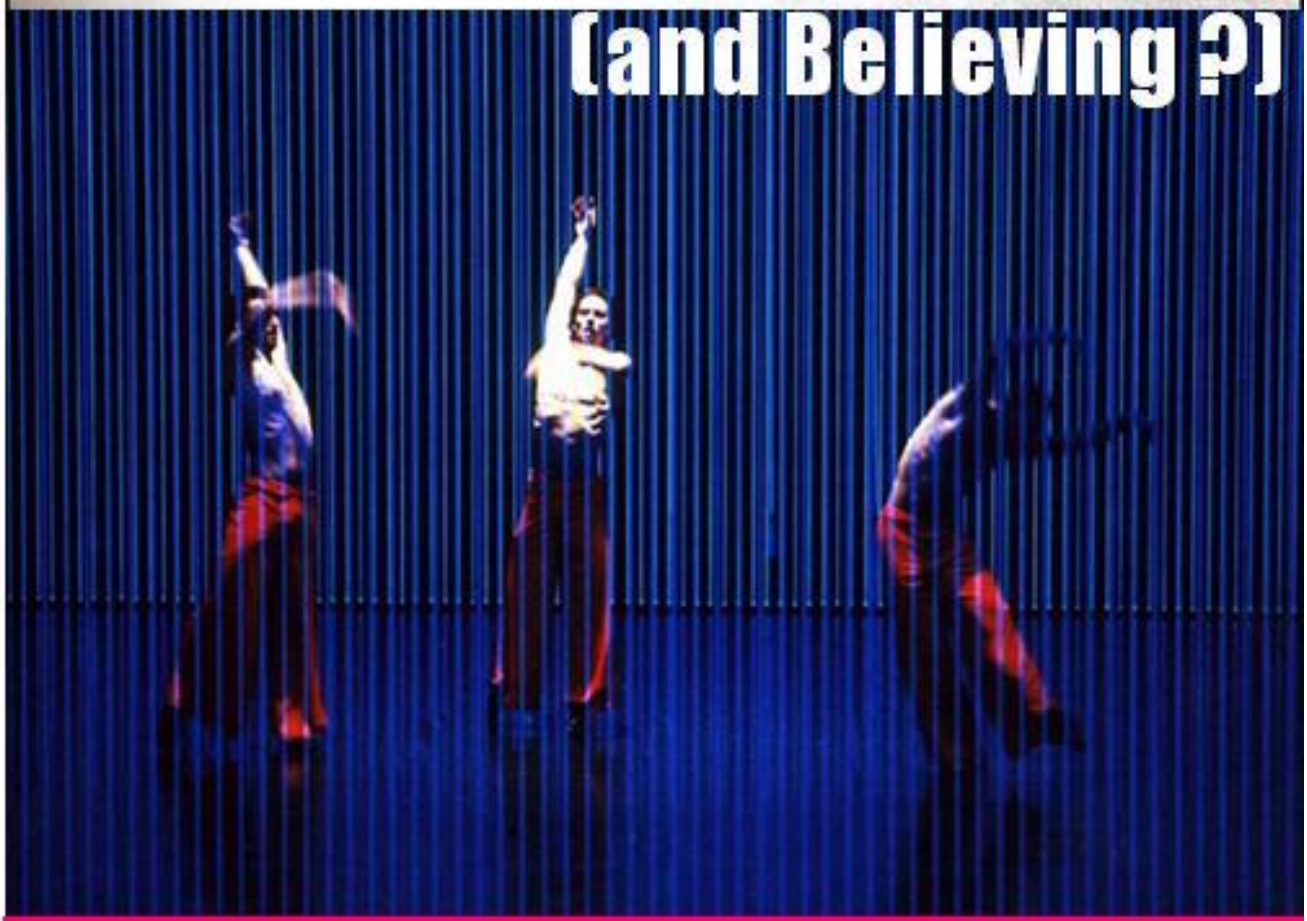
Seeing is Doing

(and Believing ?)



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Seeing is Doing (and Believing?):

An exploration of metakinesis, neuroscience, the relationship between the moving body and the watcher, and the implications for dance as a performed art form.

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ABSTRACT

In his theoretical writings on the development of American Modern Dance in the 1930s, the American dance critic, John Martin, re-invoked the Ancient Greek construct of 'metakinesis' to explain the process by which performing and watching Modern Dance in particular, becomes a unified experience. In the late 20th Century, neuro-scientists in Europe discovered that areas of the brain activated when watching actions performed were the same as those used when performing the movement. These neurons, which became termed 'mirror neurons', have also been connected to a likely engagement with the emotions and intentions inherent within movement. There have been a number of recent science-arts initiatives where collaborations between neuro-scientists and dancers are extending knowledge in both dance practice and scientific knowledge, but to date the genuine convergence of creative and scientific endpoints has rarely been achieved.

This extended essay provides an overview and starting point for predominantly new territory in science-art development, and raises key questions for further investigation. Through interviewing dance professionals, I have gauged to what extent the dance profession is aware of, and imaginatively poised to exploit, developments in neuroscience around the specific relationship between the mover and the watcher. I aim to show that mirror neuron science provides a brain basis for the concept of metakinesis, and that this science could be highly relevant to the development of our understanding and appreciation of dance in Western society. I propose that whilst the arts generally and dance in particular, have a marginalised place in society, the development of knowledge of mirror neurons as a concept, from specialist discipline to a more mainstream consciousness, has the potential to create a significant shift . I identify a number of areas within the development of dance practice where the integration of mirror neuron science could, through a deeper understanding of the integrated brain functions of observing and performing movement, bring future benefits.

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My thanks go also to all the participants in the study – those who agreed to be interviewed and completed questionnaires; and to Professor Patrick Haggard and Dr Beatriz Calvo-Merino at the Institute of Cognitive Neuroscience at University College London, who generously gave their time to talk to me and help me as a non scientist to understand their work in mirror neurons - which has formed the science core of my research.

I am also very grateful to my academic supervisor, Professor Helen Thomas, for agreeing to fit me in to her already packed schedule, and for her insightful help, feedback and academic rigour.

Tessa Gordziejko
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INTRODUCTION

This research essay looks at the relationship between the mind and the body, the watcher and the mover, in relation to dance. By examining an important concept about the moving body, termed metakinesis, which has existed since earlier civilisations, and relating it to recent developments in neuroscience, it explores the implications for dance as a performed practice now and in the future. It asks whether, now that there are scientific explanations for how we watch and respond to movement, this will in time have a significant impact on the relationship between western society and the moving body, which has for centuries been dominated by the split between mind and body with its roots in the philosophy of Descartes. It gauges awareness and ideas among a small sample of people working in dance, and asks whether we are ready to imagine a different position for dance in society.

Methodology

The early part of the essay is based on reading and online research – key texts by John Martin and Helen Thomas and a range of articles and journals in the dance field; articles from Cognitive and Neuroscience journals, media features and education resources, to understand the basis of the neuroscience.

The later parts of the essay draw on primary research conducted through interview and questionnaires with people working in the dance sector. I have taken material from specialist disciplines, in forms which communicate on 'lay' terms, and used it as the basis for a discourse with people in the dance profession itself – deliberately selected across a range of perspectives, techniques and backgrounds, and without any expectation that subjects will already be active or knowledgeable in science-art initiatives.

Fourteen dance professionals were interviewed, equally divided between male and female participants, across a range of nationalities and ethnicities[1]. Four were trained and/or practising primarily in contemporary dance, one in South Asian Dance - the rest was primarily working in ballet, although most had some experience in contemporary

work. Three were three choreographers; four worked in dance education; four were dancers employed within large companies. One was a non dancer working in senior management.

The interviews covered the same broad areas in each case: I explained the background to my research, about metakinesis and outlined the mirror neuron story, providing a summary from an article in the New York Times and Nova Science Now[2]. The key areas I covered in each interview were:

- their backgrounds, what motivated them to become dancers and their experiences of being a dancer in relation to wider society
- how they learn
- emotions – what they feel when performing, where emotions come from
- their perception and feelings about the relationship with audiences
- their awareness of mirror neuron science
- what they think the implications might be for dance

There were some areas which seemed more relevant to certain groups – so, for example I asked a question about gesture and meaning to choreographers whilst probing more deeply into education with people working in that department. Inevitably, other subjects came up during interviews which were specific to one or two participants.

This was a small sample by necessity for practical reasons, and therefore this limits the observations and conclusions in these sections on a global scale – whilst providing sufficient insight to suggest that a further study could be rolled out into the field, and beyond.

My research also included interviews with Professor Patrick Haggard at the Institute for Cognitive Neuroscience at University College London, and his colleague, Dr Beatriz Merino-Calvert. These meetings greatly helped me to understand the scope, context and purpose of the action observation studies they had carried out, and some wider issues between neuroscience and art.

I will take as a starting point in Chapter 1, the concept of 'metakinesis' written about by John Martin, dance critic of the New York Times between 1927 and 1962 in his

short book *The Modern Dance* (1933) - a work which has been since extensively referenced by dance writers and critics – but which can be traced back as far as the Ancient Greeks and Plato. This idea, which Martin described as 'muscular sympathy'[3] or 'inherent contagion of bodily movement which makes the onlooker feel sympathetically in his own musculature, the exertions he sees in somebody else's musculature'[4]. Martin's theories of the expressive dimensions of Modern Dance and the audience's engagement with it, were heavily underpinned by this concept, to which he and others repeatedly returned in dance writing in the mid 20th Century.

Chapter 2 provides a brief overview of developments and studies in neuroscience over the past fifteen years, which have shown a brain basis for what Martin was satisfied to classify as 'the relation in general between the physical and the psychical'.[5] The discovery of the parts of the brain which have been dubbed 'mirror neurons', would seem to reflect Martin's description of experiencing, and metaphysical explanation of, the phenomenon of direct engagement at a physical level with the emotions, intention and meaning of the dance. Whilst the original discovery of mirror neurons in monkeys by a team of scientists in Parma, Italy happened sixteen years ago, there has been extensive subsequent work by scientists such as Gallese, Rizzolatti, Freedberg, Iacoboni, on the associated neurology in humans, including the question of whether and how mirror neurons read the emotions and intentions of the watched by the watcher. Significantly, recent studies led by Professor Patrick Haggard at the Institute of Cognitive Neuroscience at University College London, studied the brain activity of ballet and capoeira dancers whilst watching movements from their own and each others specialist techniques, have further mapped the relationship between the visual and motor systems in the brain while watching dance.

Hypothesising what Martin's response would be to these scientific developments, one suspects that he might have considered it unnecessary to the understanding of metakinesis – the Ancient Greeks knew of its existence, as does any dancer and the seasoned dance audience member, so it makes little difference to 'what we choose to believe'[6]. However, my interest in undertaking this study is in imagining how a science breakthrough described by Professor V S Ramachandram as 'the single most important "unreported" (or at least, unpublicized) story of the decade'[7] may in time change society's understanding of the moving body in ways which would have

profound effects on widening the appeal and importance of dance as a performed and participated expressive art form.

To examine this, in Chapter 3, I explore where dance is now as a social and performed form in western society, with an emphasis on the UK. Professor Helen Thomas, in the introduction to Dance Modernity and Culture, asserts that 'as an art form… dance is a minority concern'[8], and goes on to outline the reasons for dance and the moving body as a marginalised 'something else' in culture, separated through Cartesian philosophy from the rational, higher world of the mind. In particular, Thomas demonstrates how dance has been comparatively neglected academically in both sociological and ethnographical fields – although in her later work[9], she indicates that this has started to change.

Sir Ken Robinson has identified that in most education systems in western society we 'progressively educate people from the knees up'[10] and that 'dance is probably bottom of the list' within an arts hierarchy where the arts are themselves on the lowest tier of importance. In such a social system, rational explanation and evidence-base are bound to carry more weight than the anecdotal or intuitive writings of arts critics, and hence a science based approach to understanding how metakinesis really works is likely to build a more trusted understanding than what the Ancient Greeks knew.

It is this, along with other implications of the mirror neuron science in the evolutionary mapping of culture, which Professor Ramachandran has divined as the potential 'breakthrough' importance of the discovery – the equivalent of the discovery of DNA. In Chapter 4, I explore what this might mean and how DNA and genetics have influenced thinking and popular culture.

Chapter 5 focuses on the key questions of how dancers and dance professionals view the mirror neuron science, both in terms of their own practice and the relationship between their art form and wider society. I have sought to get a view on the current level of awareness of the story of mirror neurons within the dance world and whether it is, as V J Ramachandran asserts, largely unreported in the non specialist media. Hypothesising that dance practitioners already recognise metakinesis as a daily reality of their practice and art, and that the studies by Patrick Haggard and more widely the discovery of mirror neurons simply provides a scientific explanation for what dancers

already know, I have explored its perceived and potential relevance with dance professionals in a number of areas; what the implications on the expressive form might be for them, what predictions there might there be on its impact creatively on 'pure dance' and on wider collaborations between dancers and scientists; and probed their imagination to elicit an imaginative response with regard to the future.

There are a number of worlds which a study such as this will span: the academic fields of dance sociology and neuroscience both significantly inform the line of enquiry. A growing body of collaboration between artists and scientists such as those funded by The Wellcome Trust , the Calouste Gulbenkian Foundation and NESTA across a spectrum of projects , from those whose primary focus is on 'supporting artists to develop their thinking and practice in order to make new work'[11] to those with a specific scientific end-point which set out to answer particular questions and for which dancers (for example) provide good scientific preparation, which I shall detail in Chapter 2. However, almost all – by intention or otherwise - occupy large areas within the spectrum, touching mighty questions which supersede the division between arts and science, such as 'other ways of thinking intelligently… beyond the cerebral, rational and logical'[12] , and whether aesthetics, expression, consciousness and culture will one day be more fully understood by discovering more about neural structures.[13]

Within any dance writing, and particularly when examining the transmission of meaning through brain functions which are largely embodied, there lie the intrinsic potential pitfalls of text-based language and the spoken word. On a practical level, some dancers are not used to talking about their work in the reflective mode of an interview, and for some of those I interviewed English is not their first language. In the academic field, the phenomenological cleft stick presented by embodied subjectivity has been extensively charted by sociologists and philosophers, and this is demonstrated in dance studies and referenced by Thomas[14]. Some of those I interviewed on the subject of metakinesis have mused, rhetorically, that a written essay is perhaps not the most appropriate form to fully explore the subject. Whilst engaging with this question, I also recognise that it is, however, the most trusted academic form of discourse, and the theme of credibility, proof and evidence is an important theme in the bringing together of science, the brain and art. Whilst it can be argued by those within the dance world that that we do not need the science to tell

us something we already know on a different level, we may need it to help us know that we know it – and to help the wider world find, and trust, what it knows. I shall return to the subject of embodied knowledge in future chapters.

CHAPTER 1:

JOHN MARTIN, THE ANCIENT GREEKS AND METAKINESIS

John Martin was dance critic of the New York Times between 1927 and 1962, a period which started almost as Modern American Dance was born. In a career which had already involved him in music and theatre in Chicago, Martin carved out a unique relationship with an emerging American art form which represented a complete break with the past. The year before Martin's first review appeared, Martha Graham had made her New York debut, and the following year Doris Humphrey formed her company. As key figures in the development of American Modern Dance, Graham and Humphrey featured highly in Martin's writings and he became instrumental in promoting their work. This was the background for his distinctive and well-voiced opinions: his writing reveals an antagonism to the ballet traditions of the 19th Century, such as they existed in the USA and he was controversially critical of Balanchine – but also of later developments in Modern Dance which he felt had lost its edge. His views were underpinned by strongly held beliefs and theories about aesthetics, the relationship between movement and dance and most characteristically, the emotional engagement of the spectator through a direct link via movement to the creator's emotions. The line to metakinesis starts in his analysis of movement as the substance of dance, and the rediscovery of this simple principle through Modern Dance:

> With this discovery the dance became for the first time an independent art... completely self contained, related directly to life, subject to infinite variety. Previously, movement was only incidental. In the classic dance what counted primarily was poses, attitudes and prescribed combinations of them. The movement that united them was unimportant[15].

However, he recognised that while this central principle was a liberator for Modern Dance, the movement of the body in its environment being 'the very stuff of life'[16] also served to undermine the appreciation of dance as an art form:

> Instead of contributing to the easy understanding of the dance, however, this fact has actually worked in the opposite direction. The movement of the body is so habitual, so continuous and so largely automatic that we are in the main quite

> unconscious of its range and potentialities. Familiarity breeds not contempt, perhaps, but certainly neglect[17]

Martin also talks about the body as 'the mirror of thought'; 'physical movement is the normal first effect of mental or emotional experience'[18]

Whilst Martin's theories are not grounded in scientific knowledge, they present to the reader as a combination of intellectual and historical analysis together with a high degree of intuitive and experience-based observation – although at times his evangelism for the principles of Graham, Humphrey et al led him to views that were extreme and rigid – such as the dismissal of sensual satisfaction alone, as a valid element of art[19]. However, as Jack Anderson observes in his introduction to a later edition of *The Dance in Theory*:

> He not only developed theories, he stated them clearly. Fortunately they were not foolish. When examined today they reveal that Martin thoroughly understood what the early Modern Dancers were up to.[20]

Anderson recognises that while some of Martin's views were inflexible, metakinesis remains a lasting concept.[21]

Metakinesis as a theory is most developed (and most often referenced) in Martin's book *The Modern Dance*, drawn from the text of four lectures delivered in 1931 and 1932. He introduces the concept of 'muscular sympathy' in talking about watched movements in Modern Dance:

> You have no difficulty in following their meaning because you have often done them yourself, or you can easily picture yourself as doing them. You do not have to stop and reason about them, deducing that if the hand does thus and so it must infer that the purpose is such and such. Instantaneously, through a sympathetic muscular memory you associate the movement with its purpose. Your muscles remember that when you do a certain series of movements the result is a specific result.

He goes on to conclude that, 'movement, then is the link between the dancer's intention and your perception of it'. The next section of his book introduces the term

metakinesis as 'the transference of an aesthetic and emotional concept from the consciousness of one individual to that of another' via movement and that 'it is extremely important that we see in the dance the relation that exists between physical movement and mental – or psychical, if you will – intention'. Martin sees metakinesis as an important discovery in Modern Dance, although known from man's earliest ways of dancing, in Greek theatre and, as he also recognises that it is present in ballet:

> Without it [metakinesis] audiences would have had no more delight in watching a ballerina balance herself on one toe in defiance of gravity than they would have had in watching feathers float on the air. It was their own consciousness of gravity which held them to the earth that made them applaud the feat of someone else in defying it.[22]

But, argues Martin, Modern Dance (of the early to mid 20th Century in the USA) represents a revolution in making conscious artistic use of metakinesis. Central to this for Martin was a principle core to early US Modern Dance, the Delsartian mantra of 'no movement without a meaning'. For Martin, metakinesis will expose the emptiness of inauthentic gesture:

> Any movement, no matter how removed from normal experience still conveys an impression which is related to normal experience. There is a kinaesthetic response in the body of the spectator which to some extent reproduces in him the experience of the dancer; if the dancer performs some movement without the motivation of inner compulsion, the spectator will experience no inner responsiveness. The feeling is likely to be one of emptiness except for the fatigue of physical exertion'[23]

Metakinesis theory is developed by Martin over only a few pages within a slim volume, and in quite inexact terms (ie, not scientific), although it forms an intellectual armature around which his other theory systems are built. Martin went on to be extensively referenced by dance writers for more than half a century, across a number of areas, but usually linking back to his central theory of metakinesis – by writers including Katherine Everett Gilbert (1941), Roger Copeland (1933), Selma Jean Cohen (1953 and 1982) and Joanne Kealiinohomoku(1970)[24]. In 1998, a lecture by Bojana Kunst at a European symposium on contemporary dance, *what was this about John?* Made Martin's work– 'fighting his own

heavy battle with disappearing words' a central motif in her theme of the elusiveness of capturing the dance event in words. [25]

A further example of the range of writing where Martin's theory of metakinesis continues to be referenced in the 21st Century, includes an article on the visual art of Eisenstein by Annette Michelson[26]; in an introduction to an article by Susan Manning on Modern African American Dance[27]; and Martin is extensively quoted in a *Jump Cut* article on fight choreography in martial arts film[28]. Here the concept is employed to examine the expressive power of choreographed modern martial arts movement, especially in the realm of 'romaticized empowerment' and the importance of taking a viewer on an emotional, as well as literal, narrative.

To summarise this section, the central theory of metakinesis applied in dance criticism by Martin, while undeveloped on a scientific basis, has been of fundamental influence in a range of writing about dance and other art forms over the past seventy years. It is as if Martin's exposition was somehow attuned to the meta-language of those writing about dance, and worked at the junction of the rational/verbal idea and the physical/ psychical aesthetic which is the territory of arts journalists and academics. Reading Martin led me to literature on the developments in neuroscience which provide a brain basis for his observed principles, and it is this which I now move to in the next chapter.

CHAPTER 2:

MIRROR NEURONS: A BRAIN BASIS FOR METAKINESIS?

As with many important scientific breakthroughs, the discovery of mirror neurons happened accidentally. A team of scientists led by Giacomo Rizzolatti at the University of Parma, Italy, who had set up implanted monitors to measure activity in the movement areas of the brains of monkeys, noticed that when observing a familiar action carried out by a researcher, the same areas of the monkeys' brains would be stimulated as when they were actually carrying out the movement. When the monkey watched somebody grabbing a peanut, the movement control cortex fired as if the monkey was grabbing the peanut itself. The neurons were referred to as 'mirror neurons' or, popularly, 'monkey see, monkey do' neurons.

Over the fifteen years since, extensive further studies have been undertaken to understand the implications of mirror neurons in humans. Rizzolatti's work, and that of others, went on to identify more complex functions of mirror neurons, including the understanding of meaning within observed action, the anticipation of intention and the ability to empathise with the emotions expressed by action – leading them to be further dubbed 'mind reading neurons'. Mirror neurons, it is claimed by Vittorio Gallese and Alvin Goldman , support simulation theories in understanding actions[29], that by internally replicating an observed action, the observer has an experiential understanding of the meaning, intention and emotion of the person performing it: 'The observer understands the action because he knows its outcomes when he does it'[30]. This phrase from an article by Gallese and Rizzolatti, echoes a previously quoted phrase from John Martin about a dancer's movements: *''You have no difficulty in following their meaning because you have often done them yourself, or you can easily picture yourself as doing them'* [my italics]. Gallese and David Freedberg have also recently published an article which uses mirror neurons as the basis for examining aesthetic response to visual art – static images which represent movement, either through what is represented, or in terms of 'visible traces of the artists creative gestures such as vigorous modelling in clay or paint, fast brushwork'[31]

Mirror neurons have been extensively examined as the basis for understanding a range of social phenomena, including the evolution of language[32] , the function of imitation[33] and its role in the evolution of culture[34]. It is in these extensions of human behaviour and cognition that scientific opinion has been divergent and it is recognised that the line from the observed brain functions to emotions, empathy and understanding is less clearly understood. In particular, simulation theory, a central tenet of the mirror neuron science, is a hotly debated subject among psychologists. This challenges the former primacy of narrative cognition in action observation – "oh I can see what he's doing, he's combing his hair, and this is the reason why" which is a logical, descriptive, language dependent way of knowing. Simulation theory provides an alternative, embodied method of understanding observed actions – the proposition is that my own experience enables me to 'dry run' the actions of others in the movement cortex of my own brain, and hence understand them through 'simulation empathy'. The question of how exactly the emotional, empathetic centres of the brain are engaged through mirror neurons (which evidence suggests are 'cold' systems, ie not emotionally responsive) and whether understanding follows from brain simulation or the other way around has been raised and discussed within the scientific community.[35]

I shall return to the question of the relation between mirror neurons and emotional response, as it is central in creating the strong through line from Martin's theory of metakinesis in dance. However, a more recent study in London brings dance and dancers fully into the field of mirror neuron science and the brain functions of watched and performed movement. This set out to answer the question of whether motor expertise (the ability to carry out certain technically specialist movements) and motor repertoire (specific, established movement patterns somebody performs with competence) influences the visual system when the observer watches that movement. In short, if you are familiar, through repetition and practice, with a certain kind of movement, does your brain process the watching of it differently to watching action with which you are unfamiliar?

The study, by a team of neuroscientists at the Institute for Cognitive Neuroscience, set out to get a clearer picture whether the mirror neuron system in humans was simply recognising action or re-enacting it in the motor systems of the brain. There had been no previous study to show whether the activity in the mirror system areas (pre-motor

and parietal) when observing action was really a motor response. Locating brain activation which was present only when subjects had the ability to do what they saw would provide a strong indicator of a motor simulation component to action observation – and throw further light on simulation theory.

Led by Professor Patrick Haggard, the study[36] used as its subjects two groups of dancers, with technical expertise in two different styles: ten dancers from the Royal Ballet and nine Brazilian Capoeira dancers. There was a third control group of 'naïve' subjects, ie non expert in either technique. Subjects were shown on screen short movement sequences from the ballet and capoeira technique, whilst monitored by a brain scanner. The factor of 'expertise' was predicted to have effect in areas of the brain previously identified within the mirror system, the premotor cortex, parietal cortex, superior parietal lobe and superior temporal sulcus. In the parietal cortex, the inter-parietal sulcus, is located between the motor and visual systems, so would be active in integrating movement and vision. The premotor cortex is responsible for complex motion planning, where representations or simulations of dance steps would be located. In both areas, significantly higher activations were measured in observers watching steps from their own techniques – ballet dancers watching ballet and capoeira dancers watching capoeira. Naïve subjects measured lower activity watching both techniques, and there was no difference in their response between the two forms. Hence, the conclusions were that 'expertise' in a particular movement – neural pathways strongly established for doing the movement – resulted in higher brain activity in the motor systems of the brain and arguably the strongest evidence to date on the existence of motor mirror system in humans.

Measurements were also taken outside the action observation system, in the frontopolar gyrus (processing emotional engagement and action understanding), the middle and posterior cingulated gyrus (episodic memory and familiarity) and the right parahippocampal gyrus (visuospatial memory). Activity was recorded in these areas; however, they are significantly less conclusive than the results within the action observation system, indicating that while the emotional engagement system appears to be influenced by motor repertoire, the process by which this happens is as yet not precisely located. There are relevant studies such as that led by Bruno Wicker, together with Gallese and Rizzolatti, where brain activity was measured when smelling unpleasant smells and observing others do so, which found that:

> The same participants observed video clips showing the emotional facial expression of disgust. Observing such faces and feeling disgust activated the same sites in the anterior insula and to a lesser extent in the anterior cingulate cortex. Thus, as observing hand actions activates the observer's motor representation of that action, observing an emotion activates the neural representation of that emotion. This finding provides a unifying mechanism for understanding the behaviours of others [37]

This last claim would seem to be over-stated. While there are areas which are commonly activated when observing displayed emotions (eg through facial expression) and experiencing those emotions, which might support an emotional simulation theory, they are located in different brain areas to the mirror system for action observation. Therefore, it could be summarised in lay terms that whilst the scientists know there is something linked happening in the emotional system, the precise understanding of this is incomplete.

The study by Haggard at the ICN was picked up by the media across the world, not least because of the visual appeal of scientists working with dancers. The Australian Broadcasting Corporation ran a story as part of its radio programme 'All in the Mind', which combined interviews with Haggard, Shona Erskine, a leading contemporary dance artist and Kate Stevens, co-author of 'Thinking in Four Dimensions: Creativity and Cognition in Contemporary Dance'. In this programme[38], the presenter Natasha Mitchell referred to an article by V S Ramachandran in which he claimed that mirror neurons would do for psychology what DNA did for biology and could throw light on the evolution of culture. Nova Science Now ran a feature and audio interview with Haggard's colleague, Dr Daniel Glaser, as an update to an earlier feature they had run on mirror neurons, in which he said:

> *You might think of vision as being a bit of a passive process, as if your eye is open to the world and the photons come off the world and into your eye and fall onto your retina as if it were some glorified camera. But what we're discovering more and more, and in truth the Greeks and the Renaissance scholars also had an understanding of this, is that vision is an active process. Seeing is a process of projecting what you expect out into the world and constantly matching your experience, your prejudice, your expectation with what's out there. For me the mirror neurons are a particular system which embodies this principle, and for me it's a very fruitful area.* [39]

What interests me in this description is that Glaser is explicit about what the observer brings to the process – not simply in terms of their own motor expertise, but also the cultural and experiential context which makes each action observation unique to the watcher.

Haggard's team ran a second study which attracted less PR, but which they believe to be a better designed study. The original experiment had a potential confound in the area of visual familiarity. Ballet dancers probably rarely, if ever watch Capoeira, and Capoeira dancers tend not to watch ballet. So the question of whether the extent of their previous visual familiarity had contributed to the clear differences in brain activity when observing different techniques, was one the team at the ICN wanted to address. This time they ran a study only with ballet dancers, but with male and female dancers (the first study had been male dancers only in both groups). Some ballet movements are performed only by one gender, but male and female dancers train together so will have visual familiarity with each others' 'gender specific' movements. The difference lies in performed motor repertoire – additional motor representations only for those movements specific to their own gender. The test strengthened the findings of the first study, confirming that 'mirror circuits have a purely motor response over and above visual representations of action. We understand actions not only by visual recognition, but also motorically'[40]

Haggard recognises, with a degree of concern (as a dance enthusiast himself), that these findings extrapolated in a coldly scientific sense into the experience of a dance audience could be damaging to the case for the widening appeal of dance. One interpretation of expert dancers getting a heightened mirror neuron activity which is not evident in the non-dancer, could be seen to support an elitism in dance attendance. The experience of attending dance performances was an area I covered in some depth when interviewing dancers, and whilst most dancers recognised at times a powerful metakinetic response while watching dance ('twitching'), their responses indicated a complexity which goes beyond the obvious (and arguably 'Neuro-reductive') conclusions which could be drawn from the science tests alone, about how dancers, compared to the rest of us, respond to dance as an art form. Haggard and his team are not claiming that quantitative motor activity equates with qualitative understanding or experience.

To summarise this section, mirror neurons form a firm brain basis for metakinesis as described by John Martin, and the implications of this within performed movement in humans (dance) has started to be explored. Whilst the existence of the mirror system in humans is well documented on a motor level, the connection to emotions, meanings, intentions and memory are more complex and less easily mapped in terms of pure brain function – although they are definitely there. Interestingly, when scientists describe how they believe mirror neurons function across more complex human interactions, their descriptions are resonant of some of Martin's own descriptions, which are concerned with primarily philosophical and aesthetic lines of enquiry. It may be that science and art are truly converging to communicate something which is known at a more subliminal human level.

Over the past fifteen years, media interest has started to build in the area of mirror neurons and the relationship of this area of neuroscience to dance. Whilst still largely confined to scientific or educational media, the role of broadcast media in explaining the concept to a lay audience has been significant (although not in the UK) if not yet impactful. The espousing of mirror neurons as a potentially transformative breakthrough in human understanding may be considered important in raising awareness, and the potential implications of such a transformation on dance as an art form in western society is what I shall explore next.

CHAPTER 3:

DANCE IN WESTERN SOCIETY: WHERE IS IT NOW?

To discuss any potential shift in the relationship between society and the moving body, a good point to start is the current position and trends which are already being perceived. I am doing this from a number of perspectives including a review of academic literature; from evidence showing trends in dance attendance and participation; and from the lived experiences of dance professionals. I am concentrating on the UK, although increasing globalisation (and the international nature of the dance world) means that experiences from other parts of Europe, North and South America and the English speaking world are significant and are therefore drawn on where relevant.

My starting point however is from my personal experience of projects where I have been the connecting point between the worlds of dance and corporate business - in particular, a recent corporate project with a leading global accountancy firm (2004). As part of their leadership programme for young, high potential employees, twenty accountants and directors took part in a two day programme with Northern Ballet Theatre aimed at stimulating creativity. At the beginning of the programme, when they had gone to watch a rehearsal, most had never seen a ballet before, they were almost all surprised that in ballet there were no words, and one has said she expected there to be songs !

The response in this group to watching dancers in class and rehearsal was an intense excitement at the physicality of the dancers performing in an environment, which they had never experienced before. This was combined with amazement in finding out just what a dancer's ongoing regime involved, and in learning about the complexity of getting a ballet onto the stage. I observed a transformation of the participants physically over the two days – by the end of the programme they had moved from chairs and tables to the floor, from a primarily verbal/ rational approach to their assignments to an intuitive/ demonstrative way of communicating with colleagues, and in most cases, their presentational style had changed from stiff and formal to physically expressive and passionate.

This is one example of several I have witnessed involving groups of people from mainstream business life, all of whom I would guess had been educated to degree level or beyond, for whom the world of performed dance was another country – but for whom a first experience was transformative.

However, dancing, as a social or participatory activity, is a common experience for many people in western society. The growing popularity of forms such as salsa, ballroom, line dancing and even pole dancing indicate that where people in the UK have responded to the promotion of physical activity to combat obesity, they are as likely to do so via dancing as a sports activity. According to the Central Council for Physical Recreation, dance is a popular activity for 10% of the UK population[41].

In the last chapter of *The Body, Dance and Cultural Theory*, Helen Thomas charts, through reference to a number of studies, the rise of Rave and Club culture in Britain, from the advent of the discotheque in the 1960's to the late 1990's and early 21st Century. In 1996, 43% of 15-24 years olds attended a club at least once a month[42].

However, in the introduction to her earlier work, *Dance, Modernity and Culture*, Thomas explores the comparative neglect of dance in sociology and anthropology, where, study has tended to focus on the relation with so-called 'primitive' culture, and she observes that much of the study of urban dance culture reflects similar values:

> It is interesting to note that where a concern with dance has occurred, it has largely emerged from the focus on working class subcultures and youth. While dancing is marginalised in the dominant cultural tradition, it is a central interest to these structurally marginal groups whose ideas and practices are generally seen as (morally) suspect (sex, drugs and rock'n' roll)… in relation to dance, subculture is to dominant culture as primitive is to modern culture: a dangerous, exotic, non-rational, marginal 'other'.[43]

Thomas makes important points about the way that sociology approaches the study of social dance and how it has failed to place it centre stage as a lived experience. In studies of urban youth culture, popular dance styles are defined in relation to music, which has a primacy in the description of influences and drivers in fashion and culture[44]. The 'social centrality'[45] of the embodied experience of dancing in the lives of clubbers has for the main body of work in the field been 'glossed over'.

From the statistics quoted earlier, it can be extrapolated that many of the 15 – 24 year olds of 1996, are now, as 25 - 34 year olds, in a more mainstream demographic – some of them may indeed be the high flying accountants who find dance as a performed art form so alien. This, together with the growth of clubs and festival tents dedicated to proliferating styles of dance music (trance, house, garage, electronica, hip-hop, ska, reggae, soul etc) social behaviour may be ahead of academia in relation to dance, but perceptions of rave and club culture as socially disruptive still pervade the media.

If social dance culture has its place primarily as a study of the exotic or subversive, dance as an art form is further marginalized, according to Thomas. She sets this assertion within an analysis of how western culture perceives the body and dance in western culture. The roots of this lie in Descartes defining principle 'I think therefore I am', which has driven philosophical, scientific and social thought since the seventeenth century. The principle of the mind as entirely distinct from (and superior to) the body led to the primacy of rational thought as the defining characteristic of the human species, over and above all other aspects of cognition. Linked to this is speech and verbal or written language having higher currency over physical communication, and objectivity over subjectivity – both values which hold strong today.

The mind-body dualism emanating from Cartesian philosophy and its role in marginalising dance as an art form has been written about extensively elsewhere. Its direct lines into the industrial revolution, the development of modern industrial society and the social concerns which have defined sociological study, describe a society which has continually moved in a direction which is away from the life and language of embodiment.

This has been especially profound in almost all our education systems. Professor Sir Ken Robinson has written and spoken of the way we tend to organise education in western society:

> *Why isn't dance as important in schools as mathematics, because it should be? You know, we all have bodies, don't we…truthfully, what happens in education is that we progressively educate people from the knees upwards. And in due course we concentrate on their head… don't we, and slightly to one side. The consequence is that highly educated people in our western systems for the most part… you will find that they are disembodied, they live in their heads and slightly to one side.*

> *They look upon their body as a form of transport for their head. You know, it's a way of getting your head to meetings isn't it? Which hopefully the internet will eventually relieve us of entirely. You know, I mean, why are we all in such a desperately poor physical state? Why are we so out of tune with our own physicality? Why is that? We weren't to start with. We are now.*[46]

This is echoed by three separate accounts from dancers I interviewed, who had moved from an academic education to professional dance at the level of Higher Education. Interestingly, all having come to dance later in life were able to speak in evaluative terms about the – for them – unnatural divergence between academic and physical learning:

> *Participant L:*
>
> *I've been at school for the majority of my life and I've been doing very science based subjects where the learning is so didactic… I remember just memorising lists of things ... I can remember all the words to Henry's Cat, the theme song, from when I was a child, because it was a song and I remember the visuals I did the same with medicine. My notes would be so incredibly colourful.*
>
> *Participant M:*
>
> *I was academically strong but felt distanced from my experience of myself - I mean, these are very simplistic terms and academically you could pull them all apart – but at the time my brain felt so developed that it was very separate from who I was. Academia cultivated that.*

It is worth noting that, when talking about a distinguished academic career at Oxford prior to becoming a dancer, the subject feels the need to qualify what he is saying with academic disclaimers – although the same interviewee uses many similar embodied descriptions elsewhere without the need to qualify.

> *Participant F:*
>
> *I think I was very much curious of exploring that other part because ... I've got a good intellectual brain, I'd survived … for 12 years of schooling, if through having didactic lessons and doing very well in exams. And I could have gone to be a vet or I could have gone on to do some serious medical training or whatever, architecture or … all these things were open but actually I was much*

> *more interested in exploring a completely different side of what it means to be alive and I think that's why I really fell in love with contemporary dance. I was very fascinated by doing it as well as watching it.*

Each interviewee had a successful academic career which opened up viable options which for many people would present great opportunities. Each chose to change track radically and become a dancer – it was either/or for them, they perceived no way of combining that other, physical part of them with the academic/ professional education.

It is however, nowadays, perhaps in education that there are most hopeful signs of change. In my interviews I talked to five people working directly in dance education and they all reported a growth of interest from teachers and schools in their work. *"The schools are up for it, we have more demand for work than we can provide" (Participant A)* was what one executive director of a dance company reported.

In all three earlier accounts from dancers, the experiences of becoming dance artists later in development seem to have given them greater insight into their own learning and development – as if the addition of another type of learning has thrown it into three dimensional relief. The world of education it would appear is starting to become aware of the potential for dance and movement as a catalyst for broadening approaches to learning across subjects, which was described by several dance education professionals:

> *Participant F:*
>
> *They have in year 7 … an hour a week learning about learning and … those kids are becoming really aware of what kind of learners they, are they kinaesthetic learners, are they visual learners, are they audio learners ..?*

Individuals from dance companies and the independent dancers I interviewed spoke in an upbeat fashion about the trends in education. They seemed optimistic, felt their work was valued in schools and could perceive growth for the future:

> *Participant I:*
>
> *More and more schools in my experience are waking up to ... you've got all the kinaesthetic learning stuff… but also this, the kind of waking up areas of the brain so they're now doing wake up and shake up in some schools, you know,*

> *10 minutes of the day. And you've got ... not just learning that but the knock ons of being active in that area of the brain*

Perhaps their optimism reflects that the recommendations from the Standing Committee on Culture Media and Sport in 2004 are starting to bear fruit:

> First access to dance, for many children, and particularly for those who cannot afford private lessons, takes place within the school environment. It is therefore essential that children's dance experiences in school are of a high quality, to ensure that they retain an interest in dance and continue to pursue dance when they leave school. Whilst dance is not a gender-specific art form, it does attract a significant number of young women who might not otherwise be engaged in physical activity (over 7000 young women took GCSE dance in 2002). There is also a great deal of positive work being done to engage young men in dance, its innate creativity offering a means of expression quite unique to other sport forms. We recognise the value of the work already being carried out by subsidised professional dance companies and artists in providing quality experiences for young people together with training and resources for teachers, and we will continue to promote high quality dance experiences in school through a variety of schemes.[47]

Dance as a performed art form however is showing less optimism. A guide for Canadian dance companies wanting to promote in the UK opens with the following description of the status of dance in the UK:

> "It should be remembered that England, a Protestant Anglo-Saxon society uncomfortable with passion, physicality, sexual frankness, confrontation and the body as opposed to the word, is traditionally far richer in language, literature, drama, poetry, applied design, thought and science than it is in painting, music and dance." This assertion, from one of the several promoters interviewed for this guide, sums up well the Cinderella status of dance in the UK… not only is there very little interest in dance created within the UK, there is– apart from a few exceptions – little appetite (and funding) for dance from abroad.[48]

This is surely an overly pessimistic picture of dance in the UK – although the perception from overseas is on one level an important barometer. In fact, there was a

significant increase in Arts Council funding for dance between 2001 and 2003[49] and dance audiences in the UK grew by 13.7% between 1998 and 2004 – about 11% above the rate of growth of the UK population.[50] However, these figures still represent only about 4.4% of the UK population attending contemporary dance[51] and 7.4% attending ballet.[52]

Dance as an art form is slowly growing – although it still suffers from perceptions of class elitism (especially ballet) and intellectual challenge and esotericism (much contemporary dance). The major companies are working hard to offset that perception, as described by the Director of Education at a ballet company:

> *Participant G:*
> *I think a lot of people will still think, oh its white middle class and its elitist… But … it's our department's job to go out and break that pre-conceived idea and make sure that people do know that it's for everybody. I think the split between ballet and contemporary ... in one way it's linked because you've got that sort of inbetweeny type of dance and street dance and culture and pop music… There's dance, dance, dance talked about, but it's when you drop the word ballet in and everybody goes 'wohhhh ok?'*

In ballet, it seems, those working at the coalface of access accept that their art form is considered elitist – and yet more people attend ballet than other forms of performed dance. This view holds across other interviewees, including a Director of Learning and Access who was not from the UK – although in her case, she considers ballet to be the most immediate association with dance:

> *Participant F:*
> *I think it's different in different countries in Europe. I think in this country ... it's very much a class issue as well as a cultural issue. I think … for example, in Yorkshire, most people view dance as something that is done by gay people, that's prissy, that is ... you know ... most people understand dance to be ballet … and don't think it is something for them, but then on the other hand there is a huge proportion, like a quarter of the population, actually takes part in dance themselves, albeit in salsa lessons or in saroque lessons or aerobic salsa classes at their gym, and of course children participate in a lot of dance… So I think the perception of dance is that it's for a small group of people, that it's an elite and I think most people won't go and see it.*

The figure quoted for participation in dance activities as 25% is in fact closer to 10% of the UK population[53] - suggesting that some of the optimism noted earlier may be based on slightly exaggerated perceptions from within the profession and a general lack of data in the public domain to which I refer later.

The Royal Ballet, as the largest and most heavily funded company in the UK, is also working to diversify and expand the appeal of ballet. One interviewee with working connections both at the Opera House and the Royal Ballet School described the range of thinking and initiatives aimed at reaching wider audiences:

> *Participant N:*
> *I think they're having to not be so insular in their thinking or not just think about what goes on the stage … I think with the number of … ways they're challenging themselves to reach people in different ways through different mediums ... rolling out the big screens, the live broadcasts to a bigger and bigger audience, reaching people in different ways actually I think is becoming more holistic.*

Of the three accounts above, the last participant is the only one to speak from a London perspective. Another interviewee had already identified that London is a 'country of its own' in terms of the arts, and it needs to be borne in mind that venues dedicated to dance (Sadlers Wells, The Place, Bonnie Bird Theatre) only exist in the capital.

Descriptions by dancers now advanced in their careers or retired, of the Royal Ballet School system twenty or more years ago, described a *"… machine, you're being groomed and produced… school shows were so drilled… so produced" (Participant I).* In many ways, the closed nature of the dance world has been a part of a vicious circle: dancers and dance students – especially boys - are seen as alien, hence they close ranks and retreat into their own circle which is intensified by the level and physical commitment of the training:

Participant I:
I suppose, slightly kind of blinkered ... well I'm enjoying myself… so bugger you, sort of thing. And then, entering a machine like the Royal Ballet School, where actually you're just one of a number and you're being swept along…

This is changing in the major companies, according to an Associate Tutor at the Royal Ballet School, who now run schemes which take RBS students into mainstream schools

Participant N:
I think ... for me the whole of dancing is about those things ... things that appear to be opposites held in dynamic balance, and of course dance or any of the performing arts, you know are specialised in that sense, demand an extraordinary commitment, sustained focus, over a long period of time and the danger is that . can sometimes result in people having tunnel vision. I don't think that should be the case. I think there's always ... putting a single goal into a perspective in the bigger world of what's out there…and as a younger person training, I think it ... can help you keep a really healthy perspective on things if you have some regular connection with what I call the world out there.

This participant recognised that the comments of dancers who trained twenty years ago would have been true, but that is having to change:

… Actually I think the dance world is not doing badly ... I think it has had to change … in order to survive and get a foothold in a rapidly changing world, I think we have to recognise that ...

This participant uses the phrase 'the dance world', and while what he describes is demonstrably true of a number of institutions, the sector as a whole may still not be thinking as widely as it could do. When researching figures on dance attendance for this essay, I could find no single, central source of information in the public domain, and no more recent data than 2004[54]. In an Arts Council strategy document (2001)[55] which analysed the (then) current situation and presented a vision for the future, there is nowhere to be found data analysis on trends in attendance at dance performances (although collection and submission of this data is required from all funded clients). The inclusion of an analysis of current and future market trends is not apparently considered the lynchpin of strategy that it would be in other sectors

(although some reference is made to general demographics and consumer culture) and my interpretation of this is that the sector as a whole is still characterised by an inwardness of focus.

This suggests that the dance world itself may also contribute to maintaining the Cartesian mind/body dualism which has kept dance as an art form at the margins; whilst there is not room in this essay to develop this theme, I would offer two pieces of evidence from my interviews which suggest it would be one worth pursuing elsewhere. The first was the comment by Participant M, who had pursued academic education to postgraduate level before becoming a dance artist, that when he started training he experienced a *"reverse snobbery about the mind"*

> *…in my training I was told to shut up because … .people didn't want me asking questions… dance at that time was very much taught imitatively. You saw something, you were supposed to copy it …Some dancers I felt were quite wary and negative about the life of the mind…*

Whilst this experience was some years ago, a recent comment by one of the scientists I interviewed – described as interesting, but *"quite upsetting"* is that dancers' first reaction when approached for their participation in a science study is often, *"I'm a dancer, I don't understand science".* There remains, it would appear, a perception within some parts of the dance world that the life of the mind is incompatible with that of the body. Perhaps one of the key tenets of neuroscience (and an area of contention among those who claim neuro-reduction) – that the brain is simply a part of the organic body – can contribute to a shift in this over time, but that again is the subject of another study

It is therefore perhaps not surprising that many people beyond the dance world (in which I would also include regular dance audiences), still have little understanding about dance as a profession. Several ballet dancers I interviewed said that friends and family didn't even understand that dancing was a full time, paid job:

> *Participant E:*
> *They think we do it at the weekend*

Participant D:
They think it's just like ... you know ... for one hour a day

Participant K:
Even my mum and dad, I can explain ... well I don't bother any more because they don't get it, but you can go through your timetable, and so… 'when's your other job, what do you do to bring in the money?' ... and ballet is what brings in the money ... you know ... then when you say, oh I'm on such and such a wage… they don't believe it.

Participant G:
… in my teaching career people have just thought that I did it as a hobby, that it's something that you do after school in the evenings. They don't class it as a proper job

Perceptions of ballet in society generally tend to be based on people who may have done – or known others who did - ballet once a week as a child, and the typical eight to ten hour working day of a dancer is a hidden reality which surprises most who are unconnected with professional dance. For contemporary dancers and dance makers it can be even more difficult to explain their professional practice. One interviewee sometimes does not describe himself as a dancer at all:

Participant M:
I mean I'm used to people not knowing what it is I do, or expecting that if I say dancer then it's … in a show in the West End, or doing RiverDance if I say I'm Irish... and I find it very difficult to explain what it is I do, so in fact ... I sometimes call myself an artist ... When I say dancer they see 'Strictly Come Dancing' or whatever and you know ... I do end up defining what I do negatively. I don't do ballet, I don't do the shows in the West End…

Participant N:
Some of them say oh I've not really met a dancer before, or sometimes their surprise might be because … well for example if I'm wearing normal shirt and trousers … perhaps people are genuinely surprised because I don't conform to some notion of some arty type… if I'm not carrying a big dance bag

The distance between mainstream society and the dance world is filled by a curious juxtaposition of stereotyping, and ignorance on one hand, combined – often within the same interchange – with a fascination and admiration for dancers in many quarters. Almost all the dancers who described a lack of understanding of what they do also described major elements of respect:

> *Participant C:*
> *we often talk about ... with dancers, you know… normal people and dancers .... there's that kind of division…there's admiration for what we do… the wow factor of being a dancer… I think it's the ability that we have to put our bodies into a further spectrum of movement than the normal person, sort of enthrals them.*

> *Participant I:*
> *In terms of being a dancer in society, you know, generally, it's made me feel quite a special animal, you know… ballet dancers are seen as exotic creatures in some way, aren't they?*

> *Participant K:*
> *Without a doubt people are in awe, you even go to the bank and fill in a form that says what's your job, ballet dancer, oh where do you work, Birmingham Royal Ballet, and then that's it, you can forget about extending your overdraft, they just want to talk about ballet.*

Interestingly, all these are male dancers and in these conversations very little was mentioned about victimisation or prejudice – possibly because it is something in the past which they have learned to deal with, but the tone of comments suggest that nowadays as dancers they share the admiration society holds for athletes. Most participants spoke of the links or comparisons with sport:

> *Participant I:*
> *The word is out that physicality of dance is equal to that of rugby or football or whatever and having spoken to rugby players they say 'oh yes, dancing is good for you, isn't it?' so I think it's gradually working down…*

The relatively hidden status of a dancer's training regime, and it's terminology, means that in the public realm more is known about the work required to become an elite athlete or a professional footballer,

Participant N:
People view things in relation to what they're familiar with ... it's the language used… What does Class mean for example? Class to some people sounds like going back to school ... Didn't you just train for three years or ten years? Why do you have to still learn it?

The relationship between social dance and theatre dance is complex. One participant felt that a majority of people are still reticent to get up and dance at parties and whilst nobody feels foolish kicking a ball in a park, people are generally more self conscious about dancing. Another participant, a non dancer, felt that he would not want to participate in a dance workshop in his company for fear of eroding his credibility as a Chief Executive:

Participant A:
You're in control of the situation most of the time and you can pretty much hold your own in the business sense, if you suddenly went in the studio and felt a right idiot trying to do that stuff, and I know I'd be crap at it, I'm not co-ordinated …

However, this participant along with the majority of interviewees felt that there are social situations such as weddings or clubs where everybody will dance, and against this landscape theatre dance can actually have difficulties of definition in society – echoing Martin's previously quoted 'Familiarity breeds not contempt, perhaps, but certainly neglect'. This is especially true where energetic social dance is an even deeper part of the culture:

Participant C:
Brazilian ballet companies and Brazilian dancers... it's the absolute energy that they have. It's almost as though it has to be that strong... the cultural side of Brazil which is plenty of music, plenty of movement anyway, in society naturally for a normal person. Everything that we end up doing on the stage has to be somehow magnified.

The same principle, according to one artistic director, can occur in another very physical culture – the deaf community using signing as communication:

Participant B:
When we're looking at how dance relates to …audiences with different disabilities… one of the questions I brought up was, well shouldn't people that can't hear well really be stimulated by dance? And the response was yes and no … often they don't find it expressive enough … Do not find it expressive and that's because … they are communicating, doing their signs … those words are taking on an emotional feeling, …. They colour their words with physical expression.

To summarise this chapter, the role of dance in western society is still defined largely by Cartesian principles, where the rational, verbal and objective hold sway. Whilst social dance, and participation in organised dance activities, are on the increase, the relationship between the club or the salsa class and dance as a performed art form remains distant and ambiguous. Particularly in the UK, the residual values of Protestantism and the industrial revolution characterise a general uneasiness with the body, especially the expressive body. The experiences of dance professionals reflect data which indicates that dance as a performed art form is slowly growing, and that this is most likely to be driven from the education sector. However, for the most part, professional dancers and dance-makers are perceived as exotic aliens who inhabit a world disconnected from the mainstream experience – a very different status to sporting athletes. Stated government policy is to address the social accessibility of dance, especially for young people, and the profession is working hard to fulfil that policy.

At the core of this essay is an enquiry into whether, and how, the dissemination of thinking driven by mirror neurons science could impact on our understanding of the embodied experience and hence the relationship between society and the moving body. Having tracked metakinesis from concept to possible brain basis, and given an overview of dance in western society now, I will now explore how key scientific discoveries can affect a wider range of social thought.

CHAPTER 4:

MIRROR NEURONS - THE SCIENTIFIC ' BIG BANG' OF THE 21ST CENTURY?

As previously mentioned, the eminent neuro-scientist, Professor V S Ramachandran has in several contexts, claimed that the discovery of mirror neurons represent a scientific breakthrough as significant, and as likely to have as profound effect on society, as the discovery of DNA[56]: Ramachandran speculates that mirror neurons may provide the missing link in accounting for the chronological gap of several million years between the development of human brain capacity and human attributes such as tool use, fire, language and culture. His theories challenge Chomsky's theories of language by suggesting an evolution from a pre-dated gestural language; and suggests that human ability to read the intentions of others ('theory of other minds' [57]) is linked to our ability to imitate and simulate, an evolutionary attribute.

His essay is primarily concerned with the evolution of the human brain, and his theories are speculative. Yet they give us a glimpse of a vast landscape of potential understanding about ourselves and how we came to be who we are It is therefore possible to imagine that, even were Ramachandran's specific theories to be proved implausible, the potential impact of mirror neuron science would nonetheless prove to be profound – possibly as the discovery of DNA . It is worth noting that, whilst DNA science remained important only within the scientific community and industrial research for fifteen to thirty years after its discovery, fifty years on genetic technology touches almost every part of our lives – from food and agriculture to crime and paternity suits, whilst providing cures and preventions for disease, and raising ethical questions which cut to the core of human belief. Media coverage of issues around human genetic modification such as the wave of 'Designer Baby' stories in the late 90's and 'Stem Cell Wars' in early 2000's, show how these discourses, central to our definition of ourselves, have taken root in the wider social consciousness. In the field of entertainment – always a good barometer for seismic social shift – the Edinburgh Festival and the Wellcome Trust partnered in 2006 for the first Biomedical Ethics Film Festival, to visualise and examine future scenarios around human reproductive cloning.[58] The medium of film has used genetic science as the basis for storyline of major films over the past forty years – the role call includes: The Human Duplicators,

(1965); Il Gatto a nove code, (1970); The Resurrection of Zachary Wheeler (1971); Night of the Lepus (1972); The Boys from Brazil (1978); Blade Runner (1982); Anna to the Infinite Power (1983); Primal Rage (1991); The Island of Dr.Moreau (1996); It Came from Outer Space II (1996); Multiplicity (1996); The Sixth Day (2000); Blueprint (2003); Godsend (2004); The Island (2005).

This narrative context is key, it would seem, to imagining the way science may be applied in the future – for good or evil - as was noted by one participant who was struggling to see the application of mirror neuron science to dance and society:

> *Participant A:*
> *… if this was in science fiction you could sort of somehow could accept couldn't you... something where you'd go wow, if you could do that it could be amazing…*
> [Question: so if someone makes a film like The Matrix where we suddenly understood and imagined more about the implications of virtual reality…?]
> *Yes that I could handle*

There are, however, a number of science fiction films portraying mind reading as a superpower and one dance-maker had an interesting observation to make on how that is often represented:

> *Participant B:*
> *… you know when you see science fiction films about telepathy and things… imagining that people would stand there with no expression... actually there would be <u>more</u> expression coming without words that would convey the message. You know, why would it be <u>no</u> expression?.. it's a sense of that you would be beyond emotion… and why is emotion a more primitive thing than intellect ...?*

So, if mirror neurons prove to have as profound and widespread effect on society as genetics have done, it is not fanciful to propose a future where this science influences understanding among the population at large – and where it contributes to a zeitgeist (if indeed such a thing continues to exist in an increasingly plural world) for the next century and beyond. But how might this be manifest? What is it that dancers and dance-makers already know which may relate to mirror neuron science? And how could the relationship between the watcher and the mover in a performed dance setting be transformed?

CHAPTER 5:

MIRROR NEURONS, METAKINESIS AND DANCE PRACTICE

In this chapter, I explore the implications of mirror neurons for a range of linked subjects in current dance practice, to which I consider the neuroscience to have a connection. The basis for this is mainly drawn from primary research with dance professionals. These include:

- The relationship between movement and emotion, meaning, intention
- The relationship between the dancer and the audience
- Differences in discourse between ballet and contemporary, narrative and abstract work
- Dancers learning, injury prevention and recovery

All these subjects could form the basis for separate studies in their own right. To retain a coherent focus for each, I have attempted to keep the potential implications of mirror neuron science as core to each section. However, with any process of scenario projection, lateral themes can prove to be more enlightening than purely linear development; therefore, where there appears to be a tangential yet important line of enquiry, I have followed this and included examples of those conversations within the study.

MOVEMENT AND EMOTION, MEANING, INTENTION

John Martin referred frequently in his metakinesis theory to the mantra of Modern Dance in the USA of the 30's: 'No movement without meaning'. On the basis of the notion that movement does not lie, a meaningless gesture will, according to Martin, result in an empty experience for the watcher. The principle, originally explored by Isadora Duncan, that dance movement should come directly from the soul, was a reaction to 19th Century ballet which the Modern dancers considered a technical, decorative yet ultimately empty form. The line from metakinesis to its brain basis, mirror neurons, should support the importance Martin placed on meaning – if the brain's movement cortex's really do 'read' movement with any inherent intention,

emotion and meaning which may exist, an audience will surely experience some kind of neurally induced emotional deficit when watching movement empty of meaning?

Since the early days of Modern Dance, the principle of 'no movement without a meaning', central to the work of Delsarte[59] and Graham, and strongly espoused by Martin, has had a changing importance in what that has come since. Reportedly, Merce Cunningham left Martha Graham's company, saying "the problem with Martha is, everything has to mean something" and a generation later Carol Armitage left Merce Cunningham, saying "the problem with Merce is nothing means anything"!

I explored the mantra of 'no gesture without meaning' with a choreographer in narrative ballet theatre:

> *Participant B:*
> *No gesture without a meaning…? … No, I wouldn't agree with that. Because I don't think it all has meaning… every word you say does not have a meaning when you're in conversation… a lot of stuff, it's filler… it's words getting somewhere …. What I think is that every gesture should have an importance of its own, which is different… it's trying to get the dancers to understand that… how they walk… there has to be an importance on each step and how its going …. now yes, maybe each one has a feeling, so maybe I'm going back on myself and saying yes every one has an emotion to it… Like… yesterday, I was going through the Sleeping Beauty Pas de Deux … I can shape the dancers to home in more on what I'm trying to say, so I'm trying to place the right way of doing each step, not that each step has a direct meaning or emotion, but each step is a … a building block to an overall phrase. So yes, they do have… like when they touch I don't just want them to touch, I want them to know if that touch is firm or that touch is gentle, what that touch is, and how they go into that touch. Now you might interpret that yes I'm agreeing with that statement that every gesture has a meaning…*

In answering my original question, the participant himself comes full circle in disagreeing and agreeing – working through the complex layers of implication.

Many of the dancers I spoke to talked of emotion as the key driver for them dancing. This was particularly true in ballet, as the discussion with two female dancers revealed an intuitive understanding of metakinesis:

> *Participant D:*
> *I think it's to give to the audience those emotions. I think it's the main thing.*
> [Question: Where does the emotion come from for you in your dancing?]
> *Participant E:*
> *I try and use things that have happened sort of in my life, kind of thing, and then try and just sort of like get that out. Yes.*
> *Participant D:*
> *It's yourself who brings most … and then I think more the emotions are strong, the more they're going to pass with the audience because then they're going to feel that too, they're going to feel this emotion.*

For many dancers, especially in ballet, the relationship with music is important in the emotional 'mix'. Several dancers spoke of finding emotional register through the music:

> *Participant C:*
> *It's an emotional response to the interpretation of that particular piece of music, so I suppose it would relate very much to yourself liking a piece of music …and just having a kind of feeling in your body, and then from that feeling you would put the movement on top… it comes from the centre, you know, from the breath and then … it's something that comes from within… hard to explain exactly where it comes from, but the difference is huge, you know.*

So, in the relationship between movement and meaning, emotion would seem to be key – mirror neurons read emotion through movement, or through a sequence of movement. However, the implication of the studies carried out by Patrick Haggard and his team would suggest that there is a strong cultural component to the motor programmes which enable us to interpret movement – if we are familiar with the movement by doing it, a fuller neural response will be delivered and we will be able to 'read' meaning or emotion better – and it will ultimately engage at a deeper level, as described by a Brazilian dancer who has worked in a UK ballet company for many years:

Participant C:
I worked for a Brazilian company last year ... I was interpreting for them and I was teaching them and I liked very much what they do. The movement is phenomenal; very athletic, but there's a sensuality about it as well and there is beauty and there is ... there is an element of ugliness in it somehow too and there's a lot of my background there, the Brazilian movement, the Brazilian way of walking and stuff ... the whole evening just goes very quickly, you know ... time just seems to just go because you're just immersed in it. Really immersed in it.

For dancers working with a contemporary dance vocabulary based on everyday physical language, this has stronger implications – whether the cultural background of the audience will influence how their brains will process it through their own motor programmes. This can be further affected by context, as described by one choreographer who created a piece for film, shot on a famous football ground:

Participant M:
…even though I knew the context in which it was going, I didn't consciously make material to mimic the kind of football or Gaelic games that the context would suggest. I felt the context would do that enough, but when people saw it from that background... they read all sorts of detail because that's what they were used to seeing … in that setting. On the day that we were filming it, … the groundsman was a little bit uncertain about allowing us to do it in front of the goal mouth … where the grass was most delicate. And when we showed him what we were doing he said, "Oh but you're doing a kick there, of course you have to do that kick in front of the goal post because you know ... you're kicking a goal" ... that was not what was ever going on in my conscious mind… but of course I could see why he saw that

What is being described here demonstrates clearly that any expressive movement observation by a watcher or audience member is a unique confluence of the choreographer's and dancer's intentions[60] and the meaning context brought by the watcher.

Another area in which studies show mirror neurons work strongly is in anticipating intention and outcome of movement. Talking to dancers about how they watch or

make dance, the relationship between surprise (the movement doing things which were unanticipated), predictability, what seemed 'natural' and the aesthetic impact seems to be magnified in performance and, as in the ICN study, motor knowledge of what is possible or likely can intensify that:

> *Participant C:*
> *There's an intention ... and there's also a shift of weight and balance …so that you can predict more or less what's going to happen, but … some choreographer may be extremely clever in taking a movement where you don't expect it to go and making you go 'wow',*

The study of aesthetics in movement can only be touched on in this essay, but the relationship with metakinesis and mirror neurons is I believe established through the work of John Martin and in later science. The implications for dancers and dance-makers are significant: if we knew more about how a creative work achieves a particular response among audiences (and whether there are identifiable differences in response between different groups or categories of watcher), rather than purely what works, it would throw light - or maybe simply validate – the choreographic process and creative choices made by dancers and dance-makers [61].

> *Participant N:*
> *We talk sometimes about ... doing something strongly enough … that the audience will have a kinaesthetic response. I mean we talk about that as though we know what we're talking about, but actually I think …we know it anecdotally but we actually don't really know how that works very well*

This leads to the next key area implicated in the mirror neuron science – the relationship with the audience.

THE DANCER AND THE AUDIENCE

I asked all the performers I interviewed about their relationship with audiences – whether and how they can tell what audiences are feeling. My intention was to get an anecdotal sense of whether metakinesis, or the response created by the mirror neurons, was palpable as a two way process.

> *Participant D:*
> *You get different types of audiences… like the good ones, you can feel them there… with you, through the story…. but you do get some audiences that it feels like there's a wall in between you and the audience so you're like giving all of your emotions and everything and that is not getting across to the audience. First I was a little sceptic [sic -sceptical] with the thing but it might be correct. There is a kind of physical connection between the audience and the dancer ... some evening it's just like ... oh the audience was not good because we didn't feel this connection there.*

However, when the piece is not overtly narrative, the challenge is to elicit a feeling – and for the audience to feel they can express that openly:

> *Participant L:*
> *When things are funny, people are scared to laugh ... in contemporary dance ... because they think, am I allowed to laugh? Is that allowed? You know, is it the done thing? … it's such a dynamic process, the whole idea of interacting and letting yourself feel stuff.*

This participant was describing not only the outward manifestation of response – laughter, or the lack of it – but was also describing her interpretation of audience feelings – nervousness, uncertainty. One might interrogate whether this interpretation of an audience's failure to laugh is correct, or whether an alternative might be that this particular audience don't find what is happening on stage funny. This whole area of audience 'feeling' is one where there is considerable scepticism: apart from through outward manifestations of applause, laughter, inattentive behaviours such as fidgeting or eating, how do performers sense their relationship with the audience? As one scientist said to me, mirror neurons are not a sort of extra-sensory perception. A clue to this was given by an interviewee:

Participant N:
… if someone's whispering in the audience or opening coke cans or whatever, they [dancers] will notice that. They just may not visibly respond to it, but they'll notice because they're in a heightened state of awareness

Jerzy Grotowski, theatre practitioner and theorist developed a technique based on this called, 'dilation'[62], and it is possible that dancers – in fact performers of any kind – are able to magnify the effects of micro movements among audience members and read emotion or mood back from that.

From this, the idea that the audience can impact on what happens on stage, is part of what may be a virtuous (or at times, vicious) circle of empathy built between audience and performer. Key to the importance of live performance is the sense of risk, that the audience can impact on what happens on stage. One participant used an example beyond dance to illustrate this:

Participant N:
You know, at Kings College Choir, the Christmas Carol Service, I always knew ... that they always chose the boy to sing the first verse of Once in Royal David's City, just before. Well I always thought it was about a minute before, but one year I was standing ... just a bit further back than I am from you now, and they processed in and organ music stopped, the red light of the organ went onto indicate live broadcast and the choir master turned and pointed to a boy who just had time to take a breath and sing. And when you were standing that close, the fear ... there was one point when he almost swallowed a word and.. everyone around was holding their breath, because… at that proximity.. .you felt that anything you did could easily impact upon that thing

The sense of risk, it would appear, is key, spoken about in different ways by all the choreographers interviewed.

Participant C:
There's always a correction that we give. It looks very safe.

[Question: Yes, so that element of danger's important?]
Yes. It is.

One contemporary dancer described watching a video on You-Tube of a Chinese acrobat performing incredible physical feats, but remaining unmoved:

Participant M:
… actually she is so on top of it that it kind of doesn't feel scary. Whereas someone doing a little balance on the stage can be much more affecting if it feels ... if it's being pushed to that edge …when it goes so far, it just doesn't feel real.

In particular, a residual aesthetic of the 19th Century ideal of making ballet seem 'effortless', has been reacted to in both ballet and contemporary over recent decades, and would seem to have direct relevance to mirror neuron science and on the studies to motor familiarity at UCL. Any highly honed technique tends to disguise the effort in performing it, and a question which could be further pursued is whether, by measuring responses to ballet and capoeira, motor systems fired less in naïve subjects partly because the level of energy required to perform the actions in both disciplines was not transmitted visually. Two interviewees spoke of the trend among some contemporary choreographers to embed a style in their dancers which makes them look 'untrained' (however, choreographers of this ilk such as Wim Vandekeybus in fact made strong physical demands of technique on dancers, so it could be argued that the relationship between visible and actual effort had rebounded although for different reasons). Meanwhile, in ballet there is a move against what was the predominant aesthetic of effortless grace, with choreographers like William Forsythe and Wayne McGregor pushing dancers to a visible physical extreme.

Perhaps the need to sense creative and physical risk on stage has always existed, and is just more extreme as the physical boundaries of the dancer-athlete are extended; or maybe the need for a sense of danger between performer and audience is a 21st Century aesthetic – reflecting the growth in extreme sports such as sky diving, heli-skiing, bungee jumping. But it is a dynamic which can be closely mapped through the neuroscience of mirror neurons and motor pathways, so the practice of dancers in this respect is likely to be affected with the growth of neuro-scientific knowledge.

BALLET AND CONTEMPORARY, NARRATIVE AND ABSTRACT

As in the work described above, the space between classical and contemporary dance has ebbed and flowed, fusing as it does so with other classical, traditional and popular forms, so that the observations Martin made on the radical departures of Duncan, Graham and all that came afterwards were specific to the period of transition – from the 19th Century aesthetic of classical, through the late 19th/early 20th century romantic movement to the Modern Dance emerging in the 30's. However, it is worth making a brief examination of whether the neuroscience of mirror neurons has a different application or implication for ballet than for contemporary, and for narrative rather than abstract work.

If mirror neurons help audiences read intention, emotion and meaning (of performers and choreographers) through movement, then narrative dance theatre should provide the 'first base' for audiences to develop their understanding of dance. But it can narrow the expectations of audiences, according to a narrative ballet choreographer:

> *Participant B:*
> *Because it's a story, I must be trying to say something rather than set a mood or set a feeling of what's going on now. And I do find that the narrative helps and hinders. The narrative helps people come into the theatre because there's a level of comfort that gets them over the idea of abstract, but once they're in the theatre they can be caught up in worrying that they're not understanding every move*

A dancer working in both the classical, narrative form of South Indian Bharat Natyam and in contemporary dance, described a work she had recently done, which she described as 'dance theatre' (which is also the description of the work of Participant B's company)– for her the ideal form for exploiting the dual potential to interpret a narrative story or simply a feeling – which seems to work at the heart of what mirror neurons:

Participant L:
.. anything narrative will bring another layer to it and it makes it that much more accessible when you hear and know a story …, and I think that... provides the audience with... something to grasp onto because dance is quite abstract

She sees the option of narrative as a freedom, a powerful context for expressing and exploring physical ideas, emotions and more elusive qualities which can either stand alone or be part of a storyline:

They wouldn't need to understand, they wouldn't need to know why I was feeling sad. They'd just know it was sadness and I think that is a really important thing.

Another dancer suggested out that we don't expect music to have narrative or interpretation – we are content for it to evoke a feeling – yet in dance:

Participant F:
We have to interpret it because there's a body. Yes, … because a body has meaning, doesn't it? Going back to your peanut ... [Reference to Parma mirror neuron discovery] *… I think it's difficult to strip body of meaning ... . you could argue that there is absolutely no such thing as abstract dance because every body moving is deeply steeped in meaning of that body and what looks like when it moves*

The suggestion seems to be that the automatic responses of the brain in relation to movement, the activity of mirror neurons, are responsible for us being inexorably drawn to interpretation in dance:

Is the ballet/ contemporary perceived divide, then, no more than a question of degree on the abstract/ narrative continuum? The UCL team chose to work with ballet dancers because of the specific technical discipline; the movement they were observing (which lasted just a few seconds) was not one which was obviously emotionally modulated and it represented a firmly established neural pathway of motor repertoire. It would be interesting to compare measured brain responses over a longer period of, say an expressive passage, although such a study would have a very different scientific endpoint. The process of choreography in ballet is a thing of

many more layers, including gesture and movement which will fire immediate motor familiarity with audiences who bring their own meaning individually, and in the cultural context.

It would also be interesting to compare studies with contemporary dancers, although again such a study would be for different purposes, possibly of less interest to neuroscientists and more interest to psychologists. In interviews with three contemporary dancers, what came across very clearly was a very similar way of describing their discovery of contemporary dance relatively late in their development:

> *Participant F:*
> *I didn't dance as a child. I thought people in pink things were very odd… I didn't see myself as a woman in that ballet sort of way… I really did the classic teenager thing… falling in love with contemporary dance. … to me it was a discovery of another way of being in myself.*

> *Participant M:*
> *When I finished my Masters I came and trained at The Place, and it was the hardest experience of my whole life, but it really brought me so close to my emotions and my limitations and my aspirations… I really felt emotionally switched on… that's one of the things as a choreographer, even as a performer now that's very important to me that it's ... that idea of being physically embodied is also about being emotionally present or aware.*

And of this dancer describing moving from the classical to contemporary world view:

> *Participant N:*
> *…contemporary dance is not just a different way of moving, it's just a way of thinking. It was a whole sort of deep philosophy… a metaphysical approach. There was something that ... there was teaching about life*

These passages read quite differently to accounts by ballet dancers (all male) of their entry into dance.

> *Participant C:*
> *I've always liked physical stuff. I used to do judo and football, and there's a lot of dancers in Brazil … I've always enjoyed dance very much … But it wasn't until*

I was about 17 … I had a girlfriend who used to be a ballet dancer and I went to see her… the shows and found that I know I can do this, just by looking at it. I know I can do this, if I'm given the training I know I can do it.

Participant K:
One Christmas …we all went to a pantomime and in the middle of the pantomime there was like a bit of a dance excerpt. Everyone was running around, having a real good time, the music was fab and … I just said, mum I want to go and do that….and as we were going out, there's someone giving out leaflets with the ballet teacher's name … and that was it, started. I think I did gymnastics first actually, I think, but I can never remember anything about that. Just that fizzled out as soon as I started doing the ballet.

Participant I:
I was about 7 or 8 and I saw Singing in the Rain with Gene Kelly and I decided I wanted to move like that. I wanted to dance like that. I don't come from a theatrical background remotely really. My sister, like a lot of little girls, went to ballet. That was a good starting point in terms of my ambitions so I went along to join the local ballet school in Essex … I did ballet. It was the most challenging of all of the dance forms, I thought. I got very excited about … through the sort of physicality of it. Could I jump higher each week, could my leg go high, could I turn more? … I was an active athletic young man and it made me a better sportsman and a better athlete, the training I was doing

In all three accounts there are two common factors: firstly each boy was initially turned on to dance by watching somebody else *"I want to do that", "I know I can do that"*; and secondly, all the interviewees were already engaged in athletic physical activities. It is as if whilst the contemporary dancers (two of whom are also male) went on an inward journey of embodied consciousness, ballet drew out the external performance and energy drivers of the three men concerned – although the last speaker went on to describe his excitement at discovering the interpretative dimensions of ballet later in his development.

This raises interesting questions neurologically: are there different processes happening in the psychological development of ballet and contemporary dancers? Is ballet indeed more about seeing/doing (hence a better scientific preparation for mirror neuron studies) whilst contemporary forms are more about feeling/doing? Are both in

fact different facets of embodied ways of being? This leads to my next exploration: how dancers learn.

DANCERS LEARNING, INJURY PREVENTION AND RECOVERY

At the beginning of this study I started from the proposition that mirror neuron science may not be a remarkable concept for dancers as it may simply provide a scientific tool for harnessing what dancers already know intuitively. I put this question to all my interviewees and also in the questionnaire – the response was a fairly conclusive 'yes' – in that dancers all recognise the close relationship between watching and doing from an early stage in their training – although this may be an embodied knowledge - as one said *"they may know it… but they may not know they know it" (Participant I)*

Responses across the interviewees on how this worked for them individually learning steps or longer sections of dance, varied. Some can see a routine, then stand up and repeat the steps, suggesting that for some, motor familiarity can be established quickly through vision into simulation.

Others would need to physically simulate the steps whilst watching somebody else and then work alone, for the pathways to become established. Some of these dancers spoke more about a process of 'owning' the movement.

Checking back through interview transcripts, it tends to be the dancers who spoke more passionately about emotional engagement or complex meaning who said they had less capacity to reproduce purely after watching. A hypothetical interpretation would be that the more the mirror neurons work with the areas of brain concerned with emotions (a less well charted relationship anyway), the less efficiently they operate in terms of pure simulation – possibly the mirror system as a 'cold' system works optimally when unimpeded by the emotionally responsive 'hot' systems. Further research into this speculation could prove valuable for the dance field.

This may also connect with the theme of stress and relaxation as a context for learning. Two dancer-choreographers spoke of the importance of removing pressure to optimise learning:

Participant C:
I guess it's to do with being comfortable as well. I think if a dancer's under pressure you learn less than if you're comfortable and can somehow visualise the movement better and remember it.

Participant M:
the best way to learn is to relax… relax in the face of what you have to learn

An over concentration on detail, and pressure to get it right, can perhaps interrupt the embodied dilation which enables the quality of movement to be transmitted. Many interviewees spoke about the feeling of the movement as equally or more valid as a purely visual processing of what is taking place:

Participant C:
you know ... you're teaching and you look at a movement and somehow you think ... that doesn't look right because it ... you know ... in my head it doesn't feel right.

Again, returning to mirror neurons, there may be an optimal part of the brain for dancers to process learning, which integrates the visual and motor systems, and this may be different for different dancers or for the work of different choreographers.

Many interviewees, when asked whether they recognised the value of mirror neuron science in their learning, talked about visualisation techniques they used in the studio – for injury recovery and prevention; for learning complex or unfamiliar movement; and for improving performance. In this area, many links with the training of athletes were suggested, and a number were using techniques promoted by sports psychologists. Whilst visualisation is different to observation – the neuroscientists consider it a separate process – clearly there is a perceived connection among dancers which may prove significant, if tangential, in the mirror neuron debate.

Dancers' rehabilitation and recovery from injury has been identified by Patrick Haggard[63] as a potential benefit resulting from greater knowledge around mirror neurons. If motor programmes can be learned or maintained by watching as well as by doing, then dancers can keep them neurally exercised, and retain repertoire whilst

injured, by watching others perform. Also, as one dancer suggested, the same science might be helpful in correcting physical habits which cause repetitive strain leading to injury – by watching a movement performed correctly, a dancer's motor programme might be able to incorporate the adjustments needed. There are interesting implications in terms of pedagogy here, particularly in the context of conservatoire training, where student progression requires an 80% participation rate. There is some evidence to suggest that in order to avoid repeating a year, dance students continue to dance through injuries instead of sitting out in class.[64] If observing other dancers could be in the future be accepted as a valid way to develop learning and skills, it could assist the injury and recovery rate of dancers at an early stage of their careers.

It should be observed that all the dancers interviewed (one of whom was injured), when talking about this area, returned to the subject of visualisation techniques they were using or had used. This suggests that there is as yet a difficulty in understanding the potential benefits in the act of simply watching – perceived as a passive activity in terms of the conscious mind. It may be difficult for dancers, like others, to accept that something could be happening without a conscious process of engaging the brain.

CHAPTER 6:

MIRROR NEURONS AND THE FUTURE: TO BOLDLY GO…

The final section of this part of the essay deals with where mirror neuron science may take us in future if V S Ramachandran's assessment of their importance proves founded. I asked all my interview subjects whether they could see the relevance of this science for the future. They broadly fell into three groups: a small number who felt it was too arcane and specialist to be of interest beyond the scientific community; those who saw great potential for the science within the dance profession, in many of the areas I have covered in the second part of this essay (learning, injury recovery, informing choreographic practice); and those who could see the potential to shift the position of dance and the concept of the embodied self within society. This final section will deal with the observations and vision of this third group.

A common theme which has already been opened is the difficulty that people watching dance – especially those for whom it is not an established habit – have in 'trusting' the levels on which they can best engage with it. One choreographer immediately saw the potential for a society whose perspective had gradually been shifted by mirror neuron science to be more open to watching dance on a different level:

> *Participant B:*
> *…looking at it from a different perspective, from a totally visual and emotional response, and the fact is that it does do that, but it can't do that when you're still trying to understand rationally… I think that could be hugely important in turning audiences over and in turning audiences onto what they can actually respond to. Because that is the level actually it's supposed to work on*

It is worth noting how this echoes a quotation from John Martin:

> The intellect is manifestly the wrong receiving instrument for that which by its very nature excludes rational statement, for it must thereby also exclude rational reception and perception [65]

The idea of trust was one which recurred among those who saw the potential impact – the residual skew of Cartesian rational thought (or theory theory) needing the evidence of science to re-implant a trust in embodied engagement with a physical expressive form.

But it is not just in being a member of a dance audience that the wider potential lies. The whole acceptance of a physical level of expression as something which is part of a balanced society:

> *Participant M:*
> *For me, what this research can do… it's for how it's [dance] received and perceived. ... maybe that's what it is ... it should make the people who make dance … more confident to realise that what they do is not … isolated, it's a specialism of something that everyone does…*
> [Question: The way that a very good chef would perform?]
> *Yes, yes we all need to cook. Yes. But we also respect and know that there's a huge skill… the impact on the specialist should be that they are also more confident and therefore generous perhaps, in feeding what they do back into the more general version of it.*

Indeed, it could even become something which is expected, required to be a well rounded member of society:

> *Participant N:*
> *… perhaps one day when people are looking at a CV for Chief Execs or heads of big corporate organisations, they will look at their CV … and question oh you haven't done any dance, why not? … I mean, that would be the imaginative shift, because they would recognise that someone who wasn't in touch with their body or with their creative side... you might see it as a gap.*

These comments envisioned a future which might look back on Cartesian mind/body dualism in society as a 'dark ages' where society suffered a deficit – but to imagine such a future requires not just thinking differently, but a different sort of thinking. It is perhaps why only a small number of those interviewed could project such a possible future, but why those who could were able to speak with a well formed vision – which again turned to education as the lynchpin for change.

> *Participant M:*
> *I think the impact will be that the more we can begin to understand at a rational level, then… dance on the curriculum … we'll wonder why it wasn't there all along, and … if it feeds in at that level then … the role that arts play in society will be huge and sort of inevitable*

And from there, the science as a validation for something which can only ultimately be understood through empirical experience, provides an elegant contribution to the neuro-reductionist debate:

> *Participant M:*
> *I don't think I can explain to people why dance works in that way … unless I can create an environment in which people actually experience that for themselves, it's only going to be ever sort of notional, but … this scientific language gives an explanation. It won't make people feel it, but it might give them a language which justifies them having a go.*

CONCLUSION AND WHERE NEXT?

Given the exploratory, speculative character of this essay, it has inevitably raised more questions than it has answered. In exploring the creative and scientific interface, it has scratched the surface of some of the most profound questions about the brain and art which, ultimately are about what makes us human – and whether we are fulfilling that human potential.

I set out to examine a continuum from the Ancient Greeks, via John Martin, to the discovery of mirror neurons. I believe that continuum has been established, with mirror neurons considered the brain basis for the concept of metakinesis in a motor sense. However, the science still leaves some gaps and potential pitfalls in the relationship between the motor/visual functions and the relationship with the emotions – the secret of our dancing souls is (some would say thankfully) still hidden from science, for now.

FURTHER STUDIES

During the development of the core themes of this essay there have been a number of subjects in which key lines of enquiry have been identified, but could not be developed within the scope of this study. These could however form the basis for further studies:

- **Aesthetics and the pleasure principle**. What makes movements pleasing to individuals. This would be an interesting science-art study which could have convergent – or divergent - endpoints in both fields.

- **Risk and danger**. Are we living in a society requiring ever more 'extreme' versions of vicarious, or actual, experience and does this inform the need for a sense of risk in performed dance?

- **The brain relationship between mirror neurons, emotional engagement and music**. Are these systems connected or separate? Which system predates which in the human brain? And do emotional responses to

music have a different evolutionary function to emotional responses to movement?

- **Psychological differences between ballet and contemporary dance**. Is ballet more about seeing/doing, while contemporary is more about feeling/doing? How does this relate to mirror neuron function and embodied experience?

- **Further exploration of the relationship between mirror neuron function and emotions**. Do action observation and simulation functions work as 'cold' systems, and are they more functionally effective when not engaged with the emotional engagement system? Further testing of the pattern among my small sample of dancers where motor simulation seemed to perform less effectively among dancers with high emotional engagement.

Further studies could also be broadened to include research among people beyond the dance profession – dance attenders and non-attenders – to gauge whether mirror neuron science might alter their feelings about dance as an art form.

FUTURE APPLICATION?

Areas where this and future studies might have useful application include:

Body language and presentation skills training already both feature significantly in personal effectiveness training for managers and leaders in all walks of life. I am interested to use some of the findings of this study to develop the concept of Physical Leadership – an embodied approach to communication and interpersonal actions by those who need to transmit authentic accounts of their vision, empathy, emotions and intentions to those they need to influence or lead.

A possible future where mirror neuron science has started to shift the relationship between mind and the moving body in society, could contribute significantly to scenario planning for the dance sector – looking at both how the sector can actively contribute to and hasten the shift, and what the benefits might be.

As previously mentioned, there have been, and continue to be a number of science-art initiatives where collaboration has shown benefits for both scientists and artists. However, there continues to be a clear division between scientific and artistic end-points – it would be useful if this study could inform future projects with genuinely convergent purposes.

Finally, I would return to my earlier observations on the embodied nature of this subject area, and the inevitable limitations of a purely academic, written text. I would hope that a future study could include expansions and illustrations through video, live performance and studio investigations.

Tessa Gordziejko
August 2007

NOTES

[1] See Appendix 1 for profiles of participants

[2] See Appendix 2 for background information given to participants

[3] J Martin (1933) *The Modern Dance*, Princeton Book Company p12

[4] From J Martin (1946) *The Dance*, exerpt in ed R Copeland & M Cohen (1983) *What Is Dance*, Oxford University Press p22

[5] Martin (1933) p13

[6] Ibid. p13

[7] V S Ramanchandran *Mirror Neurons*, Edge (accessed 28/9/07): http://www.edge.org/3rd_culture/ramachandran/ramachandran_p1.html

[8] H Thomas (1995) *Dance Modernity and Culture*, Routledge p2

[9] H Thomas (2003) *The Body, Dance and Cultural Theory*, Palgrave MacMillan

[10] Opening address by Sir Ken Robinson at National Arts & Education Symposium, 'Backing Our Creativity', Melbourne, 13 September 2005. This is a short-hand for a reduction of attention to physical learning, although it could be read to assume that dance is narrowly a bi-pedal mode of activity (not I believe the intention).

[11] Calouste Gulbenikian Foundation: Report of *Mind,Brain and Performance*, a one day symposium held at Sadlers Wells 7 November 2006 p3

[12] Ibid.

[13] I recognise that there is a debate ongpoing across the fields of ethnography, anthrology, sociology, psychiatry and cognitive science on 'Neuro-reductionism' - whether cultural, social and psychological processes can be expressed primarily as neuronal ones and the perceived resistance to attempting this. See E Martin Talking Back to Neuron Reductionism in H. Thomas and J. Ahmed (eds) Cultural Bodies: Ethnograhy and Theory (2004)

[14] Thomas (2003): for example, see p5 on subjectivities in studies on rave culture and p45 on Foucault and social phenomenology

[15] Martin (1933) P6

[16] J Martin (1965) (in 1989 reprint) *The Dance in Theory*, Princeton Book Company p1

[17] Ibid.

[18] Martin (1933), p8

[19] Ibid. p37: "The senses are channels by means of which contact is established with the outside world. The beauty which serves to fill them only impedes this contact"

[20] Martin (1965) - Introduction by J Anderson (1989) px

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[21] Ibid. p xv: "if Martin's categories are unnecessarily limiting, his concept of kinetic transfer may still be valid"

[22] Martin (1933) pp14-15

[23] Martin (1933) p48

[24] R Copeland and M Cohen's (ed) *What Is Dance?* All these writers are included in this 1983 anthology of dance writing, and Martin is referenced by the editors in their introductions to four out of seven sections.

[25] B Kinstat transcript of *What was this about John??* at Symposium about the theory and critique of the contemporary dance, International Conference on Contemporary, Bytom, Poland June 1998. http://www2.arnes.si/~ljintima2/kunst't-john.html

[26] A Michelson (Spring 2001) *A World Embodied in the Dancing Line*, OCTOBER 96 magazine, pp3-16

[27] S Manning: *Modern Dance, Negro Dance: Race in Motion* (June 2005) *Journal of American History* Vol. 92, No. 1 pp. 267-268

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[41] Dance UK website: http://www.danceuk.org/metadot/index.pl?id=22529&isa=Category&op=show – referencing participatory dance activities

[42] H Thomas (2003) P177, referencing B. Malbon (1999) *Clubbing: Dancing, Ecstasy and Vitality* pp7-9

[43] H Thomas (1995) pp 9-10

[44] Ibid. p4

[45] Thomas (1995) p211, referencing Malbon (1999)

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[46] It is perhaps interesting to juxtapose Ken Robinson's observation with the obsession with the (predominantly female) body in consumer culture, which indicates a different kind of physical obsession. Commercially driven, the obsession is almost entirely with static images (usually digitally manipulated) of perfection to which the reality of the moving, un-posed body cannot possibly correspond.

[47] Government Response to the Culture Media and Sport Report on Arts Development: Dance (HC587) Session 2003-2004

[48] C Deby (March 2005) *The UK Dance Industry: A Guide for Canadians*, The Canadian High Commission &The Department of Canadian Heritage

[49] In March 2001 the Arts Council announced a £3.2 million increase over two years for dance companies and organisations within it's portfolio.

[50] Dance UK Website, sourced from: Inquiry into Dance published by the Culture Media and Sport Committee (2004) http://www.danceuk.org/metadot/index.pl?id=22529&isa=Category&op=show

[51] C Deby (2005) as above – quoting Association of National Dance Agencies research into contemporary dance audiences in England

[52] Ibid. – quoting British Market Research Bureau's *Target Group Index* (1995/96 + trends analysis 1987-1996) – the figure has been adjusted to account for the growth rate in audiences overall quoted earlier (11% above base population growth)

[53] Council for Physical Recreation figures quoted on Dance UK website

[54] Inquiry into Dance – Culture, Media and Sport Committee (2004)

[55] J Siddall (March 2001) *21st Century Dance*, Arts Council of England

[56] Ramchandran: The Edge

[57] Proposed by N Humphrey and S Baron-Cohen in a number of works

[58] M Clark (21/2/06) *Scotch Eggs with a Difference*: A report on 'Ethics of Cloning' – the first Biomedical Ethics Film Festival - held at the Filmhouse, Edinburgh on 11–13 November 2005 as part of European Science Week. http://genome.wellcome.ac.uk/doc_WTX033937.html

[59] Delsarte also strongly influenced Isadora Duncan with his teaching which was based on extensive research into gesture – studying human movement and facial expression to the minutest detail. Martin wrote: 'To him the crime of crime was a gesture without a meaning'

[60] The question of whether what is observed/transmitted is the choregrapher's or the dancer's intention is a complex one. I believe it will be different in a range of contexts – for example the dancers quoted here are all dance artists mostly making their own work. However, as the quotation from Participant B recorded earlier shows, the relationship between the choregrapher and dancers is often one of disclosure so that the choregrapher's intention becomes translated into the dancer's own emotional drivers.

[61] My earlier comments about the uniqueness of each engagement between an individual audience member and the performance notwithstanding, the potential benefits in this case lie with the ability to understand group response (for example does a certain section or gesture carry the same emotional resonance or meaning for different cultural groups).

[62] A concept developed by Jerzy Grotowski and Eugenio Barber, for example in J Grotowski (1968) *Towards a Poor Theatre*, where the actor's awareness, energy and presence is intensified to heighten expressive power and audience focus.

[63] Professor Haggard is an Adviser to the Royal Ballet

[64] This statement is based on initial findings from Helen Thomas's research on dance injuries http://www.danceinjuries.org/initial_findings

[65] Martin (1933) p37

Front Cover Images

Students Watching Dance Demonstration 1980, Guanghzhou Ballet School, China
Photo : King Douglas

Chistophe Dozzi,Vaclav Kunes and Jose Tirado in 'Kazahana'
Photo : Sakee Oguma

APPENDIX 1 : PROFILE OF INTERVIEWED PARTICIPANTS

Each participant is described in terms of background, gender and professional details, whilst retaining their anonymity. Definitions of nationality are only specified where these were given by the participants themselves within the course of the interview, and is therefore considered relevant. Participants were not asked to define either their nationality or ethnicity as a routine part of the interview.

Participant A :
Chief Executive of regionally based, UK and international touring ballet company – not a dancer, earlier background in production management. Male.

Participant B :
Artistic Director of regionally based, UK and international touring ballet company, of USA origin. Choreographer and former principal dancer. Male.

Participant C :
Ballet Master of regionally based, UK and international touring ballet company, until recently a principal dancer. Of Brazilian origin. Male.

Participant D :
Dancer in regionally based, UK and international touring ballet company, of French origin. Female.

Participant E :
Dancer in regionally based, UK and international touring ballet company. Female.

(Participants D and E were interviewed together)

Participant F :
Director of Education in regionally based, UK and international touring ballet company, of Dutch origin. Trained in contemporary dance. Female.

Participant G :
Director of Education in regionally based, venue based, UK and international touring ballet company. Formerly a ballet teacher. Female.

Participant H :
Student on placement to Education department of regionally based, venue based, UK and international touring ballet company. Female.

Participant I :
Former dancer in regionally based, venue based, UK and international touring ballet company, now working in the Education department and freelance, running a dance group of people with profound learning disabilities. Male.

Participant J :
Dancer in regionally based, venue based, UK and international touring ballet company.

Participant K :
Dancer in regionally based, venue based, UK and international touring ballet company. Male.

Participant L :
Independent dance artist and choreographer originally trained in medicine. London based. Working in Bharata Natyam and contemporary styles. Female.

Participant M :
Independent dance artist and choreographer came to dance after doing first and post graduate degrees at Oxford. Based in London and Dublin. Working in contemporary styles. Irish, male.

Participant N :
Independent dance artist and choreographer, also an Associate Tutor at the Royal Ballet School and a Board member of the Royal Opera House. Trained in ballet and contemporary. London based. Male.

Participants were interviewed in London, Birmingham and Yorkshire between 7th June and 5th July 2007. Interviews lasted between 30 - 40 minutes, with the exception on Participants M and N, with whom interviews were in excess of an hour. Interviews were digitally recorded and transcribed.

Four completed questionnaires were received – two from interviewees.

APPENDIX 2 : BACKGROUND READING GIVEN TO PARTICIPANTS

CELLS THAT READ MINDS

From NYT report Jan 10 2006

On a hot summer day 15 years ago in Parma, Italy, a monkey sat in a special laboratory chair waiting for researchers to return from lunch. Thin wires had been implanted in the region of its brain involved in planning and carrying out movements.

Every time the monkey grasped and moved an object, some cells in that brain region would fire, and a monitor would register a sound: brrrrrip, brrrrrip, brrrrrip.

A graduate student entered the lab with an ice cream cone in his hand. The monkey stared at him. Then, something amazing happened: when the student raised the cone to his lips, the monitor sounded - brrrrrip, brrrrrip, brrrrrip - even though the monkey had not moved but had simply observed the student grasping the cone and moving it to his mouth.

The researchers, led by Giacomo Rizzolatti, a neuroscientist at the University of Parma, had earlier noticed the same strange phenomenon with peanuts. The same brain cells fired when the monkey watched humans or other monkeys bring peanuts to their mouths as when the monkey itself brought a peanut to its mouth.

Later, the scientists found cells that fired when the monkey broke open a peanut or heard someone break a peanut. The same thing happened with bananas, raisins and all kinds of other objects.

"It took us several years to believe what we were seeing," Dr. Rizzolatti said in a recent interview. The monkey brain contains a special class of cells, called mirror neurons, that fire when the animal sees or hears an action and when the animal carries out the same action on its own.

In humans, mirror neurons are much smarter, more flexible and more highly evolved than in monkeys, scientists have found, and they appear to be involved not only in actions but in intentions and emotions—the things that make humans social animals. When a person watches someone else perform an action—say a kick—mirror neurons in the brain simulate the action and provide a template for anticipating what will happen next.

Mirror neurons are at their best when humans are face to face. But at least one study found that the cells, along with several brain areas involved in aggression, were activated when children watched a violent television program. That activation increased the chances that the children would behave aggressively minutes or hours later.

"We are exquisitely social creatures," Dr. Rizzolatti said. "Our survival depends on understanding the actions, intentions and emotions of others."

He continued, "Mirror neurons allow us to grasp the minds of others not through conceptual reasoning but through direct simulation. By feeling, not by thinking."

Found in several areas of the brain - including the premotor cortex, the posterior parietal lobe, the superior temporal sulcus and the insula - they fire in response to chains of actions linked to intentions.

Studies show that some mirror neurons fire when a person reaches for a glass or watches someone else reach for a glass; others fire when the person puts the glass down and still others fire when the person reaches for a toothbrush and so on. They respond when someone kicks a ball, sees a ball being kicked, hears a ball being kicked and says or hears the word "kick."

"When you see me perform an action - such as picking up a baseball - you automatically simulate the action in your own brain," said Dr. Marco Iacoboni, a neuroscientist at the University of California, Los Angeles, who studies mirror neurons. "Circuits in your brain, which we do not yet entirely understand, inhibit you from moving while you simulate," he said. "But you understand my action because you have in your brain a template for that action based on your own movements.

"When you see me pull my arm back, as if to throw the ball, you also have in your brain a copy of what I am doing and it helps you understand my goal. Because of mirror neurons, you can read my intentions. You know what I am going to do next."

He continued: "And if you see me choke up, in emotional distress from striking out at home plate, mirror neurons in your brain simulate my distress. You automatically have empathy for me. You know how I feel because you literally feel what I am feeling."

In a study published in March 2005 in Public Library of Science, Dr. Iacoboni and his colleagues reported that mirror neurons could discern if another person who was picking up a cup of tea planned to drink from it or clear it from the table. "Mirror neurons provide a powerful biological foundation for the evolution of culture," said Patricia Greenfield, a psychologist at the U.C.L.A. who studies human development.

Until now, scholars have treated culture as fundamentally separate from biology, she said. "But now we see that mirror neurons absorb culture directly, with each generation teaching the next by social sharing, imitation and observation."

Still, there is one caveat, Dr. Iacoboni said. Mirror neurons work best in real life, when people are face to face. Virtual reality and videos are shadowy substitutes.

The ability to share the emotions of others appears to be intimately linked to the functioning of mirror neurons, said Dr. Christian Keysers, who studies the neural basis of empathy at the University of Groningen in the Netherlands and who has published several recent articles on the topic in Neuron.

When you see someone touched in a painful way, your own pain areas are activated, he said. When you see a spider crawl up someone's leg, you feel a creepy sensation because your mirror neurons are firing.

People who rank high on a scale measuring empathy have particularly active mirror neurons systems, Dr. Keysers said.

Social emotions like guilt, shame, pride, embarrassment, disgust and lust are based on a uniquely human mirror neuron system found in a part of the brain called the insula, Dr. Keysers said. In a study not yet published, he found that when people watched a hand go forward to caress someone and then saw another hand push it away rudely, the insula registered the social pain of rejection. Humiliation appears to be mapped in the brain by the same mechanisms that encode real physical pain, he said.

Art exploits mirror neurons, said Dr. Vittorio Gallese, a neuroscientist at Parma University. When you see the Baroque sculptor Gian Lorenzo Bernini's hand of divinity grasping marble, you see the hand as if it were grasping flesh, he said. Experiments show that when you read a novel, you memorize positions of objects from the narrator's point of view.

Professional athletes and coaches, who often use mental practice and imagery, have long exploited the brain's mirror properties perhaps without knowing their biological basis, Dr. Iacoboni said. Observation directly improves muscle performance via mirror neurons.

Similarly, millions of fans who watch their favorite sports on television are hooked by mirror neuron activation. In someone who has never played a sport - say tennis - the mirror neurons involved in running, swaying and swinging the arms will be activated, Dr. Iacoboni said.

But in someone who plays tennis, the mirror systems will be highly activated when an overhead smash is observed. Watching a game, that person will be better able to predict what will happen next, he said.

For more on Mirror Neurons go to : http://www.pbs.org/wgbh/nova/sciencenow/3204/01.html

Research Update

Daniel Glaser's Latest Study With Ballet and Capoeira Dancers

If you're skilled at a physical activity like ballet, the part of your brain that controls movement activates differently than the same part in the brain of someone who's not skilled in that activity. That's what researchers at the University of College London (UCL) have found in a fascinating new study. The study has implications for helping injured athletes continue to train without moving a muscle, and perhaps even helping stroke victims regain lost movement.

In the UCL study, dancers from London's Royal Ballet and experts in capoeira, a Brazilian martial arts form, were asked to watch short videos of either ballet or capoeira dancers performing brief

dance moves. While watching the videos, the dancers were lying perfectly still in an MRI scanner. A control group of non-dancers also participated in the study, which was published in the December 2004 online edition of *Cerebral Cortex*.

The researchers found that areas of the brain collectively known as the "mirror neuron system" showed more activity when a dancer saw movements he had been trained perform than when he observed movements he hadn't been trained to perform. (All the dancers in the study were male.) The mirror system in the non-dancers showed appreciably less activity while watching the videos than either of the dancers' mirror systems, and the response it had was the same whether it was watching ballet or capoeira.

Earlier studies with monkeys revealed that brain cells called mirror neurons respond both when we do something, like pick up an object, and when we simply watch someone else do it. It was known that these neurons fire when we perform an action, but it came as a surprise that the same cells also fired when we only saw that action being performed. The new study went a step further by showing that such a system operates differently depending on what you are physically expert at doing.

"This is the first proof that your personal motor repertoire, the things that you yourself have learned to do, changes the way that your brain responds when you see movement," says Daniel Glaser, a neuroscientist who was part of the UCL team.

"Our findings suggest that once the brain has learned a skill, it may simulate the skill without even moving, through simple observation," says UCL's Patrick Haggard. "An injured dancer might be able to maintain his skill despite being temporarily unable to move, simply by watching others dance." Similarly, by understanding how the mirror neuron system works, doctors may be able to better rehabilitate people whose motor skills were damaged by stroke.—*Peter Tyson*