouver-based choreographers and 1 was a New York based choreographer. The pilot study was held in a single 2-hour session in which choreographers were asked to work with Scuddle to physically explore movement possibilities from which they would create a short movement phrase. The researcher used participant-observation methods to view choreographic decisions and to discuss choices throughout the exploration, followed by open-ended interviews at the end of the session.

The pilot study provided choreographers with Scuddle data, either on a laptop or with a hardcopy set of movement catalysts. Five choreographers were provided with Scuddle on a laptop to generate their own set of movement catalysts, and two were provided with printed copies of a generated set. Choreographers using laptops were given instructions to generate catalysts and all participants were asked to explore the movement catalysts on themselves. After time was spent exploring and reflecting on movement possibilities (ranging from 40 minutes to 60 minutes), choreographers were asked to pair up and take the roles of dancer and choreographer. Each pair had the opportunity to take both roles, performing the role of the dancer and of the choreographer of the movement phrase to ensure they explored and could share the experiences with similar goals.

6.1.2 Pilot Study Results

The pilot study identified five main approaches to the choreographic use of Scuddle: 1) Scuddle prompted comparison to their usual creative process (n=5), 2) There was a heightened awareness of personal habits when a habit was explicitly addressed by Scuddle (n=5), 3) Choreographers reported re-examining their approach to structuring movement when using Scuddle (n=4 choreographers), 4) movement generated through Scuddle was initiated in non-habitual and creative ways (n=7), 5) Choreographers were able to verbally articulate their experience which can support the research goal of facilitating further study into creative cognition. (n=4).

Pilot study choreographers felt that working with the movement catalysts was very different from their typical creative studio processes (approach 1). Statements were made by 5 choreographers that their movement is often generated from a concept and explored through improvisation to make creative decisions based on what feels ‘right’ or ‘interesting’ internally or kinesthetically. While the choreographers stated that they did not often work strictly from movement descriptors in order to generate movement they were able to find connections to the Scuddle movement material that could motivate them to explore further. An example is included below in the statement by P2 regarding the valued of starting with ‘pure movement’ rather than a conceptual seed. However, working with Scuddle still prompted a strong reliance on habitual kinesthetic knowledge and the body’s ability to take care of itself (approach 2). P5’s statement emphasizing reliance on the body’s survival skills was mirrored

by 3 other choreographers, though the habitual dependence on prior ‘expert’ motor training to maintain safety while executing risk-oriented movements was contingent on how exuberant the choreographer was in execution.

P2 stated ‘I usually start with a concept but this time I started with pure movement and I still made the movement meaningful to me.’

P5 discussed ‘a heavy reliance on the body’s survival skills’ that took time to explore before reflection could occur.

Choreographers were able to bring attention to particular habits when the generated movement catalysts of Scuddle presented constraints that directly addressed these habitual movement choices, especially in relation to body symmetry and balance (approach 3). As described in Chapter 4, By imposing constraints in solving movement generation goals, the choreographer was required to direct their attention toward habitual movement choices, particularly since these habitual choices could not solve the constraints proposed by the system. For example:

P3 stating that the system ‘forces me to think of my arms at all times, which I never do’

P2 ‘it is weird for my body but actually feels really interesting - it makes me be really asymmetrical’

P1 found ‘with the legs I wanted to revert back to what I was comfortable with, but the arms I could really do something interesting with’.

The choreographer’s decisions about *how* to structure movement based on the constraints imposed by the Scuddle movement catalysts varied, and also required a re-examination of their personal choreographic approach (approach 4). Choreographers 3, 4, 5 and 6 ‘read’, parsed or selected the components from top to bottom in order of height, body position, effort qualities and attempted execution (in that order). However, choreographer 1 selected height and the effort qualities first, and attempted to fit the position into these components as a second order operation. When confused by how to execute a movement catalyst, choreographer 1 changed her perspective of the catalyst to a bird’s eye view, stating that ‘it was most important to find out what *I* think this is and then shift it to or adjust it for my body’. This statement illustrated the choreographer’s approach to exploring movement in a conceptually creative way as a primary *motivating* goal, and then to *secondarily* locate a way that worked physiologically (and that could refer to kinesthetic habits). Choreographer 1 and 2 both tended to attach different effort qualities to different parts of the body, for example Time as Sustained to the legs with Weight as Strong to the arms. Choreographer 4 focused on Weight and Time when executing a movement catalyst and assumed that Space and Flow would emerge automatically. However, choreographer 4 was not ignoring these qualities, but recognizing her own kinesthetic knowledge in relation to what for her, were easily accessible qualities. By being aware of her

own ability she was able to choose appropriate dominance between her attentions therefore allowing her dominant focus to be on Weight and Time and her subdominant focus to support the emergence of Space and Flow. In contrast, choreographer 2 looked for the similarities and differences between two catalysts and attempted to execute them consecutively. A striking result from collected data was that all 7 choreographers initiated movement in non-habitual and creative ways in relation to their own choreographic practice.

P3 stated that 'It pulls me out of my body at first, but it doesn't feel bad.'

P2: 'This is not a narrative but makes me connect the dots in an interesting way.'

P6: Scuddle 'gives you these very specific guidelines, but being creative people we interpret them in our own way. It's a very valuable tool and gives an interesting angle to work from.'

P1: Scuddle would be useful 'to get out of a rut or the habits you go back to.'

P4 : 'felt disjointed now physically but I am interested and would want to explore more artistically.'

Choreographers who participated in the pilot study also found they could better articulate their experience verbally as a result of the technical perspective that Scuddle presented them (approach 5). In this pilot study, choreographers became aware of their decision-making processes through the use of Scuddle's

constraints, particularly the occurrence of habitual choices, and the choice to select other novel or creative choices introduced by the constraints of Scuddle. The emergence of this awareness ~~is~~ facilitates verbal articulation of choreographic experience and is evidence of an external dialogue that begins to describe tacit, non-verbal and underrepresented data regarding choreographic decision making.

P3: ‘this helps me to verbalize my decisions’

P2: ‘I am talking about it more technically as opposed to making decisions that feel right’.

6.2 Overview of Formal Study

The main focus of this research is to explore choreographic cognition in the process of generating and constructing movement into a short composition. In the context of this discussion, cognition refers to both the body’s process of constructing understanding and the mind’s process that work together to make embodied actions. Cognition will be referred to as either *kinesthetic* or *conceptual* throughout the results section to suggest the dominant cognitive component at a given time. This section details the results of the formal study from choreographer’s phenomenological interviews, and includes the researcher’s second-person assisted interview~~s~~ as well (See Figure 46). These results illustrate how choreographic attention shifts between a choreographer’s beliefs

and expectations, and the habitual and creative options in both kinesthetic and conceptual knowledge throughout the iterative creative process. All participants in this study were choreographers, who will be referred to in their comments as a participant and their number. The researcher's comments from her second-person assisted interview will be referred to as the researcher (R). This follows the participants comments.

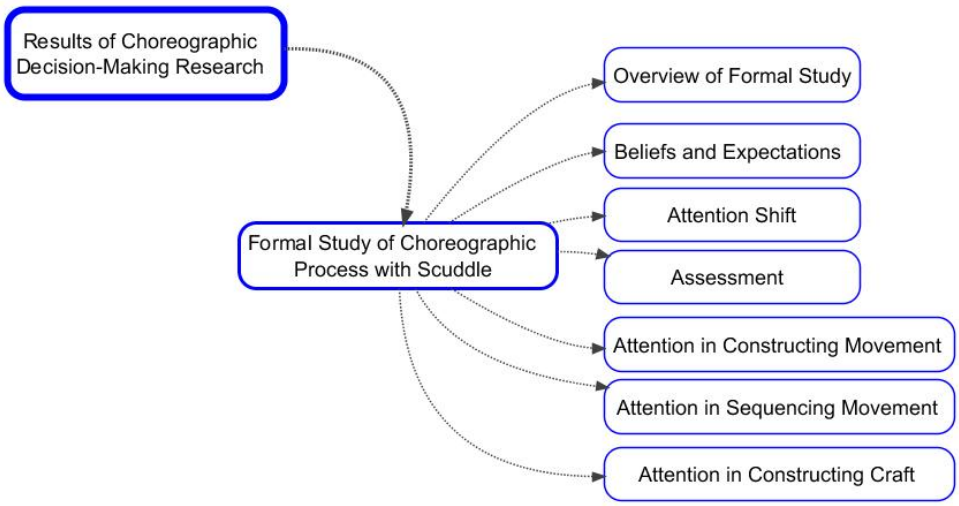


Figure 43. Map of Formal Study Illustrating the Overview Through the Analysis of Attention Throughout the Process

Eight local Vancouver-based choreographers participated in the formal study on creative decision-making in choreographic process. All choreographers were new to the process, had not worked with Scuddle prior to their participation and had not participated in the pilot study. Each choreographer participated in 3, 2-hour studio sessions for a total of 6 studio hours. While this length of studio time can be considered limited within normative creative process standards, it

provoked choreographic actions rather than ‘over-thinking’ the selection of actions to be made. This could be described as an appropriate cognitive load for effecting novel and creative outcomes. The approach taken is concurrent with an educational or workshop technique exploring and developing creative process. The first session for each choreographer presented Scuddle images from which the choreographer was asked to create a movement vocabulary.

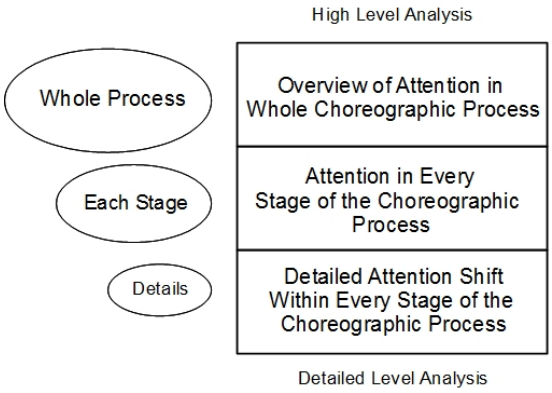


Figure 44. Description of Three Levels of Analysis

Choreographers illustrated similar creative processes during their explorations with Scuddle. Scuddle required choreographers to develop movement based on incomplete physical components (of a body position, height and effort qualities). The movement-focussed requirement is different than creating movement from a conceptual or affective intention. Results from the interviews are categorized into 3 levels of abstraction, beginning with the highest level. The interviews were focussed on gathering data about the choreographer’s attention. Specifically where this attention was most precisely focussed, and what the focus of attention was able to reveal about choreographic decision-making process. The highest

level of choreographic abstraction relates to an overview of choreographic process, where the attention shift within each of the 3 stages of the choreographic process (movement generation, sequence generation, craft), incorporates ongoing assessments that select actions or additional assessments. This occurs within each stage of the choreographic process (See Figure 46, pg. 138). All choreographers *assessed the amount of information presented to them* with the movement catalysts (See Figure 52, pg. 159).

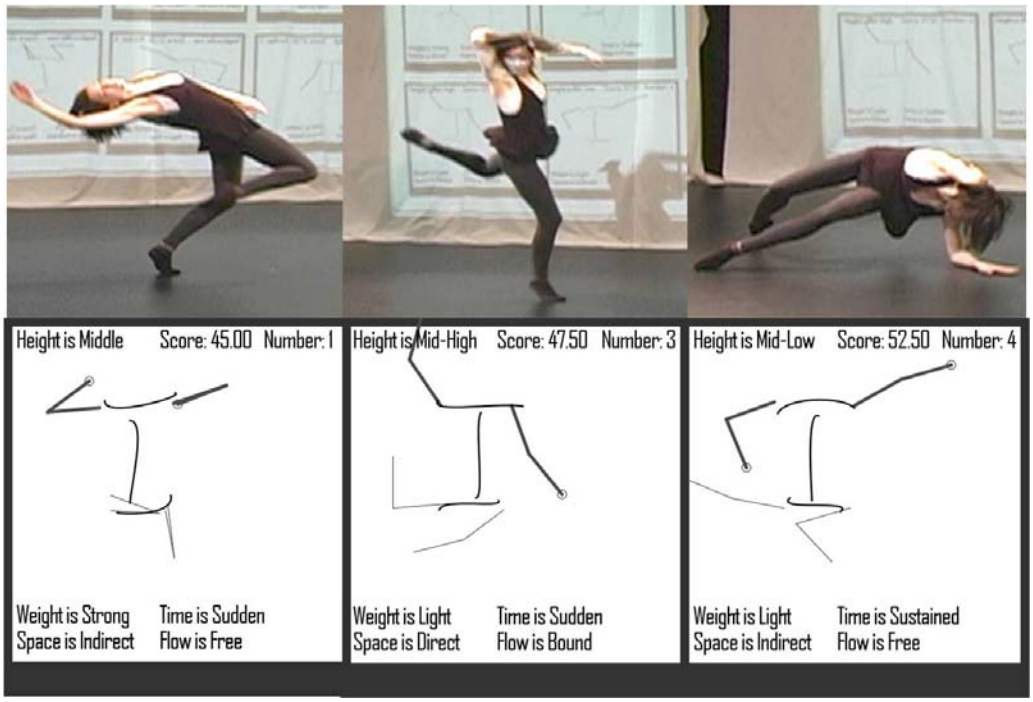


Figure 45. Choreographer Working with Scuddle. Each Movement of the Choreographer was the Result of the Movement Catalyst Presented Below It

6.2.1 Amount of Choreographic Information from Which to Act Upon

Scuddle provides incomplete movement data. In fact, it is so incomplete any physical movement enacted from Scuddle's suggestion will incorporate a

great deal more movement information. Some choreographers “add” conceptual or metaphorical information or meaning to the incomplete movement data suggested by Scuddle in order to create movement phrases. For example, one choreographer associated the shape of a bird from the Scuddle image and then applied this movement metaphor to her explorations. But not all choreographers need to add movement information prior to exploring the movement and are able to start moving directly from the incomplete movement suggestions. Three choreographers attempted to find a visual or conceptual ‘whole’ from information to inform their initial movement explorations (similar to the bird metaphor). The other five choreographers worked strictly with the incomplete set of physical information they had been given, developing the rest of the needed information on their own bodies. The attempt to find more information or a ‘whole state’ that could provide more information was important because it highlighted a level of choreographic awareness required to make novel decisions. For example P5 noted the lack of physical detail on the stick figure and noted that this lack of detail enabled freedom of choice in adding expression that was not indicated on the stick figure.

P5: ‘there are no heads or hands and they are both huge communicators. There is a whole range of rotation that can happen – that is a huge freedom that is not indicated.’ (choreographer discussing Scuddle movement catalyst images and the information provided by the catalysts)

6.2.2 Individual Choreographic Temporal Structure

Choreographers typically explore, perform and assess movement patterns in an iterative process. In this study, all choreographers worked in some iterative temporal process that shifted between creating movement, performing it and assessing it. We can generalize this shift between moving and assessing at all 3 stages of the choreographic process 1) movement exploration, 2) sequencing, and 3) crafting by creating structure and pattern. This was observed for all choreographers in the study and follows the following temporal pattern: choreographer 1) begins the process by assessing the starting place, attempting an action(s), assessing that attempt, 2) sequencing actions, assessing the sequence, searching for a theme or motif, assessing that theme or motif, 3) searching for patterns, assessing patterns, structuring and assessing structure. A sample of the categories found in the study for 3 choreographers can be seen in Table 7. Also, all choreographers started the process with a

Choreographer 1	Choreographer 2	Choreographer3
Attempt	Attempt	Attempt
Assess	Remember	Assess
Sequence	Attempt	Fit/ Find/ Capture
Theme	Sequence	Assess Attention
Assess Novelty	Building Patterns	Problem Solving
Sorting + Assessing Patterns	Feeling	Attempt
	Structure	Assess Contrast
		Sequence

Table 7. Individual Choreographer's Temporal Structure

dominantly kinesthetic approach that gradually became more conceptually focussed towards the end of the process. The shift between kinesthetic and conceptual was a constant iterative cycle that is seen in the model for assessment (See Figure 50, pg. 153). This conceptual shift follows from movement exploration to crafting, mapping the cognitive aspects of choreography. The process for all choreographers began with generating movement. However the order in which they explored sequence and compositional structuring craft in their short work varied. Images of the analysis process, worked out on large whiteboards, can be found in the appendix.

6.2.3 Structure of Iterative Choreographic Process

While 3 choreographers in the study worked through a normative pattern of composition: 1) create a movement vocabulary, 2) sequence the movements and 3) craft the developed material into a work, the other 5 choreographers jumped around the process depending on their beliefs, expectations and awareness of the processes (See Figure 48). Successive progression through the creative stages was observed through all choreographers. While this succession of stages illustrates the normative development process for starting with kinesthetic knowledge, some choreographers required the integration of conceptual knowledge and ‘meaning-making’ such as the use of metaphor prior to exploring initial movement stages.

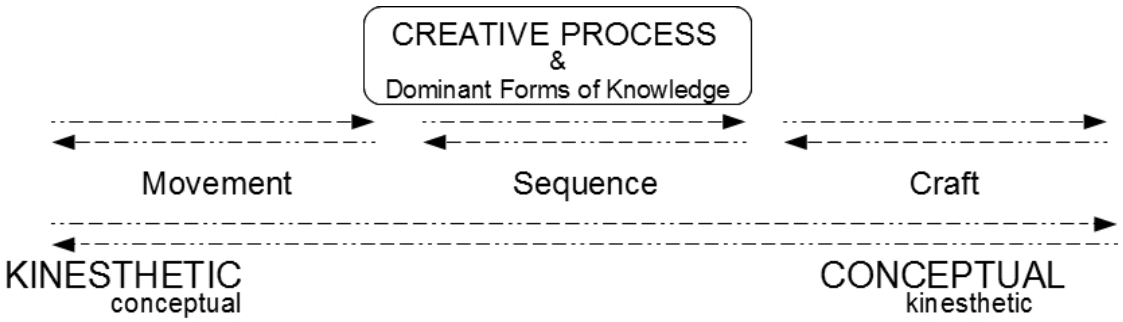


Figure 46. Scuddle Approach to Exploring Cognition Through Choreographic Process

In the study, the process of shifting strictly from movement to sequence to craft (the normative creative cycle) was mainly observed in the youngest and oldest participants (3 choreographers which also correlated to the least and most choreographic experience in the study group). Within each studio session the 'stage' of the process became an expectation and goal of these 3 choreographers. They faithfully developed a movement vocabulary, worked it into a sequence and then thought about how it could be crafted into a choreography. However, non-successive progression was observed in the other 5 choreographers. While many choreographers started with creating movements, choreographers illustrating non-successive progression immediately developed a phrase of movement from a catalyst. Non-successive progression through the creative stages is illustrated in these comments:

P1: 'I like to work in sequence, so that I decide what comes next based on what I just did…rather than creating a vocabulary and then creating a sequence, usually I just have a very general idea and just start and keep going based on what I did

previously.' (choreographer discussing her habits when generating movement)

R: 'they all start off as a position and when you are trying to turn them into a movement I'm trying to find some characteristic that is going to provide a thread…both legs are folded in so to move from that as an inverted position to a jump, I have to figure out what the trajectory is to transition. It turned into a swoop, a circular pathway.' (researcher working with Scuddle movement catalysts to develop a sequence of movement)

P1's comment above indicates an approach of developing movement material successively, in the order of the presented movement catalysts. When working this way, the initial sequencing of movement happened automatically (as opposed to conceptually assessing movement material and re-designing the sequence). This way of working also allows the theme or thread to develop from within the generation of the movement material. R's comment also suggests a tendency to develop movement material in sequence while constantly assessing the movement choices to discover what patterns already exist that could be novel to explore and possibly exploit.

6.2.4 Choreographic Awareness in Creative Process

Within the iterative creative process, choreographic cognition was found to oscillate between habitual and creative choices in both conceptual and kinesthetic knowledge. While it was rare to find many choices that were on the

end of either extreme (highly creative in both kinesthetic and conceptual knowledge or highly habitual in both kinesthetic and conceptual knowledge) there were unusual or novel combinations of both. It was also found that all decisions made, regardless of the form of knowledge or how creative they were (in this case creativity is described as a non-habitual choice), within the parameters of and directed by the individual's beliefs and expectations. Choices made in choreographic process were found to be based on the choreographer's awareness of potential solutions as defined by their beliefs and expectations and the state of their conceptual and kinesthetic knowledge (See Figure 49, pg.144). The details of these observations are described through an analysis of the transcripts of the choreographer's reported attention shifts through the choreographic process of working with Scuddle as a constraint for generating movement.

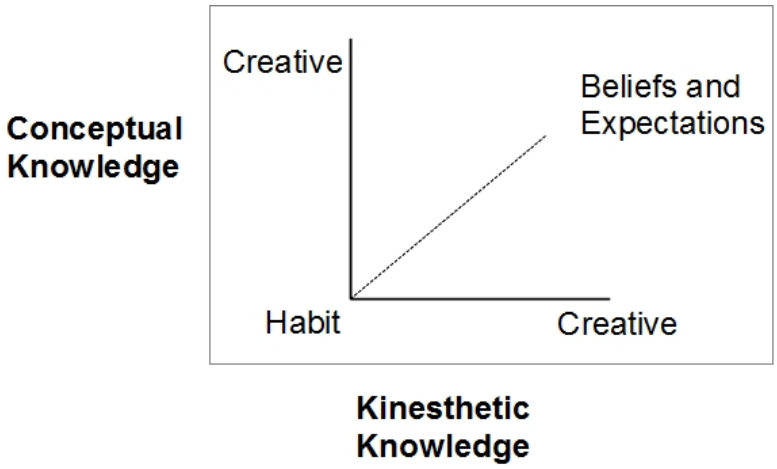


Figure 47. The Situated Environment is Dependent on the Range of Available Options (Based on Awareness) Between Habit and Creativity in Conceptual and Kinesthetic Knowledge

6.3 Beliefs and Expectations

Within the interview process, many choreographers made comments that acknowledged overarching attentions. Outside or overarching attentions could refer to one's personal experience, cultural influence, knowledge of previous experiences (choreographic history), personal goals or anything that was not directly related to the current situation. These overarching attentions directed situated choreographic actions by stating the way the choreographer saw the world, the art of choreography and themselves. Comments from choreographers regarding these attentions were divided into two categories: 1) beliefs and 2) expectations. Beliefs referred to one's understanding of how the world was and what they knew about the world, while expectations referred more to the individual's active desires about the process. These are illustrated through the comments below:

Beliefs:

P1: 'I like telling stories and I gesture a lot with my hands – maybe my use of gesture in dance has something to do with that?'

P1: 'Dance is about communication with the audience and the way we experience movement as communication on a daily basis is just through body language.'

P2: 'when I look at my choreography I feel that something is habit, but when I moved from Hong Kong to Vancouver people were really surprised [about my movement choices] So its not only about myself sometimes but is also about the environment.'

P5: ‘ideally you would have a circular trajectory, and there is something to be said for theme and variation’ (about the structure of choreography)

P5: ‘I like to work with music, I’m married to it. I think dance is rhythmical, human expressive potential. Its not the avant garde. What I’m interested in is that there is something fundamental about your heartbeat and your breath.’

These comments illustrate how choreographers have experienced choreography in the past. P1 and P2 discuss reflections on a personality or cultural habit that might affect choices in movement. These ‘habits’ of self and culture direct beliefs of what is creative, what is habitual and what actions are correct or novel. P1 and P5 discuss their beliefs on the purpose and structure of choreography. These beliefs developed from their experience performing, creating and viewing choreography while understanding the place for choreography in the world.

Expectations:

P1: ‘it was really interesting to have someone else in the room when you are in a really frustrating place. But even if I was by myself I would expect to get it done.’ (choreographer commenting on having the researcher in the studio while developing a choreography)

P3: ‘today there was more intention to make something out of it. Last time was more of look at the shapes, try something out, but nothing good comes to mind from that rehearsal.’ (comments of working with movement catalysts in the second study session)

P4: ‘I stopped exploring because I was self-judging’

P5: ‘one of the most difficult things is to stop being so judgmental… I’m in the studio and I’m making something and its supposed to be *good*!’

P5: ‘making dances feels so traumatic to me! To get this shit out is always painful. I have to spend tons of time by myself before I’ll even start dancing with anyone else. I’m very controlling.’

Choreographer’s expectations developed from their immediate personal experience (in the present). However, expectations can quickly develop into judgements that affect the choreographer’s actions. The comments above show that P1 and P3 discuss the expectation to simply complete a task and to move forward while P4 and P5 let expectations stop actions by focusing on the conceptual assessment of actions before they were kinesthetically made.

Based upon the choreographers’ comments made throughout the interview process, combined with the researcher’s observation of the choreographers’ studio process and, it became evident that beliefs and expectations overlap (See Figure 51). This overlap illustrates the development of expectation from belief. Beliefs and expectations also underlie conceptual knowledge by filtering understandings of how things are and how things should be. The history of choreography, the culture you are from, your experience with the world and how you feel about it can all be considered beliefs while they also direct your expectations. Expectations help to construct personal goals, define interests, level of control and level of awareness.

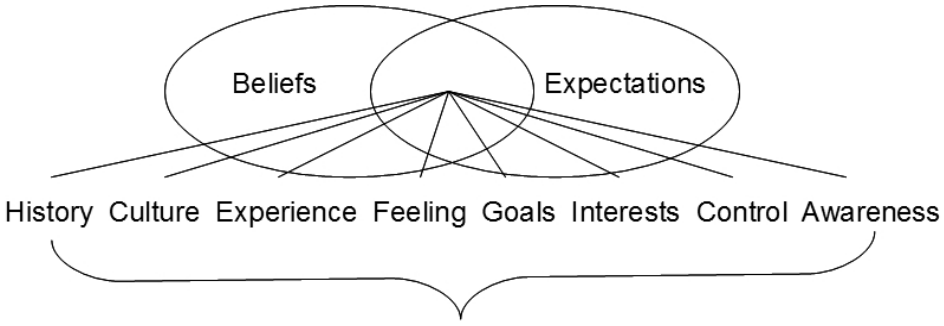


Figure 48. Components of Beliefs and Expectations Found to Contribute to Choreographic Cognition

As beliefs and expectations inform every action throughout the choreographic process, the choreographer continues to constantly shift between kinesthetic and conceptual knowledge to make and assess actions. Beliefs and expectations can dictate what dominant form of knowledge is used for making and assessing actions. In this study, choreographers tended to start their creative process by assessing the amount of information they have, then exploring how to physically execute that information. The process of developing movement, sequencing movement and crafting the work is an iterative cycle that is defined by the situated attention of the choreographer. Beliefs and expectations affect how movements are constructed, how sequence and craft are considered and acted upon, as well as how the choreographer's iterative process of moving through the stages is developed (See Figure 52).

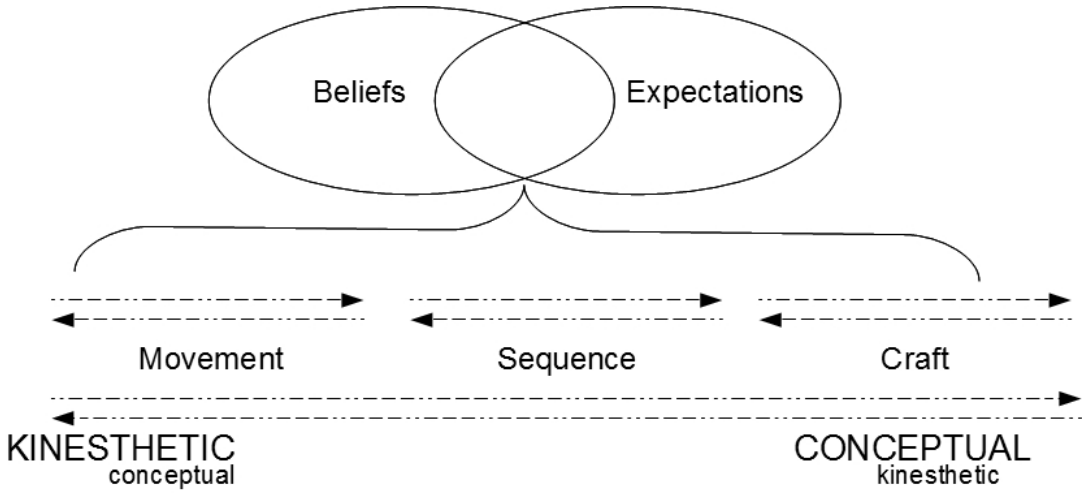


Figure 49. Beliefs and Expectations Inform Every Iterative Stage of Creative Process

6.4 Attention Shift

Attention directs focus during choreographic decision-making. Attention focus can be used “like a flashlight” (Csikszentmihalyi, 1997) to shift between various modes of acting or assessing. This choreographic study highlighted the importance of the use of attention in order to create and evaluate movement choices during stages of choreographic process. Generally, choreographer’s reported that their attention shifted between action (trying out something physically) and evaluation (assessing the action). Choreographic knowledge that informs actions is more kinesthetically based, while evaluations or assessments of actions require conceptual reflection. The need for shifting choreographic attention is informed by the current situation, and in the case of this study, is informed primarily by the constraints imposed by Scuddle. Comments that illustrate attention shifts are:

P3: ‘first I was just doing the movement according to all the rules and then decided I didn’t like it. It was too literal. They all looked like positions which were kind of boring so I thought maybe they were pathways. So I started running around in the shapes and then I started to think about the qualities and they were a source of inspiration after that.’ (choreographer adapting the body position from a shape for the body to a floor pattern to follow)

P4: ‘the most complicated thing was to transition from standing up to being on the floor. The more I thought about it the worse it got – it didn’t feel natural. So I just told myself not to think so complicated. Just go down. And it worked.’ (comment on working through a movement problem, conceptually exploring a movement transition until a kinesthetic solution became apparent)

P4: ‘when you are just rehearsing there are all these questions that come about but when you are onstage you can’t think about it – you just have to act.’ (comment on composing conceptually and performing kinesthetically)

R: ‘I had to make a conscious choice. Just focusing on breath and seeing how this works. Oops I fell over, remember the spine, test the spine. Go back to the breath. It has its own intuitive knowledge about how it needs to control everything else.’ (choreographer shifting focus between conceptual and kinesthetic knowledge to execute a difficult movement)

Data from the interviews show that choreographers frequently discussed *acting* and *thinking*. The above comment shows how P3 began with kinesthetically ‘doing’ the movement but frequently shifted to assess the movement, to attempt to conceptually re-design the movement and then back to ‘doing’ the movement to re-assess the actions again. P4’s comment discusses this process from a different perspective. By ‘thinking’ too hard about how to design the movement, the kinesthetic knowledge of how to perform the movement is dominated by the conceptual knowledge. This reversal in dominant knowledge to make an action caused a roadblock for the choreographer’s decision-making process. P4 also discusses the awareness of this issue in her second comment about performing, that when you are on the spot in a performance, you must be in control of the dominant knowledge needed at the time.

The researcher’s comment came from exploring a particularly unstable movement. Though conceptual knowledge about how the components of the movement need to be lined up to make it function properly are in place, they don’t always translate to kinesthetic knowledge. However, when kinesthetic knowledge is not able to pull off the movement, such as in a highly constrained environment, conceptual knowledge is relied upon to help the body prioritize actions to re-order or re-align itself towards successful action.

6.4.1 Situation Influencing Process

Choreographers also reported the influence of the ***situation*** influencing their choreographic process of decision-making. The *situation* is a context that

influences variables that affect their attention and could be a kinesthetic feeling, an emotional feeling, the architecture of the space or the constraints of Scuddle. How the situation affects the choreographer's decision-making is dependent on their awareness of the situation and openness to being influenced by the situation. Comments illustrating movement decisions based on the current *situation* include the sun affecting movement choices and the spatial architecture:

P5: 'Is it touching my nose or pulling my hair or blocking the sun, because I was practicing in the park and I had the sun in my eyes a lot' (choreographer adjusts movement to cover her eyes with one hand. This decision becomes part of the choreography)

P6: 'maybe because I dropped my water on the floor I realized there was a raised mat and its [shaped] like a box, so this idea of a box kept working out in my head. So I went with that idea and ran with it...using the space and linear floor patterning like a box. At one point I was exploring a hand phrase and thought, 'where is my box?'' (choreographer's hand gestures developed into a movement sequence that began by exploring box shapes)

R: 'I was just on *this* piece of marley [dance floor] and my front was you [researcher observing], everything in the first 3 movements were towards you. It was like this angle parking thing towards you and it was nice for 3 [movements] but once we got to the back and did the duck slice thing the space felt 3D and has depth.' (The choreographer was influence by the immediate situation of the environment when creating movement material. However when an accidental turn switched the choreographer's orientation, the

choreographer's awareness shifted to the whole space, as opposed to the immediate elements of the situation.)

These comments illustrate how choreographers made structural movement decisions based on the current situation of the environment they were choreographing in. One choreographer (P5) was rehearsing her movement sequence outside at the park, and hence needed to cover her eyes when exploring movements that looked up at the sun. This decision to 'use' the hand gesture covering her eyes developed into a theme throughout the choreographic process, which also informed associative metaphors that directed movement decisions. The comment from P6 illustrates how the choreographer became aware of the space she was choreographing in and used it to define her movement and spatial choices. The researcher was exploring the architecture of the immediate space: the way the dance floor had been arranged, the location of the interviewer, the establishment of a front and back (or a downstage and an upstage) to the space. The awareness supporting the current decision-making process was focused on the nearby spatial elements of the environment. Once the choreographer shifted facings the whole perspective of the situated environment changed, and she was able to address the specific decision to explore depth in the environment.

6.4.2 Creativity as an Act of Novel or Non-habitual Choreographic Choice

In the previous section we have seen that there is a shifting balance between giving attention to acting and assessing movement choices. Attention is also constantly shifting to identify and assess the action or assessment as either

habitual or novel. In this research the term ‘novelty’ is taken from Margaret Boden’s definition of creativity discussed in the creativity literature review in Chapter 2 (1998). Choreographer’s habitual actions refer to their frequently used kinesthetic knowledge while habitual assessments refer to their frequently used conceptual interpretations. Novelty is enacted in contrast to habit and refers to new or unusual actions or assessments. Choreographers in this study often discussed the process of trying to balance habit and creativity when problem-solving the task of physically executing complex movement catalysts from Scuddle. A few examples are illustrated below:

P2: ‘I don’t want to do something like last time, but its hard because I already have a frame of it. Now I need to break through the frame, but sometimes when I start someplace its because I can’t rip the frame.’ (comment on trying to make a creative decision but already having the habitual decision defined)

P3: ‘you’ve gotta contrast, to make it interesting and so it becomes engaging. Randomness creates surprise and surprise creates engagement. But too much contrast becomes bland again.’ (choreographer discussing sequence and craft in choreography)

P4: ‘There are so many ways of how to physically do something, but no matter which angle, you’ve been there before and that’s why we make it spontaneous, to try and make it interesting and get away from our habits.’

P2: ‘habits are good in technique, but bad in creative process. You get a blockage in your body.’

P1: ‘There are a lot of places where my movement patterns are super ingrained – so I try to find a compromise, how can I start that way and redirect it somewhere else. Then it doesn’t feel really unnatural but I’m not doing the same thing over and over again.’

P1: ‘It was trial and error until I found something that felt good but wasn’t too predictable.’ (comment on finding a balance between habit and creativity in movement)

P2: ‘this one is light, I can walk light. But how to walk light? Maybe I have to carry my weight so I can step light.’ (thought process to solve creative problem regarding effort quality)

P5: ‘the arms are all weird things which reminds me of awkward bird dancing…but how are herons and storks related and why do storks bring babies? It seems like a really awkward bird to be bringing children.’ (comment on association that influenced decision-making in movement generation)

These comments illustrate choreographers reflecting on habit and creativity (or exploitation and exploration in artificial intelligence) as a way of finding balance in choreographic decisions. Movements that typically feel habitual to the choreographer are believed to be habitual to others, hence making creative choices themselves will be reflected upon as creative choices to the audience. These creative choices are seen to support the audience’s engagement – if used well. P3 noted that creativity becomes habitual if its overused.

The last two comments by P2 and P5 illustrate using associative metaphors to provoke creative actions. P2 used the Laban Effort Quality

constraint to explore movement away from its intended use. Instead of performing the entire action in a ‘light’ way, the choreographer decided that only her leg needed to be light, and because the action was walking that she needed to step light. The action then changed to physically lift her leg in order to step lightly on the ground. This process was similarly explored by P5 who was reminded of a bird she watches often. This bird had its own awkward qualities of motion in real life yet is used as a particular character with particular qualities in children’s stories. Both of these qualities were explored to help shift movement decisions towards unique and creative decisions around the associative metaphor.

6.4.3 Memory’s Ability to Filter Creative Choice

In this study, memory was described by choreographers as being a critical deciding factor in choosing a creative action, one that was able to filter out decisions regarding the assessed novelty or creativity of an action or movement. In order to choreograph, select movement, sequence and pattern/craft, decisions needed to be remembered and easily accessible in either the body’s muscle memory (kinesthetic knowledge) or in conceptual knowledge through association (knowledge that can be associated to another known and easily accessible concept). In choreography, this is because choreographic decisions are enscribed or retained in the body itself, and not in a notated or documented form outside the body. While video documentation is frequently used in choreographic practice, it documents but does not replace the body’s physical memory to physically remember an action).

P3: ‘I found myself repeating a lot, It helps with memorization but also with finding the momentum of swing.’ (comment on kinesthetic exploration)

P5: ‘The awkwardness increases the mind difficulty to get it memorized. Mental images gel more, then it gets easier to know that process of solidification. When I’m comfortable enough with it to stick.’ (comment on how choreographer remembers movement)

R: ‘to remember I have to put the focus on the general *one* thing to get across. The easiest way to do that is to combine qualities into a feeling – this breath breaks down to these things at this position.’ (comment on how choreographer remembers movement)

These comments were used to extract an understanding about how a choreographer’s attention was shifting between making an action and assessing it. The image of this understanding is seen in Figure 53. Creativity and memory define and redirect action to be noteworthy, novel, visible and useful to the choreographer. All these components relied on the situation and frequently reference the use of the movement catalysts. For example, P3 not only kinesthetically repeated movements for rote memorization, but to find the quality of movement that would be most memorable. This association was also described by P5 (as illustrated above) as a way to memorize movements through association, finding an image that could contain all the information of the movement in a higher-level component (such as an awkward bird). The researcher also used this tactic by attempting to find a breath that could hold all

the necessary movement information but to keep the kinesthetic sensation of this information readily accessible.

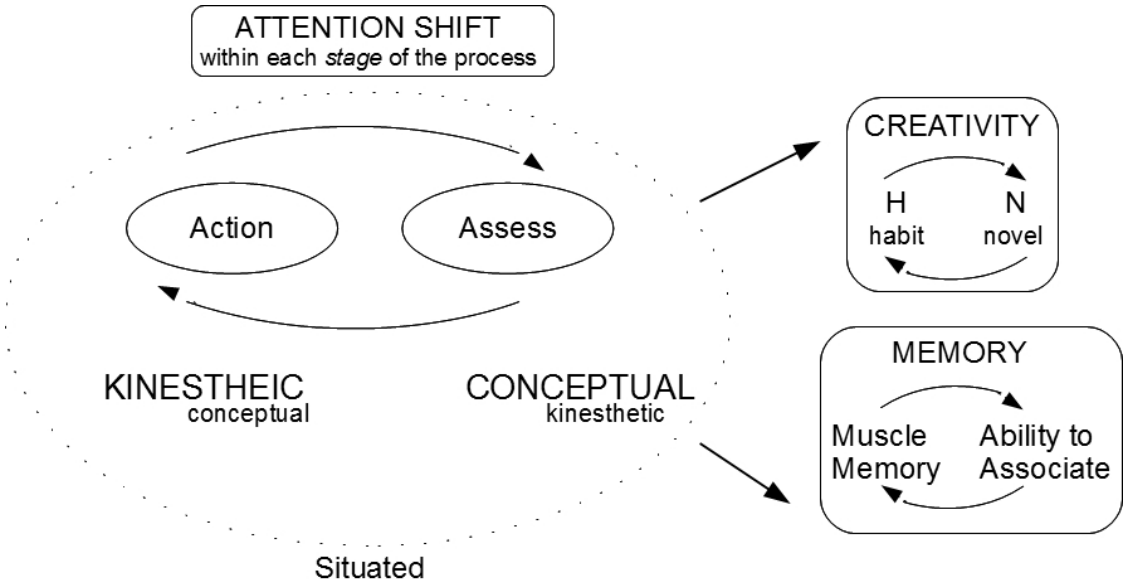


Figure 50. Attention Shifts Between Action and Assessment Including Creativity and Memory

6.5 Assessment Used by Choreographers to Evaluate Choreographic Decision-Making Processes

During the interview process with choreographers, many comments addressed the process of evaluation or assessment. These comments illustrate a set of *criteria* for assessment of creative decision-making within choreography, which include the criteria of creativity, memory and local creative assessment. Assessment criteria ultimately referred the connection to kinesthetic and

conceptual knowledge that is most prevalent in the situated action of choreographic decision-making.

P1: ‘it’s a combination of how it looks, feels and finding that right level where it is challenging for me.’ (how choreographer makes a decision about movement)

P1: ‘I’m always thinking about the shape, about the audience’s view of it for sure’ (decision-making about movement)

P2: ‘Its hard for me because I’m a dancer, in the process I don’t notice my habits as much. But when I watch the video after rehearsal I can see what looks good and what is habit and go back and edit.’ (using video technology to make the creative work objective and provoke awareness of habits)

P4: ‘its not so much about how it looks but is more about feeling good. I feel my body, but if I stare in the mirror I can’t find the rhythm.’ (comment on how conceptual knowledge can get in the way of kinesthetic knowledge)

P3: ‘when I started I didn’t know where I was going but I found out the more I kept it simple the more easily it came. When I was walking, why was I walking, was I following something? Well, what? Oh that thing – so I kept following what I saw in my head.’ (choreographer explaining process of working with Scuddle movement catalysts)

P1: ‘I tried lots of different options but I was unhappy with everything I thought about today. I feel like there is some momentum that is stopping and not making sense to me, I couldn’t find the right pathway for my upper body. I went through all the choreography really slowly and succinctly to think about

what things are repeating and what things are missing but when I tried to go back to fill in the blanks I was thinking too hard about what I thought was missing. But trying to put that in was not natural.'

Throughout the choreographic process, continual assessment or 'reflection-in-action' is employed. Choreographers explained assessment as a combination of how it feels (kinesthetic), how it looks (objectively, as through video or in the mirror), how it looks in the choreographer's imagination (visualization) and how it fits into the current association, belief or expectation of the action (often resulting in constructing meaning) (See Figure 54). The process of choreographic assessment often occurs following an action or reflection, or in other cases, slightly following the start of the action or concept. The comments elicited from choreographers emphasize an attentional focus on noting how the movement/action feels prior to assessing how the movement/action looks or is imagined to look.

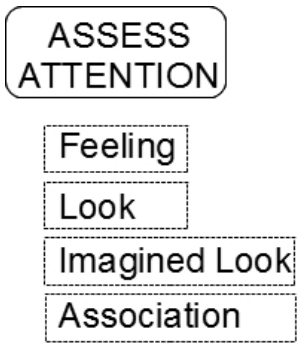


Figure 51. The Process of Shifting Attention During Assessment

6.6 Attention in Constructing Movement

At the beginning of the study procedure choreographers were provided with Scuddle movement catalysts printed in a static form as 6 images on one page. Based on the provided material, the choreographers' initial decisions to act (by selecting movement choices) focused on their physical ability to enact or perform the phrase or movement and then quickly evolved to their curiosity in meeting the challenges of the novelty and challenge of the movement constraints.

P1: 'I started with the shape on the page, then I challenged myself to make that as accurate as possible, after that it was a matter of taste? And trying to work with the things that weren't there… so I can make it as interesting for myself as possible. Then after I work through the first couple I started thinking what can I do that is different from the first 3 I made?' (choreographer working with a movement catalyst from Scuddle and exploring the balance between habit and creativity)

P2: 'You have 6 pictures with different words. For each picture I develop a movement image and develop a set of movements. I get the whole picture of one specific stickman and try to copy the movement.' (choreographer's approach to working with Scuddle movement catalysts)

P2: 'when I look at the image I can see the whole. I saw actions that are fragmented, they are there but you have to form the sentence.' (choreographer piecing together information to help guide decision-making)

P1: ‘I tried to think ahead a few steps, so this step didn’t carry so much weight for me’ (choreographer using the presented sequence of movement catalysts and their potential movement actions to help define the initial decision)

P4: ‘I just do the movement fast and then I go back and try to do it sustained… I want to get a sort of feeling so I try to go there’ (choreographer improvising through Scuddle movement catalysts to better understand what potential movement decisions exist to assess possibilities before making a decision)

P4: ‘when you are in the studio improvising you go into your natural tendencies, but when you have a shape you have to follow and the task that has to be fulfilled, you may change the way you move and I think that is a lot more interesting than your habit.’ (choreographer using Scuddle constraints as a task and becoming aware of movement possibilities through that task)

P5: ‘I normally improvise with the music while listening to it over and over until the movement self organizes out of that. I spent a lot of time now trying to figure out what the arm positions might be and also imagining what they *could* be’ (choreographer giving the music and her kinesthetic knowledge dominance over movement decision-making)

The above comments illustrate the choreographic decision-making process *to take action* by performing movement from a Scuddle catalyst. Choreographer’s decision-making process to take action was dependent on a constant shift of attention between the constraint at hand and the potential

outcome, the search of an interesting yet possible movement. P1 discusses a process of working accurately initially, but shifting focus to more creative options later. The process of broadening focus to allow possibilities other than what was initially presented in the Scuddle movement catalyst aided the decision making process by not putting so much pressure on the correct, immediate decision, also discussed by P1. The comments of P2 and P4 used this sense of broadening focus to see the ‘whole’ of information which provided more information to direct the decision-making process. The ideal space from which to explore movement decisions (which was reported consistently among choreographers as choices regarding balance between knowledge, habit and novelty in the interviewing sessions) is a balance between habit and novelty. As a method of exploring this balance many choreographers attempted to ‘make a whole’ set of information from which to act from. For example, the incomplete movement data of Scuddle was associated to an image, an imagined movement or some other higher level meaning that had some habitual ties from which to explore novel or challenging possibilities. Also, if a particular step was seemingly difficult the choreographer would sometimes think-forward, jumping to the next ‘known’ step of the process to allow the difficult step to self-organize.

Assessing habitual and novel possibilities was a constant and continuous cycle that depended on the current situation/choices regarding amount of information and potential next actions. Within this cycle, the tension between habit and novelty is complicated or challenged by adding accuracy and challenge. Choreographers reported that focusing on performing the catalysts

accurately is more difficult than simply acting habitually. To push accuracy to a challenge, choreographers were required to move beyond habitual reasoning or accurate actions. Exploring movement that is solely novel was very difficult for choreographers to remember, because it was so unfamiliar. Unless the choreographer found a way to construct meaning, association or simple execution from that unfamiliarity, there was often a pull back toward something that could actually be remembered, which was often, by definition, a habitual response (See Figure 55).

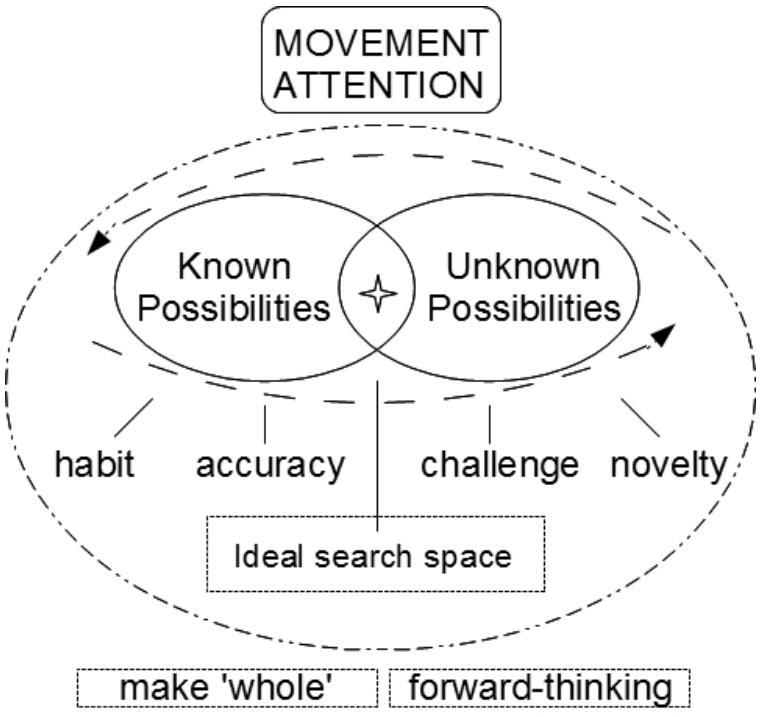


Figure 52. The Process of Shifting Attention Through the Development of Movement

6.7 Attention in Sequencing Movement

Comments regarding sequence devised 3 categories: function, association and sense. The same process for attention continued to flow from beliefs and expectations to iteratively assessing stages of the choreographic process, to devising how movement was constructed and assessed. When one choreographer was creating sequences of movement their attention for current decisions relied upon where their attention had been in the previous decision. The consistency in attention to construct patterns and associations continued into the process of sequencing movements. Comments that helped to define the 3 categories of function, association and sense are below:

6.7.1 Function

P1: 'I thought about which ones I liked the best and kinda stuck the other ones in the middle. So in case I ever got stuck and frustrated I could just tack on the ending and I'd have an escape plan in case I didn't know what to do. Then I ran through the phrase and decided on which transition felt the weakest and saw that as a starting point to insert some new material.' (Choreographer discussing decision process for sequencing movement)

P5: 'its easier for the sudden to come out of the sustained ones, rhythmically and bodily just trying to figure it out – the sustained ones probably end up being touchstones that you come back to.' (comment on decisions about sequence based on kinesthetic experience)

Here choreographers P1 and P5 discussed making decisions based on whether the decision functionally worked. P1's comment that she place the movements (created from Scuddle movement catalysts) she liked best at the ends of the sequence and the movements she liked least in the middle became a functional decision because she had an accessible 'escape plan' if she got stuck. This action is function because the sequence is successful based on how the movements themselves were functioning in relation to the choreographer's interests. P5's comment also discusses the functionality of the movement based on the qualities of each movement and her ability to perform them.

6.7.2 Association

P1: 'I kept thinking about dirt and being outside and its night time. That's as clear as it got and I just went with that.' (comment on metaphor discovered in the process of working with Scuddle)

P5: 'I impose my own structure…the arms are all weird things which remind me of awkward bird dancing, like stork or herons. I'm thinking about what you do when you first wake up in your nest. When you are itching, flying, etc. It helps by defining how and what it is and what quality, what kind of performance.'

Choreographer P1 did not use associations a lot to guide movement, however she did work with the theme of dirt at night through the entire process. This association developed out of the feeling of the movement (from Scuddle movement catalysts) itself. However, the identification of association allowed her to make future choices on movement, sequence and craft based on this

association. One movement evolved to be performed on the floor while dragging her fingers through the imagined texture of dirt while the quality of 'night' association made further connections to qualities of caution, instability and sneaking around. P5's comment illustrates how she looked to actions of her associative metaphor of a heron or stork bird to help define how the movement catalysts would be performed (the same as developing a 'whole' set of information or meaning to define the movement).

6.7.3 Sense

P1: 'what comes next is based on what I just did. I think about how I feel right now and rather than creating a vocabulary and creating the sequence from that I have a general idea and just start and then keep going based on what I did previously.' (comment on sequencing movement based on previous decisions)

P4: 'Its [knowledge of how to sequence movement] built up from your experience beforehand and you develop this sense by watching other people dance, and other dance performances. You start slow and then you build it up.'

P5: 'how many **permutations** are there? [of movement combinations in order to make a sequence] I was trying these different sets and trying to get from one to the other and seeing from my logic which ones were possible. All are possible but it could be awkward or ugly or don't fit the image I was working with.' (how many different possibilities are there to sequence movements and how do they make sense with the rest of the choreography?)

P7: ‘I was just standing there and taking a few deep breaths and thought ‘that feels good’ so I was doing repetition and circular stuff and if felt good, I haven’t done a lot of repetition in my work so I just kept doing that and before I knew it I had a seqence’ (choreographer discussion how she was exploring movement that ended up as a sequence of movement)

Sense refers to the choreographer’s subjective feeling that a movement, sequence of movement or crafting of movement was successful in both kinesthetic and conceptual knowledge. This meant that the decision was functional, made an association to a metaphor or another guiding principal (such as a belief or expectation) while also fitting in the current balance between habit and creativity. This can be seen in P1’s comments on developing her understanding of ‘sense’ through the constant process of acting and assessing her successive movement decisions before making the next one. P4 develops her understand of ‘sense’ through her prior experiences and used this to assess her current decisions. P5 assessed the possible combinations of movement to make a sequence but made the decision based on what was physically possible and how they fit previous decisions in order to make sense with the rest of the piece.

The image below was developed from these comments about function, association and sense (See Figure 56). Function defined what was physically possible, how was the momentum flowing, was there continuity, what worked from an objective point of view or how the selection fit. Association referred to the potential for meaningfulness, semantic metaphors or narrative. Sense referred to

the choreographer's subjective feeling about the sequence. Did it make sense kinesthetically, structurally, aesthetically? This process was often a temporal, yet iterative process that started with function, moved to association and ended with sense.

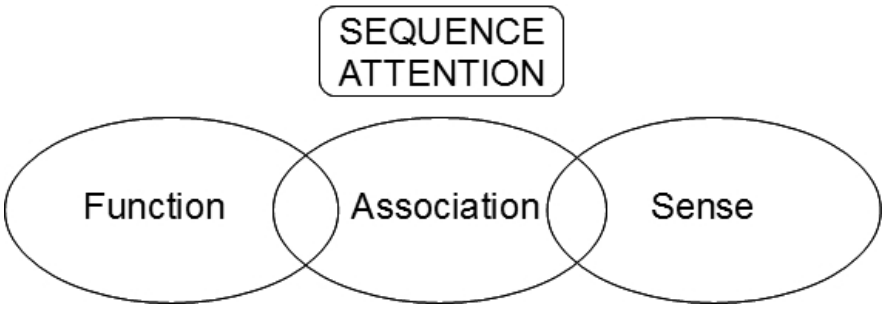


Figure 53. The Components of Attention in Building Sequence

6.8 Attention in Constructing Craft

Craft builds on sequence by adding concepts of performance, time and pattern. Craft looks for the big-picture of the choreography, and frequently relies on conceptual knowledge above kinesthetic knowledge for assessment. Assessment continues to cycle through the devised sequences and movements to compare patterns of novelty and consistency.

P1: 'Right from the beginning I wanted to be more tension felt and watching the video, I had a better idea of whether that worked or not and whether I liked that as a layer on top of a certain movement and some of those ideas changed today.' (choreographer talking about the quality of movement she was attempting to find and how she knew if it was working or making sense with the movement decisions made so far)

P1: ‘I wanted something to give it a more finished feel for me and I just kept thinking about dirt so I thought that my hand on the ground was a nice way to finish that image.’ (this choreographer continued exploring her associative metaphor of dirt to assess how the overall piece was working or making sense)

P2: ‘I always take video for myself so I try to take in the balance – I feel good but is it good from the outside? Its also about what I’m doing *now* because I’m more concentrated on form and structure so I’m not showing the feeling or the framing that is suitable to what I’m showing.’ (P2 is assessing how the choreography feels and how she imagines it will look to the audience, taking into account what she is currently focused on)

P3: ‘Like that moment, a sense of weightlessness – you can stay there for a very long time and it feels like you aren’t moving, though you are. You are in perfect control of where you’re going, or I just really want to go fast and I don’t want to control it anyways.’ (assessing the feeling of the choreography and where control is held and where it is given up)

P4: ‘a lot between tension and timing came from my interests in dynamics and start and pause and the juxtaposition between them, and the engagement with the audience. Like, oh, she’s not moving and she still isn’t moving but all of a sudden she moves and its like it grabs your attention again.’ (choreographer focusing on contrast to assess how the audience will experience viewing the work)

P4: ‘that pause puts you in the present time, it gives me **time** to absorb the space between you and me, time to breathe with

different parts of the space. Its more about opening your head and looking too, peripherally more and kinesthetically too.' (making craft decision based on awareness of the present situation and needs of the choreographer and the choreography)

P6: 'the driving force to choreograph today was to use the space and explore the box. I was trying to make a conscious effort to keep those in mind. For one of the things I realized that I ended up over here but I hadn't used the backspace, so I changed my decision to end up here in order to make sure I used that space. There are different ideas for how to get out of a position and today it was important to explore those instances.' (choreographer discussing her choices used to adjust her work in the final studio session)

P6: 'I was thinking about what happens if it starts as a duet, and 2 dancers enter like a flip image, working with visuals and levels and different spatial changes.' (comment on craft possibilities from imagination)

R: 'the intention [to move] is in the top of my head and my foot that are moving together on a straight plane. But then my hip opens up and takes precedence but I end up in my foot which goes down and then my head comes up. Top of head foot, foot top of head and then there is a new wall.' (discussing the location of the choreographer's attention from executing a movement to being aware of spatial elements)

All of the above comments discuss the process of making decisions in the crafting stage of choreography. Decision-making in this stage of the process is reliant upon the decisions made prior, the choreographer's kinesthetic and

conceptual experience of the work, and their beliefs and expectations to assess how the many elements of the choreography are making sense. Within this stage the choreographer's attention is shifting through many higher-level components of the choreography. Comments made by P1, P2 and P4 suggest they were exploring how to make choreographic decisions based on how the current composition made sense. Making 'sense' relied on their understanding of the patterns within the choreography so far and what qualities were most important to get across to the audience. Finding qualities of tension or weightlessness or contrast to match to the pattern and exploit were discussed along with identifying places that needed a shift in the choreographer's awareness in the performative state to change a quality of the performance. The comments made by P3, P6 and the Researcher suggest how choreographers may explore the shifts of awareness within movement choices such as the potential for performance and of how control was held by the performers to make decisions about the craft of the piece that made sense.

The combination of these comments demonstrate the level of considerations beyond just making the sequences of movement (See Figure 54). Attention throughout the crafting process shifts between dynamics of the movement and variability to the flow, to the level of control held over the movement, the amount of permutations that are being worked with and the overall trajectory of the composition. These components all stem from and iteratively cycle through assessments of function, association and sense on a

higher level than sequence to construct a work that is consistent, whole and dynamic.

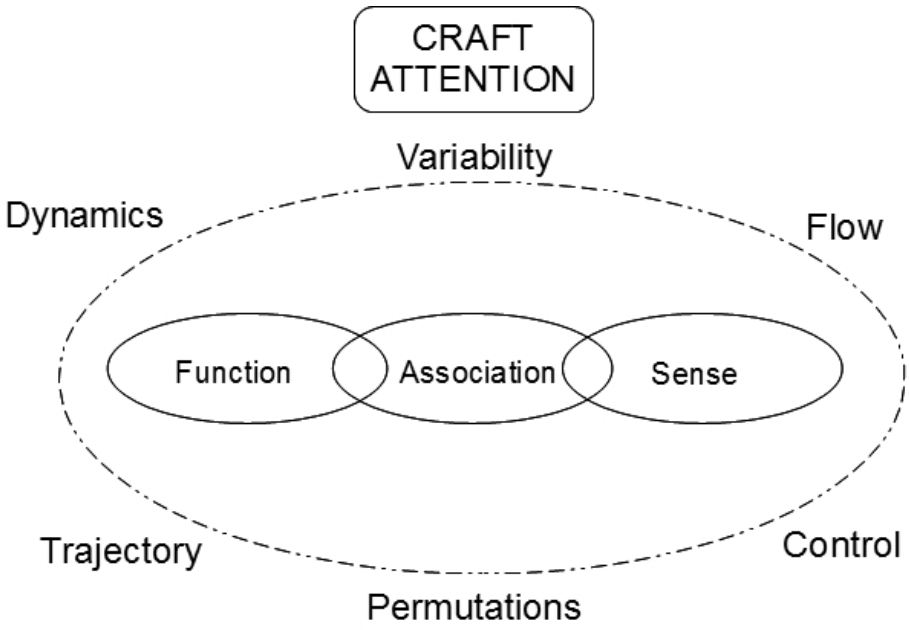


Figure 54. The Components of Attention When Crafting Choreography

7: CONCLUSION

This chapter aims to summarize and highlight the work described in this thesis. The chapter 1) summarizes the study, 2) describes the contributions found in the study through the design and research process and 3) illustrates the findings from the Scuddle study. This chapter concludes by 4) discussing future work in relation to the outcomes of this research. The thesis explored the decision-making process of 8 choreographers while using Scuddle, a technological tool for generating constraints as movement catalysts. The 5 contributions of this research include: 1) a definition of paired constraints for choreography adapted from Stoke's model of constraints for creativity, 2) the concept of defamiliarization as a method of constraints to support research in creative process, 3) the development of the technological tool, Scuddle, to introduce constraints into the creative process, 4) the application of Phenomenological interview methods to access verbal articulation of choreographic experience and 5) the 3 levels of explanatory results from the data analysis of the formal Scuddle study.

7.1 Revisiting Objectives, Actions and Methods

This thesis examined choreographic decision-making through the use of creative constraints, modelled within a technological Artificial Intelligence (AI) tool entitled Scuddle. Choreographic practice relies on the iterative interaction between kinesthetic knowledge, conceptual knowledge and situated awareness.

This research accesses choreographer's experience in action through the use of technological constraints to defamiliarize the creative decision-making process, hence making the resulting actions present-at-hand (Crawford, 1984; Heidegger, 2008). In this research, the choreographic process is constrained by using Scuddle, a system for generating incomplete movement data as catalysts for movement. Movement catalysts are composed of a 2 dimensional body position, a height and a combination of effort qualities to direct how a movement should be explored. Scuddle uses a genetic algorithm to create, breed and select movement catalysts to be asymmetrical, off balance and with unusual effort qualities in order to inhibit choreographer's habitual movement tendencies and provoke creative exploration. This study constrained initial movement options through the use of Scuddle's generated movement catalysts. Movement catalysts constrain movement choices guiding specific movement components of body position, height and effort qualities.

Phenomenological inquiry was applied to access choreographer's experience with the use of technological constraints in the creative process. Eight choreographers participated in a study to investigate an in-depth exploration of choreographic decision-making. Data gathered from this interview process was used to develop a model of choreographic decision-making by assessing the shifting of attention between different forms of knowledge (See Figure 50). The researcher guided the choreographer's attention to resonate with and articulate moments of their experience. By bringing awareness to memorable moments in choreographic experience, and focusing the choreographer's attention on 're-

living' that experience during the interviewing process, the researcher enables the choreographer to articulate verbal descriptions of experience.

7.2 Contributions

This thesis explored 4 main components in the research design that developed into main contributions by the end of the study. These 4 contributions include: 1) the adaptation of Stoke's paired constraints model for choreography, 2) the use of defamiliarization and constraint to facilitate the research process, 3) the development of the technological tool, Scuddle and 4) the use of phenomenological methods for accessing choreographer experience of creative process. These components are contributions because they make choreographic evidence available to the researcher, facilitating study into choreographic experience. To replace the high-level components of Stoke's original model for constraints to shift from the art movement Abstract Expressionism to Pop Art, high-level components were devised for use in Scuddle (P. Stokes, 2007). The high-level elements devised for paired constraints in choreography are body positions, heights and effort combinations. These elements were chosen because they are major aspects of creative movement that determine how a movement can functionally be executed. Constraints were paired by precluding comfortable, stable or habitual actions in order to promote unstable, unique and creative actions.

The use of these constraints were found to make the decision process 'present-at-hand', guiding choreographer's awareness to the action of making the decisions. These constraints were built into a technological tool titled Scuddle to

provoke creative movement decisions from choreographers. Scuddle implements the paired constraints to guide choreographic decisions through incomplete movement data, directing the components of body position, height and effort quality yet allowing a high level of free to be retained by the choreographer. Giving this freedom alongside the constraints made the choreographer rely on their *own* agency in the decision-making process, making their *own* agency more apparent to them. This process provided heightened self-agency to the choreographer, making articulation of the choreographer's experience more accessible. The researcher's use of phenomenological interviews at this stage of the research process guided choreographer's immediate attention through the decision making process that is now so apparent after creating with Scuddle constraints. By helping to guide the choreographer's attention to how critical moments in their experience were addressed, rich descriptions of the choreographic experience were extracted from the creative process.

Contributions of this research can apply to pedagogy, the development of creativity support tools and the understanding of embodied cognition for human computer interaction. Pedagogical support can aide in understanding choreographic process to enhance the teaching of movement and composition, in addition to concepts of learning in which dehabituation is a core motivator to change. Creativity support tools can be applied to any creative task where technological design can facilitate a creator's, composer's, designer's or choreographer's needs by understanding how attention is used throughout the creative process. The application of kinaesthetic knowledge construction in

situated environments is useful to human computer interaction as interfaces continue to explore embodied and movement interaction. For example, learning and collaboration through technology could be made more efficient and resonate through a combination of kinesthetic and conceptual interaction devices. This approach would support learning and working through multiple perspectives simultaneously by automatically providing a view(for example, a kinesthetic knowledge mode) that resonates with the individual. This also designs built in assessments of the opposite view (for example a conceptual knowledge mode) to retain engagement and evaluation.

7.3 Analysis Summary and Discussion

The verbal articulation of choreographic experience was facilitated by Scuddle's technological movement catalysts used as constraint, along with phenomenological interviews to explore the use of these constraints. The results from this study revealed explanatory models of how attention shifted through the choreographic creative process. Choreographer's attention was dependent on the choreographer's state of awareness of: the situation, the environment, and their kinesthetic and conceptual forms of knowledge at that particular time and place. Results illustrated how choreographic attention shifted between forms of knowledge. It was found that Conceptual and Kinesthetic forms of knowledge were used equally and simultaneously and were extremely important through choreographic process. Though dominant forms of knowledge were used during the beginning and ending of the processes, the dominant forms shifted over the development of the process.

Both kinesthetic and conceptual forms of knowledge are present and iteratively referred to throughout the entire creative process. The choreographer's situated awareness directed every action. Though situated awareness is always present in creative process, *how* awareness of the situation was attuned by the choreographer greatly affected how strongly beliefs and expectations guided the use of kinesthetic and conceptual knowledge. For example, one choreographer attempted to design a choreography based solely on their individual beliefs and expectations of what a choreography is. Another choreographer designed a choreography based solely on information or influence from the environment, such as making spatial pathways and body positions reflect the architecture of the immediate space. A third choreographer focused on designing choreography solely from the movement catalysts. These examples illustrate the choreographic choices made based on the choreographer's immediate awareness of the situation.

The use of Scuddle movement catalysts as constraints created a reflective space for choreographers to generate novel and non-habitual movement that were often facilitated by the choreographer's associative choices (associating movement catalysts to an outside but familiar concept, such as a type of bird). However, it was observed that the choreographic range of creativity from habit varied depending on the choreographer's awareness, training, or attentive openness to solutions and potential meaning-making. The potential scope for creative or novel choreographic decision-making could be identified through the

choreographer's beliefs and expectations, which is dependent on prior knowledge, experience and world view.

The stages of choreographic process as defined by 1) developing movement material, 2) sequencing that material and 3) pattern-searching to develop a theme into a dynamic work through craft, were observed and discussed in every study. The development of detailed movement material (stage 1) in this study required an emphasis of kinesthetic knowledge from the choreographer to both execute and assess movement, while the crafting stage (stage 3) required an emphasis on conceptual knowledge to visually imagine the entire work and assess patterns of details, often on a higher level of meaning-making. The sequencing stage (stage 2) in this study extended the development of detailed movement material and began to assess potential patterns which used a combination, or constant shift between kinesthetic and conceptual knowledge. This stage of the choreographic process (stage 2, sequencing movement material) found the shifting of kinesthetic and conceptual knowledge to be equally balanced across choreographers.

The results of this study illustrate that, while forms of choreographic knowledge is intertwined, emphasis in the process of choreographic decision-making is placed on dominant forms of knowledge (kinesthetic, conceptual, situated) at different times during the process. Choreographers in the study frequently described a need to stop 'thinking' in order to act, while other times required sitting back to view (or imagine the view of) the piece, and conceptually constructing the next decision. It is also a common view of dancers and

choreographers that ‘thinking’, or *conceptually* working out a creative problem, inhibits the development of creative movement and choreography. Better understanding the use of each form of knowledge supports greater exploration and design of choreographies by enabling the use of each form of knowledge to its highest potential.

However, more importantly, the ongoing and constant attention shift required between forms or levels of knowledge abstraction is present at an even deeper level beyond the dominant forms of knowledge in each of the 3 named choreographic stages. While different aspects of the creative process required different forms of dominant knowledge, it was surprising to learn that the choreographer’s attention was constantly shifting between kinesthetic, conceptual and situated knowledge regardless of the type of the decision or location in the choreographic process. It was also intriguing to find that, while this constant shift may actually be happening simultaneously in the neurological system, the choreographer perceives the experience to be a shift of attention. Continual assessment is being made between how habitual or how creative an action is, as well as how easily the body remembers the action or what the action can be associated to for conceptual memory. Assessments shifted between how the action felt (kinesthetic experience) to how it might look (a combination of objective view and body knowledge/ experience) and what it might be associated with as ways to build creativity, interest and meaning.

Understanding how this shifting of attention functions is useful to choreographic training to bring awareness to compositional elements that may be

overlooked. By emphasizing how to understand movement conceptually through structures and patterns, the kinesthetic knowledge of how to integrate structures and patterns intuitively is strengthened. This also supports better understanding of kinesthetic knowledge of movement to support conceptual decisions. A potential application of attention shifting with technology could be address when designing interaction. By using both kinesthetic and conceptual forms of knowledge in a technological interface in a way that allows for the constant shift of attention between them, information processing could be strongly integrated through the technology to support learning.

These results are important because they support a discourse within the dance community relating to choreographic cognition and how it functions from the choreographer's point of view. While many systems have attempted to better understand choreography through analysis, and books have been written to provide tasks and tricks for designing choreography, there is still little codified knowledge that articulates what kinds of knowledge, processes and structures support a successfully designed choreography, and how those design strategies can be transferred and learned by others. While this study has focussed on identifying components of choreographic cognition, it has also explored new forms of language-making that can support discussion and discourse that describes choreographic components as they are intuitively known in the dance and performance field.

7.4 Limitations of the Study

This study examined the cognitive decision-making process of choreographic composition. A high-level (or top-down) approach was taken in order to investigate choreographic cognition by constraining the creative process and then interviewing choreographers frequently and iteratively throughout the process. There is minimal existing research in this area, which made this approach useful as a device for exploratory investigation. However, this approach also led to a large scope with numerous undetermined variables, resulting in many components being assessed rather than a more focussed singular, deep assessment.

While this study focused on exploring the breadth of the research area, there are many future opportunities for exploring the contributions in depth. Currently these future opportunities can be viewed as limitations that are reflected in the contributions. Five contributions of this study are listed: 1) a definition of paired constraints for choreography adapted from Stoke's model of constraints for creativity, 2) the concept of defamiliarization as a method of designing constraints to support research in creative process, 3) the development of the technological tool, Scuddle, to introduce constraints into the creative process, 4) the application of Phenomenological interview methods to access verbal articulation of choreographic experience and 5) the 3 levels of explanatory results from the data analysis of the formal Scuddle study.

In adapting Stoke's model of paired constraints for Scuddle, I chose the choreographic elements of body position, height and Effort Qualities as

constraints to inhibit habitual movement decisions and provoking creative movement decisions (contribution 1). These constraints were chosen based on the researcher's personal experience working with computer-generated constraints in the studio, while attempting to inhibit personal habit and provoke creative decisions. While these constraints are applicable to any body moving in space (and fit with the initial goal of the research), they are not the only choices for constraints. Other movement qualities or physical parameters could be used instead. For example parameters might be drawn from Laban Movement Analysis (Laban, 1966; Newlove, 2003) or other choreographic elements such the performer's gaze, level of exerted effort and the symmetry in the body (Carlson, et al., 2011).

Defamiliarization was used as a method of controlling constraints within choreographic creative process requiring choreographers to make situated decisions outside of habitual or familiar choices. To utilize this approach more specifically, the definition of 'familiar' choices in the context of choreography needs to be narrowed. Narrowing the definition of familiar (or habitual) creates necessary limitations on the scope of the project. This thesis defined *unfamiliar* choreographic choices as synonymous with movement positions that derive from asymmetrical, complex and difficult to execute physical body positions based on principles within Bartinieff movement principles, although these are not the only definitions of *unfamiliar or non-habitual movement choices*. It could also be argued that by requiring the choreographer to construct new movement choices within the situated actions required by this study, that their truely familiar creative

processes were not being investigated. However, as the choreographic process is a highly individual and tacit knowledge-based practice, it was deemed impossible to gather information about each choreographer's cognitive processes without making the cognitive process more apparent. Finally, it is debatable how well the use of defamiliarization supported choreographer's verbal articulation. This process appeared to make the verbalization of decisions more available, but additional approaches may well exist that were not addressed in this study.

The use of Scuddle as a technological constraint supported the concept of Stoke's definition of paired constraints by inhibiting specific movement parameters while invoking new movement explorations. Though as mentioned in the above discussion regarding Stoke's model, these are not the only available movement parameters. Additional, possibly more creative, more asymmetrical or more familiar constraints could be implemented. The main limitation of the constraint design is that the study focused on how choreographer's compose from strictly a biomechanical movement generation point of view. Though many choreographers work in this way, it was not within the scope of this study to investigate movement generation and sequencing from a higher level and more strictly conceptual base. Future work may look at the use of conceptual constraints as movement catalysts.

This thesis explored choreographic decision-making with physical movement-based constraints. Because the constraints provided choreographers' a task, the results are limited to discussing the choreographers' cognitive process when designing for solving for situated actions (for this task). The study focused

on choreographer's experience of creating a short phrase based on movement catalysts, which limits the results to choreographic experience instead of choreographic actions. While further studies could assess the creation of and development of movement actions through the choreographic process, this is outside the scope of this study by not providing information about *how* choreographers make decisions. The small sample size also restricts the results from being implied to all choreographers.

The application of phenomenological interview methods to access verbal articulations as choreographic evidence were also used to focus on the choreographer's experience, rather than assess the direct actions made. Retrieving this evidence was difficult, and limited by both the choreographer's ability to articulate their experience and the researcher's ability to guide the choreographer's awareness through their experience. I tried to replicate Petitmengin's interviewing technique (Petitmengin, 2006) as closely as possible while adapting it for performance to eliminate potential confounds (such as questions being led by the researcher, the study design influencing how choreographers made decisions).

7.5 Future Work

This thesis has explored decision-making in choreographic process. While this research has unveiled a deeper understanding of choreographic process through the use of technological constraints and phenomenological interviews, there are many opportunities for further exploration. The use of purposefully designing constraints to facilitate creativity has been used

traditionally in artistic exploration throughout history. More recently it has also been introduced as a method of creative problem-solving. However it has been rarely articulated as a primary technological tool within art research, particularly in the domain of choreography. This gap in exploring the use of technology as a facilitator in creativity support and generation tools is addressed in part through the research presented in this thesis. Artifical Intelligence (AI) and machine learning are well suited to expanding upon potential solutions within this defined search space. The development of new AI constraint tools could be used to expand awareness of creative opportunities in the choreographic process, to model or illustrate the process or to serve as a research instrument.

In this research study, Scuddle focused on how choreographers develop choreographic decisions from physical properties of movement, without accounting for higher level semantic concepts explored through affective, narrative or conceptual inspiration. The research study described here dictated creative results generated by the choices made in the movement constraints. While this was an intended structure, it also constrained the results in a very specific way that does not account for the unique properties of choreographic process. While every dance starts with movement, choreographers get their inspiration from multiple sources including conceptual, musical or narrative forms. This study is limited to the exploration of instantiating creative forms of movement, an area of personal choreographic interest. In choreography, exploring underlying inspiration which may rely on semantic forms of affect, metaphor and narrative construction is beyond the scope of this research.

However, future studies could examine the higher order semantic forms of affect, metaphor and narrative construction to explore how an associative beginning leads to movement choices.

While this work explored the use of phenomenological methods to collect data, the use of this method is still in the process of being developed and explored. Additional work is required in exploring how interview methods can be applied to temporally-based experiences such as dance, which rely on the development of actions over time (through iterative cycles of kinesthetic and conceptual knowledge in a situated environment). Bringing attention to moments of experience is difficult and subject to the choreographer's awareness, openness, willingness and ability to assess deeply embedded actions. During the interview process, when asking a choreographer to 're-live' a difficult decisions or remember specific sensations, mental processes, associated with key movement decision-making processes, some choreographers are able to immediately access that experience and verbally describe it, while others attempt to do so, but rely on the rationalization of the experience (stepping out of the experience to describe it, rather than remaining in the sensation and feeling state of the experience to describe it), and other choreographers simply invoke rational judgement to inhibit any re-living of the experience at all. While each of these interview responses result in verbal articulation, these articulations vary in their ability to describe essential sensation and experiential qualities of choreographic decision-making.

While phenomenological or hermeneutic methods can support rich experience in choreographic decision-making, future studies assessing choreographic cognition could explore a mixed-methods approach. For example, empirically testing a choreographer's perception of what a creative act is by utilizing video analysis to explore an observer’s perception of choreographic choices. In a more qualitative vein, further studies could also include explorations in how a decision ‘feels good’, where the balance is between habitual and creative decisions, how to get deeper into the choreographer’s capacity for and interest in creativity. The understanding and search for personal and historical creativity continues to be obscured, and the relation of creativity to beliefs and expectations of the choreographer are also interesting and complex components of the process. Future work could further explore choreographic approaches, new forms of constraints, technological and AI tools for creativity support and research instruments.

APPENDIX

First-Person Journal Excerpts

December 2009

- Working with Scuddle today I was making weird shapes with my body but the positions still feel static. I'm not sure how to think about working with Scuddle to make my body do something more interesting than just a contorted shape.

March 2010

- I have to change my headspace to find Scuddle useful.
- No other dancer would want to work this way, with a computer saying what to do
- all my exploring [movement] gets stuck

May 2010

- maybe if I dictate a height I can find new ways of working with Scuddle. The positions just feel weird – either I have to do it exactly as I see it or I can't do anything. It puts you in a weird stuck place where you can't find a way to be creative without adding other ideas

July 2010

- I'm finding that if I add more restrictions it actually provides more options when exploring movement.

Sample Questions

How are you feeling today?
How is the movement feeling today?
How do you feel compared to the last session?
Do you remember everything clearly or only specific parts?

How did you start?
Can you recall any specific sensations today?
What kind of explorations did you do today?

Can you recall any specific explorations today?
What qualities/ movements/ intentions did you explore?
How did you explore them?

What were you thinking about when trying things out?
How did you think about it?
Could you identify trajectories to follow?
How did you follow them?

What was the situation?

How was it informing your decisions?

Sample qualities to deepen into:

time speed rhythm

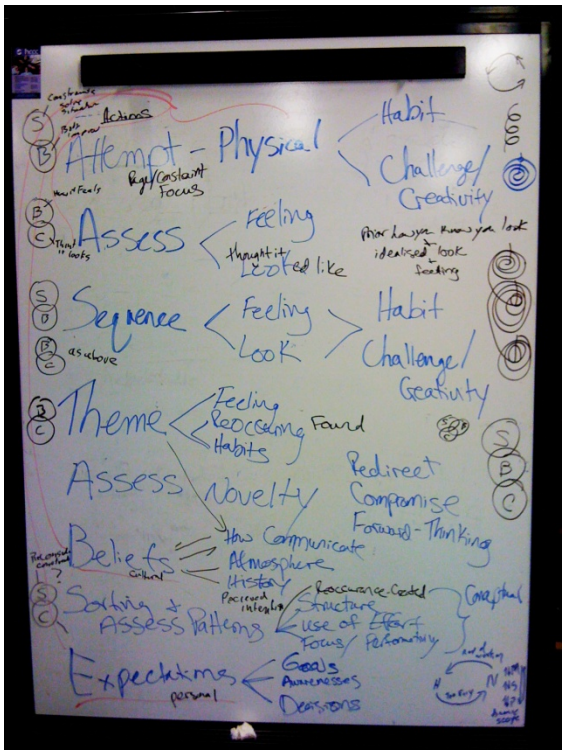
space levels shape
quality gaze facing

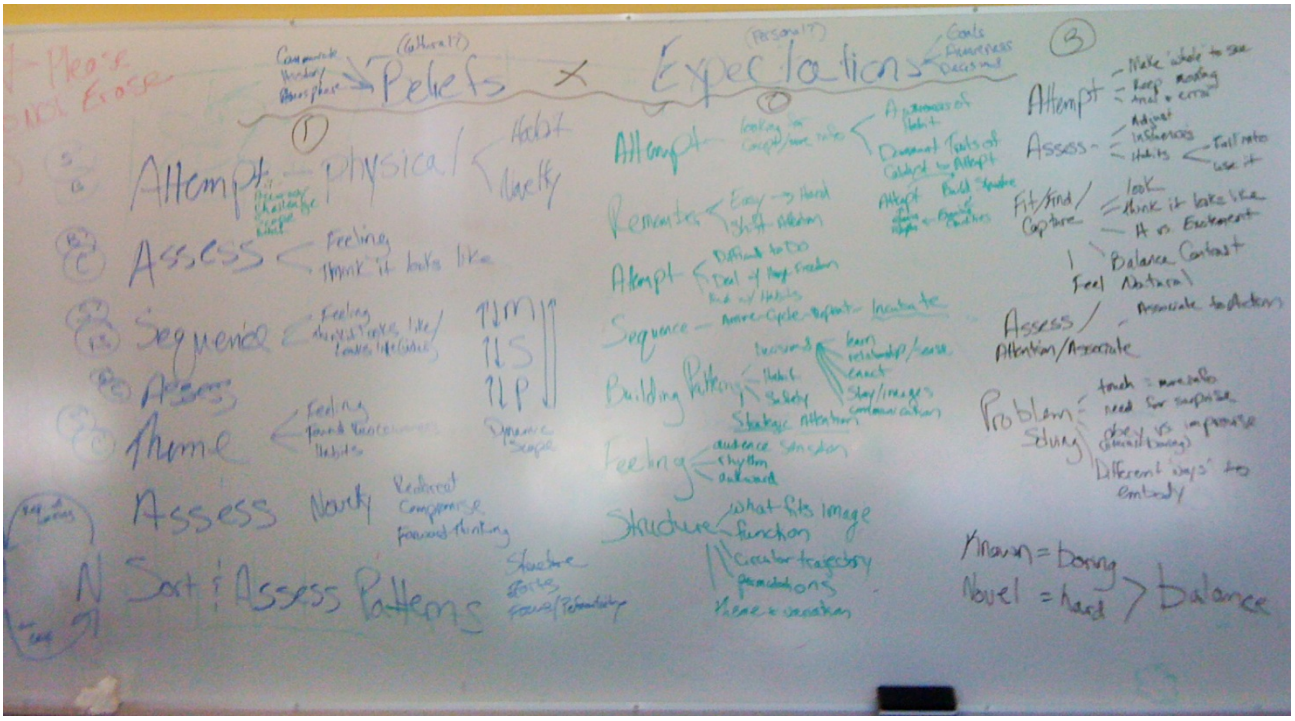
weight flow inertia

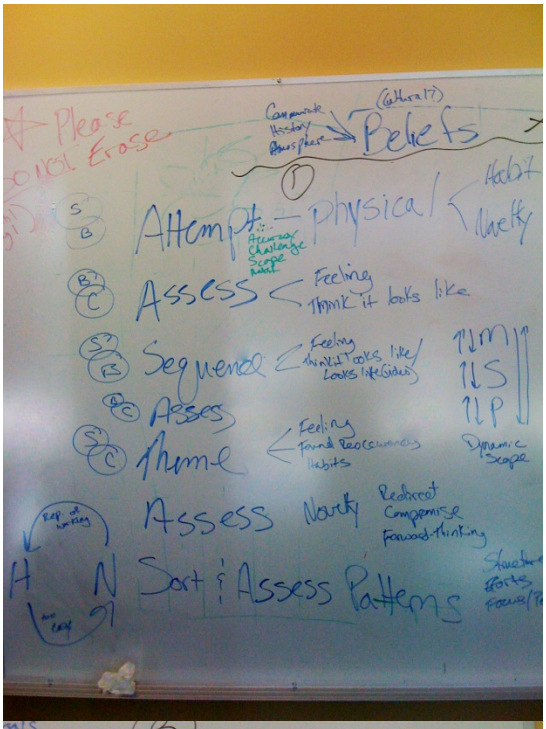
When making decisions:
What do you find interesting?
How did something feel right?
Did one body part feel more dominant?
Do you notice your habits?
Can you identify when something feels right vs. not?
How does that affect how interesting it is?

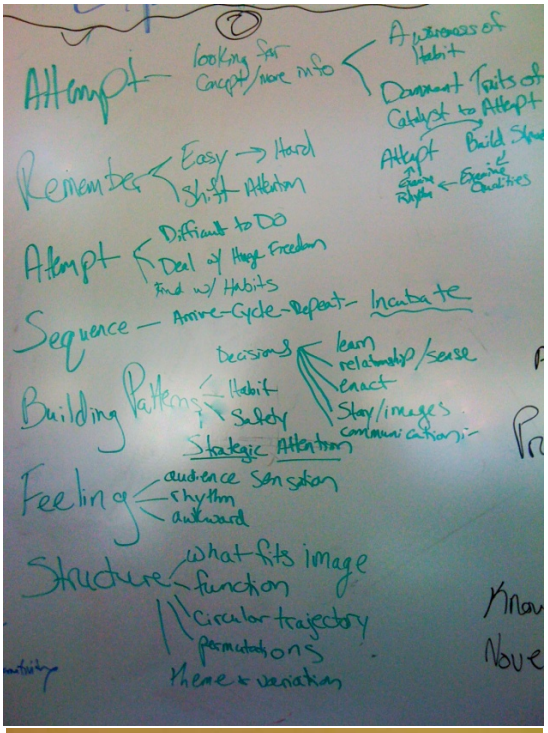
How do you work between doing and thinking?

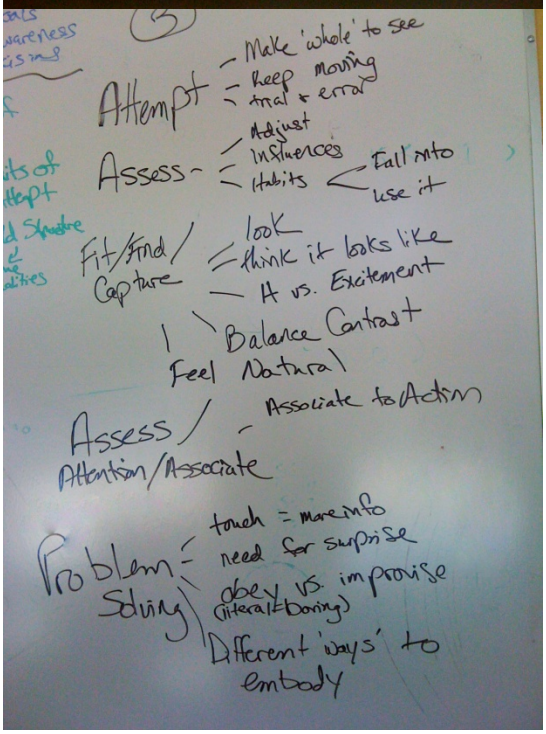
Images From Data Analysis Process

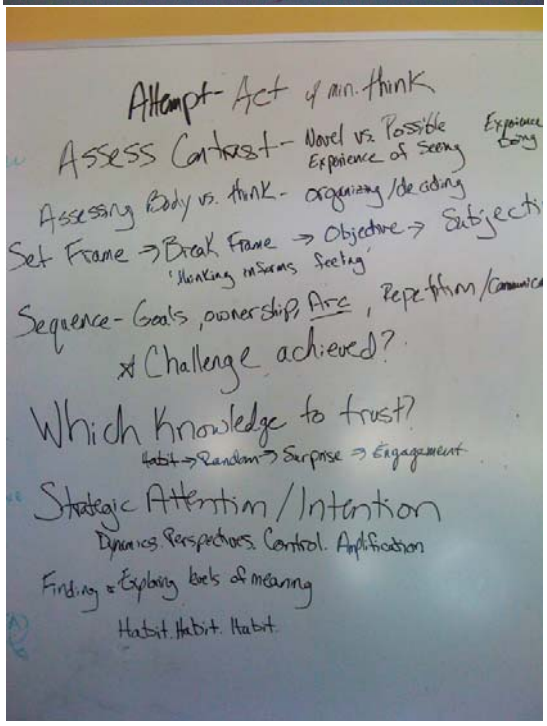





Please Don't Erase
Beliefs
Attempt — physical
Assess
Sequence
Assess
Theme
Assess Novelty
Sort & Assess Patterns


Attempt
Remember
Attempt
Sequence — Incubate
Building Patterns
Feeling
Structure
Strategic Attention


Attempt
Assess
Fit/Find/Capture
Balance Contrast
Feel Natural
Assess / Attention/Associate
Problem Solving
Different ways to embody


Attempt- Act & min. think
Assess Contrast-
Assessing Body vs. think-
Set Frame → Break Frame → Objective → Subjecti
Sequence- Goals, ownership, Arc, Repetition
Challenge achieved?
Which Knowledge to trust?
Strategic Attention / Intention
Dynamics. Perspectives. Control. Amplification
Finding = Exploring levels of meaning
Habit. Habit. Habit

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