

Institution: University of Roehampton
Unit of Assessment: Panel A, UoA 3 Allied Health Professions, Dentistry, Nursing and Pharmacy
Title of case study: Biomechanics of Ageing, Parkinsonism and Dance
<p>1. Summary of the impact</p> <p>This case study details the impact of research on the biomechanics of ageing, and the translation of novel methods developed in this research into clinical applications for Parkinson's disease. Our work, commissioned by and developed with English National Ballet (ENB), has raised the profile of dance as a novel health intervention, promoting the health of patients and facilitating the public services of ENB. The reach of our impact is international, and includes a wide range of beneficiaries including Parkinson's patients, dance and health professionals, the general public, ENB and other dance organisations. The significance of our work is indicated by the profound differences it has made to the beneficiaries, awards that the project has received, and the substantial press coverage it has attracted.</p>
<p>2. Underpinning research</p> <p>Ageing research at the University of Roehampton, which underpins the impact reported in this case study, is undertaken by academic staff in the Department of Life Sciences (Prof Lee, Professor of Biomechanics, 2008 to date; and Dr Strike, Principal Lecturer, 2000 to date) and in the Department of Dance (Dr Houston, Principal Lecturer, 2009 to date; and McGill, Senior Lecturer, September 2009 to date). This ongoing, inter-disciplinary programme of research is led by Lee, and has been undertaken since 2008. It has evolved in two distinct stages.</p> <p>The first stage of research examined how ageing affects the physical functions of the body and how physical activity may enhance the health of older people. We conducted a correlational study that examined the various biomechanical determinants of the age-related changes in muscle strength (Singh et al., 2013). It showed that muscle strength continues to decline with age in people aged 65 and above. The posture of the body and the architecture of the muscles were also found to influence muscle strength significantly. These results have provided new insights into the functional capacity of older adults. The focus of exercises for older people should not be building strength, but their physical functions may be exploited to full potential by using exercises that can help improve their posture and mobility. It is suggested that dance, as a form of physical activity, may be a suitable clinical intervention for older people, including specific patient groups such as those with Parkinson's, who often suffer from postural problems such as trunk rigidity. We have developed a novel technique of assessing trunk mobility and motion irregularity (Williams et al., 2013), which has been used to assess the trunk functions of Parkinson's patients in the second stage of this research programme.</p> <p>It is well recognised that physical activity is essential to musculoskeletal health. Functions of bones and muscles are dependent on the mechanical signals transmitted through the body. We have been studying these mechanical signals during various forms of physical activity. They are difficult to measure as any external skin-mounted sensors will be subjected to soft tissue deformation. However, we have developed a new technique of measuring these mechanical signals by taking into account the physical characteristics of the soft tissues (Morgado-Ramirez et al., 2013). As a result of this technological development, we are now able to explore the mechanisms of how physical activity may affect musculoskeletal health.</p> <p>The second stage of our research directly applies the novel measurement techniques developed in the first (e.g. trunk mobility assessment, physical activity monitoring), and the findings of our research (e.g. the influence of posture on muscle functions), to examine how a specific form of exercise - in this case, dance - may help improve the functions of patients with Parkinson's disease, a clinical condition more commonly seen in older people.</p> <p>The research shows that dance can bring about improvement in trunk motion quality, postural balance and stability. It is also associated with intellectual, artistic and social benefits (Houston and McGill, 2013). This second part of the research programme won the Vitality for Life Prize awarded</p>

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by the BUPA Foundation, recognising the quality and the significance of the work. This project is continuing, with funding support from BUPA (as part of the award) and the English National Ballet (ENB). It is using a mixed-methods approach, including experimental measurements and interviews, to study the effects of dance on the motor functions of Parkinson's patients, and how the improvement in motor functions is related to the performance of everyday activities, quality of life and the psychological benefits.

3. References to the research

1. Singh DK, Bailey M and Lee RYW (2013) Decline in lumbar extensor muscle strength the older adults: correlation with age, gender and spine morphology. *BMC Musculoskeletal Disorders* 2013, 14:215. DOI: 10.1186/1471-2474-14-215
2. Williams JM, Haq I and Lee RYW (2013). A novel approach to the clinical evaluation of differential kinematics of the lumbar spine. *Manual Therapy*. 18(2):130-5. DOI: 10.1016/j.math.2012.08.003
3. Morgado-Ramirez DZ, Strike S and Lee RYW (2013). Measurement of transmission of vibration through the human spine using skin-mounted inertial sensors. *Medical Engineering and Physics*. 35(5):690-5. DOI: 10.1016/j.medengphy.2012.12.013
4. Houston S and McGill A (2013) A mixed-methods study into ballet for people living with Parkinson's. *Arts and Health*. 5(2):103-119. DOI: 10.1080/17533015.2012.745580

The research has been supported by the BUPA Foundation (Vitality for Life Prize Award, £15K) and the English National Ballet (£10K).

4. Details of the impact

The main non-academic beneficiaries of this case study include (1) older people, Parkinson's patients and their carers, (2) health professionals (e.g. physiotherapists) and professional dance teachers, (3) user groups (e.g. UK Dance for Parkinson's Network) and (4) English National Ballet (ENB), which is funding our research and is our active research partner.

The underpinning research has generated a wide range of significant impact including:

- developing dance as a novel physical activity intervention in the management of Parkinsonism;
- collaboration with charities/dance organisations, enhancing and facilitating their public services, and;
- promoting the benefits of dance for Parkinson's sufferers, which has raised awareness among the general public, Parkinson's patients, and health professionals about the benefits of dance.

The research into ageing started to generate impact through the Shape Arts event called "Specimens to Superhumans" which was funded by the Wellcome Trust Public Engagement People Award. This event was held in September 2011 (source 1, section 5), and provided initial dissemination of the findings of the underpinning research to over 80 people who were professional dancers, elderly dancers, dancers with disabilities, choreographers, and digital artists. It explored what elderly dancers could do, despite the decline in motor functions, in order to to unlock their body's potential and perform to full capacity. The event included workshops, demonstrations, and data capture using video analysis and skin-mounted sensor technologies that we have developed in our research. Six participants of the above event were invited to attend focus group meetings in June 2013. They reported that one key impact of the event was to motivate them to continue to engage in dancing, despite ageing. The event also allowed us to further develop dance as a novel form of physical activity intervention, and to look at how it may bring benefits to older people and specific clinical populations such as those with Parkinson's.

A major pathway to impact has been through the partnership with the English National Ballet

(ENB), which is also a key beneficiary of our research. Our research has influenced ENB in building a Dance for Parkinson's programme, which is now one of its public services. The ENB has benefited from this knowledge transfer by successfully acquiring funding support from the Paul Hamlyn Foundation (£97K). Some of the funds (£10K) were used to support our ongoing research to study the effects of dance on Parkinson's, and the remaining funds used to develop more dance programmes in various cities in the UK. The ENB project involves the use of techniques that we have already established in our laboratory to look at how dance influences motor function and everyday activities of Parkinson's patients. The underpinning research has provided data about the benefits of dance, and the ENB project allows the translation of these findings to reach a wider community of beneficiaries.

The significance of the impact has not only been recognised by the BUPA Foundation and the Paul Hamlyn Foundation, but can also be demonstrated in the many positive comments of the participants in, and blogs associated with, the ENB project (see sources 4-8). They show how the programme has increased the awareness of the public of the physical and psychological benefits of dance, and how it has improved the perception of the Parkinson's patients about what they can do, their health and well being, making a real difference to their lives. A support worker of Parkinson's UK commented that the project "has made my job much easier", and "has had a profound effect on the participants in so many areas – and not just the mobility issues for the hour and a half they're in the studio ... and that's priceless." (source 9)

An indicator of the reach of the project is that more than 100 Parkinson's patients have already directly benefited from the dance programme, showing significant improvement in their physical and psychological well-being. The programme is rapidly expanding, and we are now increasing our areas of coverage from London to many other parts of the UK such as Cardiff, Liverpool and Oxford. The reach of the impact is not limited to those who participated in the ENB programme, but includes also patients, dancers and health professionals in many overseas countries. Our report, published by the ENB ('Dance for Parkinson's'), has received international attention (source 10). We have received more than 45 requests for full details of the report from dance teachers and health professionals in Canada, USA and Australia, seeking advice about the research methodology and pedagogic tools for the dance classes.

Our work has not only benefited the ENB but also many other organisations. For instance, the Hamilton City Ballet, Canada, has referenced our work and, based on our framework, secured funding to start its own programme. Their programme manager pointed out that "it has played a crucial role in the success of Hamilton City Ballet's preparation to launch our own programme" (source 11). The Queensland Ballet is planning to launch similar programmes, and has requested our research team member Houston to act as a member of their Advisory Board. The Jewish Family and Children's Service, Boston, USA, is also seeking help to launch their dance programme. It commented that our work "is extremely interesting and very applicable" (source 12). Moreover, in the past, there has generally been a lack of interest among therapists to use dance as a therapeutic intervention; however, as a result of our high-profile research, the Chartered Society of Physiotherapy has referenced our work, and physiotherapists have started to use dance in their clinical work (source 2).

In order to ensure that the various beneficiaries identified above fully understand the benefits of dance and promote its use in clinical practice, we have delivered workshops and talks in various cities in the UK (e.g. Cardiff, Bristol, Chesterfield, Oxford and London). A UK Dance for Parkinson's network has been established, through which we contribute to improving the knowledge of the health benefits of dance among professionals (source 3). The collaborative work between ENB and our research team has already attracted much media attention, including the BBC, BBC News online and major newspapers such as *The Telegraph* and *The Daily Express* (sources 4-8). This high-profile coverage extends the reach of the research and impact.

Through the continuing engagement and support of the key stakeholders, including ENB, and the collaboration of professional and patient user groups that we have already established, the impact reported in this case study represents significant and wide ranging benefits of our research to

society.

5. Sources to corroborate the impact

Internet sources

1. http://www.artscatalyst.org/experiencelearning/detail/all_that_happened_to_us/
2. <http://www.csp.org.uk/frontline/article/let%E2%80%99s-dance>
3. <http://www.danceforparkinsonsuk.org/about-us/who-we-are/>

Press media

4. <http://www.bbc.co.uk/news/health-21682196>
5. <http://www.bbc.co.uk/news/uk-england-london-16573752>
6. [BBC Inside Out programme 16 Jan 2012 7:30pm](#)
(http://www.bbc.co.uk/iplayer/episode/b019p4fv/Inside_Out_London_16_01_2012/)
7. <http://www.telegraph.co.uk/health/healthnews/8554887/Dancing-ballet-can-relieve-Parkinsons-symptoms.html>
8. <http://www.express.co.uk/life-style/health/288054/Can-dancing-help-to-tackle-Parkinson-s>
9. <http://www.epda.eu.com/EasySiteWeb/GatewayLink.aspx?allid=24182>

Report

10. Houston S and McGill A (2011) Dance for Parkinson's: an investigative study. English National Ballet.

Testimonial:

11. Programme Manager at the Hamilton City Ballet (Identifier 1).
12. Senior Programme Evaluator at the Jewish Family and Children's Service, Boston, USA (Identifier 2).