

## Basic Movement Video - Analysis of Modern Dance Performance

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### Introduction

Published data (Wyon, 2003) suggest that during modern dance performance the work to rest ratio of 2:1 indicates that more time is spent dancing than resting. This implies a great demand on the aerobic and lactate system to produce the required energy, which could cause an accumulation of blood lactate (Bahr & Gronnerod 1992).

### Methods

Thirty videos of modern dance performances were analysed to calculate the work: rest ratio of each performance and carry out movement analysis. Four fields were assessed every 30 seconds. They included work intensity, transitory, partner and descriptive. The first field provided a qualitative description of the intensity of the dance and the transitory field referred to movement of the dancer's centre of gravity. The partner field referred to any interactions with other dancers. The final field provided a description of the style of dance taking place and involved three pair of options: strong or light, central or peripheral, and quick and slow. Video-analysis was also used to calculate work: rest ratio of the whole performance.

Video - analyses were conducted by one dance expert. The performances from which data were collected varied in time between 17 to 45 minutes (M = 31). Analysis of the results included the use of descriptive statistics.

### Results

As currently not all results have been processed, at the time of the conference these will be discussed in depth.

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# **Dancers and Smoking: Designing and Implementing a Smoking Prevalence Survey**

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Thesis completed in partial fulfillment of MSc Dance Science at the Laban Centre, London

## **Introduction**

Numerous competitive athletes report a very low smoking prevalence (Chmelar, Fitt, Shultz, Ruhling, & Zupan, 1987), yet research into the numbers of dancers smoking is limited. Various factors affect smoking initiation; dance-specific research is needed to determine what factors are relevant to dancers (Clippinger, 1999). This study aimed to establish the percentage of dancers smoking and their reasons for initiation and maintenance.

## **Methods**

The study was divided into two mini studies: Study A collected smoking status percentage data on a large sample of student dancers; Study B designed and piloted a smoking prevalence questionnaire focusing on dancer smoking initiation and maintenance beliefs. Participants completed an evaluation form for the questionnaire. To validate tobacco status reported by participants, carbon monoxide (CO) breath tests were utilised on a sub sample. Descriptive statistics for collected results were calculated with frequency data evaluated by Chi-square analysis. One-way ANOVA served to uncover statistical significance in variables grouped by smokers and non-smokers.

## **Results**

Study A: - Over 60% of student dancers were non-smokers.

- Peer pressure and relaxation are documented as the greatest contributors to smoking initiation.

Study B: - Qualitative analysis showed that the questionnaire fulfilled its objectives.

- Over 40% of professional dancers were non-smokers.
- Over 80% of regular smokers reported that smoking could be beneficial to their dance performance at times.

## **Discussion**

Data collected from both studies indicated that UK professional and student dancers have a higher prevalence of smoking than the US general population of a similar age range. Results compare to recent findings in scientific research involving dancers. However, comparisons must be made with caution due to different wording and formatting. Smoking initiation and maintenance was not contributed to weight control strategies as predicted but to curiosity and enjoyment respectively. There was no difference recorded between smokers' and non-smokers' BMI as expected.

## **Conclusion**

Questionnaires used appear to fulfil objectives, providing information on the percentage of dancers smoking and their reasons for initiation and maintenance. However, to validate the study further it would be beneficial to involve a larger subject pool.

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# Relationship between Q-angle and First Position Turnout in Female Pre-Professional Dancers

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Thesis completed in partial completion of Chiropractic degree  
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## Objective

To further the understanding of turnout by investigating the relationship between Q-angle and turnout. Little research exists documenting the extent to which turnout affects lower limb alignment. Q-angle was used as a standard measurement of alignment.

## Methods

Twenty-three female pre-professional dancers aged 16 to 24 from Rambert, Elmhurst, Royal Ballet School and Tring Arts School took part in the study. Subjects were excluded if suffering from any current or recent injury or pain at the hip, knee or ankle, impairing the dancers' ability to achieve maximum turnout. Maximum first position turnout was measured using Functional Footprints®. Two Q-angle measurements were taken in neutral and full turnout using a standard goniometer. Functional Footprints® consist of two large footprints, each affixed to a platform slightly larger than the footprint itself. The footprints pivot through 360° and a transverse line passes through the axis of rotation. An arrowhead extends level with this line on either side of each footprint. These arrowheads indicate the degrees of turnout on a circular scale. Raw data was recorded on an Excel™ spreadsheet. Data analysis was performed using Excel™ and GraphPad InStat™. Pearson's Correlation was used and the statistical significance was set at 0.05 (95%).

## Results

No relationship was found between Q-angle and maximum first position turnout for either total or individual leg turnout. A trend emerged when comparing the data for Q-angle in parallel and maximum turnout. The greater the Q-angle in parallel, the greater the Q-angle in maximum turnout. A correlation coefficient of 0.7 was found for both right and left legs. This was deemed an extremely significant relationship. Additionally in nearly all subjects, Q-angle was the same or greater in maximum turnout than in parallel. When comparing right and left legs, mixed results were obtained. Comparison of mean turnout showed that average turnout was significantly larger on the right than the left. However, no significant difference was found between Q-angles bilaterally in either parallel or turnout.

## Conclusion

The results show a positive correlation between Q-angle in parallel and turnout. This indicated that, in some subjects, Q-angle was increased in maximum turnout compared to parallel; however, the results are inconclusive. No linear relationship between Q-angle and maximum turnout was detected.

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## Self-Recognition and Dance Action: A Literature Review

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Literature Review from Thesis completed for MSc Dance Science, The Laban Centre, London

### Introduction

There has been growing interest among cognitive scientists to understand motor/proprioceptive function and perception with dancers as participants.<sup>1,2</sup> There has also been increasing interest among dance researchers and artists to explore cognitive science in relationship to dance practice and the choreographic process.<sup>3,4</sup> The purpose of the current literature review was to explore research potential between cognitive science and dance, particularly concerning self-recognition (i.e. imagining a movement or perceiving one's own moving body).

### Results

Johansson's point-light technique showed that humans are good at action generation and recognition ability.<sup>5</sup> Research identifying the mirror system has suggested the same brain mechanisms fire when watching a movement as when performing a movement and the mirror system may play a large part in recognizing biological motion.<sup>6</sup> Self-recognition has been considered a possible means to investigate visual and motor/proprioceptive input related to recognizing biological motion.<sup>7</sup> However, links between action-recognition and self-recognition have received little explicit investigation.<sup>8,9</sup> Dancers utilize self-recognition on a number of levels to acquire, maintain, and advance technique and choreography, among other aspects of the profession.<sup>10</sup> In addition, Western-based dance forms often take place in mirrored studios. Previous research has found that mirrors heighten self-attention and can alter body perception.<sup>11,12</sup>

### Conclusion

This literature review supports an intriguing cross-over between cognitive science and dance, particularly regarding self-recognition, and supports further dance-specific research in this area. Future investigations could provide valuable information for dance training, execution, and the choreographic process.

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# Impact of Joint Hypermobility on the Pattern of Musculoskeletal Morbidity in Young and Older Dancers

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## Methods

Seventy-five student and professional female dancers were seen between 2000 and 2003 in a performing arts clinic. Data were collected on age, diagnosis, hypermobility, and conformity to the 1998 Brighton criteria for Joint Hypermobility Syndrome (JHS) (J Rheum 2000; 27(7):1777-1779). For analysis, dancers were divided into two groups - above or below 30 years.

## Results

Forty-seven 'young' (mean age 22.3 years  $\pm$ SD 3.8; range 15-29 years) and 28 'older' dancers (mean age 44.8  $\pm$ SD 13.8; range 30-78 years) were seen; 42 (89%) and 22 (79%) with JHS respectively. In dancers with JHS, soft tissue injury (ankle/other ligament sprains), arthralgia and back pain predominated, regardless of age; soft tissue injury was more common in younger dancers. In older dancers osteoarthritis (OA), mainly hip, was a common presentation and the predominant finding amongst non-JHS cases. Of note, OA occurred earlier in JHS than non-JHS dancers: mean ages were 55 (sd 9.4, range 41 – 67) and 62.3 (sd 13.8, range 52 – 78) respectively.

**Table 1:** Distribution of diagnoses

Lesion	Female below age 30 (%)		Females age 30 and above (%)	
	BJHS	Non-BJHS	BJHS	Non-BJHS
Soft tissue	17 (41)	2 (40)	6 (27)	1 (17)
Arthralgia	8 (19)	1 (20)	3 (13)	1 (17)
Back pain	8 (19)	2 (40)	4 (18)	0
Osteoarthritis	1 (2)	0	5 (23)	4 (66)
Dislocation / subluxation	3 (7)	0	1 (5)	0
Miscellaneous	5 (12)	0	3 (14)	0
<b>Total</b>	42	5	22	6

## Conclusions

Clinic JHS prevalences encountered are several orders of magnitude higher than published estimates for dancers in general (46%; 26%) (J Rheum 2004; 31(1):173-178.), suggesting that JHS represents a hazard for dancers of all ages. Greater emphasis should be placed on the identification of those at greatest risk.

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# **Sources of Stress, Coping Resources, and Support: an Insight into the Interior World of the Professional Contemporary Dancer**

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Thesis completed in partial fulfillment of MSc Dance Science at the Laban Centre, London

## **Introduction**

Existing research examining dancers' sources of stress and coping resources has traditionally focused on classical ballet, with a notable absence of research within the field of contemporary dance, especially within the independent dance sector. This study explores the differences in stress experiences, coping resources and perceived support between dancers working in the independent (i.e. freelance) and non-independent (i.e. employed) contemporary dance sectors.

## **Methods**

Unstructured, in-depth, open-ended interviews were conducted with ten professional contemporary dancers, five of whom were working as independent dancers. An interview guide approach was used and all transcripts were analysed using inductive content analysis.

## **Results**

Findings suggest that issues with choreographers, anxiety about the future and the general working environment are sources of stress for both employed and independent dancers. Independent dancers were concerned with finances, maintaining fitness levels, career transitions and aging, and demonstrated entrepreneurial qualities and a healthy internal locus of control. In comparison, employed dancers appeared less autonomously competent and were dependent on the leadership and opinion of others, suffered more self-doubt and occupational stress, appeared more concerned with externalities and company politics and veered towards a more external locus of control. Social support, work-life balance and self-care were important sources of coping.

## **Discussion**

The difference in age and experience of the two groups may have played a part in the specific perceptions between sectors. Considering the transactional perspective of stress (Lazarus, 1984) and the fact that contemporary dancers move from one working status to another during the course of their career, suggests that as situational contexts change, so might the dancers' perspectives. Future research should consider observing dancers repeatedly, intra-individually over time, in order to establish patterns and sources of stress and coping. The specific needs of independent dancers and the unique and complex roles they play within dance should also be acknowledged, researched and supported.

## **Conclusion**

While contemporary dancers share many of the same stresses and coping mechanisms as classical dancers, there are significant differences between dancers working independently as opposed to employed dancers. These differences warrant further investigation, in particular, issues with choreographers.

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# Teaching Silent Bodies: Historical and Contemporary Perspectives on Emotional Aspects in Ballet Education and Performing Arts Pedagogy at Elite Dance Conservatoires

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## Introduction and Rationale

The study reveals historical and contemporary perspectives of performing art pedagogy in relation to ballet education at elite dance conservatoires. The balletic mould, master-apprentice relationships, and discipline/authority are discussed. Stringent training is identified as an authentic symbol of nineteenth century and vocational training models. Of the existing literature in ballet education, much has focused on the technical aspect of learning ballet rather than taking psychological factors into account. While sports psychology has seen an enormous amount of research over the last two decades, little has been published on this aspect of ballet pedagogy. Notably absent are first hand accounts from conservatoire teachers; thus a focus group with semi-structured interviews was conducted to explore the physical, psychological, and cultural aspects of the ballet body.

## Conclusion

This enquiry served as a pilot study to investigate the role of emotions in ballet pedagogy. Limitations to the present research include subjective interpretation of another individual's meaning/phrasing of emotions. However, the views expressed by the focus group demonstrate the "silent student body" as an authentic symbol of traditional ballet teaching, which largely neglects emotional aspects of learning and teaching ballet. Further research focuses on developing a curriculum to apply emotional intelligence into existing curricula.

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## Superior Proprioception in Dancers: How and When?

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### Introduction

Dancers have the ability to control their body limbs with outstanding precision. Especially on stage, dancers cannot rely on visual feedback and therefore have to have an elaborated proprioceptive sense. The proprioceptive sense provides feedback from the muscles, joints and tendons. Several studies showed that dancers have superior proprioception (Ramsay and Riddoch 2001; Vuillerme et al. 2001). We conducted two experiments to further investigate how expert dancers and control subjects use proprioception to sense limb position. In general, two effects have previously been reported. First, when visual and proprioceptive information is available, both sensory systems are combined to accurately match target locations (Haggard et al. 2000, van Beers et al. 1996). Second, an increase in the mismatch between the actual target location and the matching attempt can be observed when a target location has to be matched repeatedly without visual or proprioceptive update (Wann and Ibrahim 1992, Wolpert et al. 1998). In one of our studies (under review) we found evidence that dancers rely more strongly on proprioceptive feedback than do control subjects, even when vision is available. We further investigated whether proprioceptive information remains more stable across time in dancers than in non-dancers.

### Methods

In the experiment, dancers and non-dancers repeatedly matched 5 different target locations on a table, under 3 different sensory conditions. The information about the target location was either a visual marker, a proprioceptive marker (the blindfold subject's fingertip placed on the target location by the experimenter), or multisensory (the subject saw their finger on the target location). Subjects had to match a target location by reaching under the table 5 successive times. The matching movement was the same in all three conditions.

### Results and Conclusions

We did not find any significant difference between dancers and non-dancers in the drift in accuracy across the 5 successive reaches. Although dancers have more precise proprioception than control subjects, proprioceptive information is equally short-lived in both groups. Further investigations on proprioception in dancers will help to understand how visual and proprioceptive information about limb position are integrated, and may be valuable in assessing, screening and training dance students and performers.

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# The Dancer's Physique: Somatotype, Body Composition and Proportionality of Full-time Students

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Thesis completed in partial fulfillment of MSc Dance Science at the Laban Centre, London

## Introduction

The physiological demands of dance, in addition to the widely-recognised aesthetic requirements of the dancer's body, are becoming increasingly acknowledged. Body physique assessment may be considered particularly relevant to this area. However, research is limited, showing large variation in participants, procedures and findings. This study sought to quantify the dancer's physique and determine how this may vary between different genres of dance.

## Methods

ISAK restricted anthropometric profiles (in addition to sitting height) of 126 full-time male and female student dancers studying musical theatre, ballet or contemporary dance were obtained. Individual and group means of Heath-Carter anthropometric somatotypes, percentages of body fat (%BF) and cormic indices (SH/S), were calculated and between-group differences were statistically analysed using F ratios.

## Results

Two-thirds of hypotheses revealed significant differences between the genres' physiques. Largest variations were identified between the ballet (most ectomorphic, lowest %BF, lowest SH/S) and contemporary dancers (most endomorphic, highest %BF, mid-range SH/S); significant differences were found in somatotype, percentage body fat and cormic index. Female musical theatre dancers (highest SH/S) closely resembled the female ballet dancers with significant differences found only in the cormic index. However, the physique of the male musical theatre dancers was similar to that of the male contemporary dancers, with no significant differences identified.

## Discussion

The dancers showed a degree of homogeneity in physique overall. However, measurement of all three components (somatotype, %BF and SH/S) allowed numerous differences to be identified. Due to the lean, lithe body composition of the ballet dancers, the muscular physique of the contemporary dancers and the more varied results of the musical theatre dancers, analysis suggests the various effects of the aesthetic, physiological demands and inner structure in each genre, in addition to gender, are somewhat responsible for the dancers' physique.

## Conclusion

The physique of dancers differs, and the extent of these differences varies depending on the predominant training genre and the circumstances surrounding them. Continued and developed research is warranted, not only to determine the dancer's physique with greater accuracy, but also to further understanding in this area.

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## **Striving for Perfection: The Relationship between Perfectionism, Stress and Injury.**

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Thesis completed in partial fulfilment of MSc Dance Science at the Laban Centre, London

### **Introduction**

The present study investigated the relationship between perfectionism, stress and injury. It was hypothesised that higher levels of perfectionism would predict higher levels of stress in modern dance students. The study examined differences between injured and non-injured dancers in reported levels of perfectionism and stress.

### **Methods**

Seventy-nine fulltime undergraduate modern dance students from 2 institutions in Britain and Australia voluntarily participated, completing the Multidimensional Perfectionism Scale for Dance (Cumming & Duda, 2005), and the Dance Experiences Survey (Mainwaring, Kerr & Krasnow, 1993), measuring levels of perfectionism and stress respectively. Participants with a current injury completed an injury questionnaire (Dance/Gymnastics questionnaire; Krasnow, Mainwaring, & Kerr, 1996).

### **Results**

The hypothesis that higher levels of perfectionism would predict higher levels of stress was not supported by the findings of the study. However some of the dimensions of perfectionism significantly predicted levels of total stress (*Concern over Mistakes, Teacher Expectations*) and negative stress (*Concern over Mistakes, Parental Expectations*). There were no significant differences observed between injured and non-injured dancers in levels of perfectionism or stress.

### **Discussion**

The combination of *Concern over Mistakes* and *Teacher Expectations* in predicting total stress emphasises the importance of the teacher's role in influencing the stress experienced by students and supports the investigation of motivational climates in determining perfectionism and stress in dancers. The finding that *Concern over Mistakes* and *Parental Expectations* predicted negative stress levels was similar to previous research (Krasnow et al., 1996) but the effect of *Parental Expectations* in predicting negative stress is unique to the present study. One possible explanation for this may be the differences in the populations under investigation.

### **Conclusion**

No significant differences were observed between injured and non-injured dancers in terms of their levels of perfectionism or stress, suggesting that these factors were not the main determinants of injury in the population under investigation. However, the findings of the present study support the assumption that perfectionism may be conceptualized as a multidimensional personality construct and suggest that individual dimensions of perfectionism may be important in predicting increased levels of negative and total stress in modern dance students.

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# 'My Hobby Has Become My Ambition': Motivating Factors from the Perspective of Young Talented Dancers

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## Introduction

A developing range of research exists that considers motivating factors from the perspective of the people involved in the activity, but very little from the perspective of young, talented dancers as they engage in developing their talent. There is little research evidence in relation to motivation, young dancers, and the implications of positive and negative perspectives on their dance development and emotional and psychological welfare<sup>1-8</sup>. This study aimed to examine motivating factors to dance and to continue to develop as a dancer, from the dancers' perspectives. Social and environmental factors were also considered. The poster describes a pilot study of longitudinal research, exploring motivating factors in relation to young, talented dancers through. Observations and semi-structured interviews concerning the experiences of 104 girls and boys, between the ages of 9-16 years, engaged predominantly in ballet/classical 'outreach' training programmes, were conducted. The programmes are for talented young dancers at two 'elite' dance institutions, one in the North and one in the South of England.

## Results and Conclusions

The young dancers in this study consistently referred to a number of motivating factors to dance that seemed important. These included enjoyment, affective engagement, identity development, achievement and success. It is suggested that these dancers were intrinsically motivated<sup>9,10</sup>. Perceptions of ideal learning environments and opportunities were also examined. By exploring the motivating factors, experiences and perceptions of successful, young dancers, we can identify lessons that can inform related schemes concerned with the promotion of engagement in the arts and sport to wider populations.

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# The Effects of an Eight-week Creative Dance Programme on the Physiological and Psychological Status of 11-14 year old Adolescents: An Experimental Study.

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## Introduction

As a result of recent UK government level health initiatives encouraging more children to participate in physical activities, dance is increasingly on the agenda as a way of enhancing physical and psychological wellbeing. While the benefits of sports activities are well documented,<sup>1,2</sup> the potential benefits of dance are less well known. The aim of this study was to investigate the extent to which creative dance affects the physiological and psychological status of adolescents.

## Methods

Two hundred and twenty-six participants, 11-14 years, from 9 schools across southern England, took part. The intervention consisted of a 60-minute creative dance class once per week, for 8 weeks. A series of physiological and psychological assessments were carried out pre- and post- the programme; lung capacity (Lung Spirometer<sup>3</sup>), flexibility (Sit and Reach test<sup>4</sup>), aerobic fitness (20m Shuttle Run<sup>5</sup>), self-esteem (Rosenberg's Self-esteem Scale<sup>6</sup>), intrinsic motivation (Intrinsic Motivation Inventory (IMI)<sup>7</sup>), and attitudes toward dance (researcher devised questionnaire).

## Results

Group results indicated an overall positive trend for physiological and psychological adaptations. Statistical analysis ( $p < 0.05$ ) showed a significant improvement in all areas of physiological assessment for female participants (N=158). Females also showed greater motivation as a significant difference was evident between genders in two subscales (interest-enjoyment and effort-importance) of the IMI. No significant difference was found in either gender's self-esteem. Qualitative analysis resulted in an overall positive response to the dance programme (68%) with a higher percentage of females responding positively (72% female, 50% male).

## Conclusion

A study of this kind has never before been undertaken in the UK. It is therefore pioneering and forward thinking in determining, through scientific methodology, the physiological and psychological affects of creative dance among adolescents. Overall the results from this study indicate that creative dance elicits a positive affect on the physiological and psychological status of adolescents, in particular females.

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## The Development of Turnout in Young Dancers

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Thesis completed in partial fulfilment of Chiropractic degree  
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### Introduction

Turnout is an essential characteristic of classical dance; it allows the hip joint more freedom, leading to higher leg extensions and better stability. The purpose of this study was to investigate the development of turnout in young female ballet dancers and to discover at what age turnout measurements peak.

### Methods

A cross-sectional study design was used including one hundred female ballet dancers between the ages of ten and eighteen. Turnout of both legs in first position was measured in degrees using Functional Footprints™.

### Results

The average turnout measurements showed a gradual increase in the degree of turnout with age. The means of each age group were analysed using the ANOVA statistical test which gave a p value of <0.0001, considered extremely significant. Therefore, variation amongst column means was greater than would have been expected by chance.

### Discussion

These results are consistent with Huwyler's (2002) proposition that only a fully-grown student can perform turnout. However, more research is required before any conclusions regarding the age at which turnout peaks are drawn, as it is possible that turnout may increase further after eighteen years of age. Also, there are many other factors – including developmental age, muscle strength, joint laxity and most importantly, how long each student has been training and the number of classes taken a week – that contribute to the development of turnout in young dancers, which should be investigated in the future.

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# Pathoanatomy of Anterior and Posterior Impingement of the Ankle in Ballet Dancers

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## Introduction

Ballet dancers are high performance aesthetic athletes who suffer a number of recalcitrant injuries due to their unique abilities and demanding training regimens. The purpose of this paper is to highlight anterior and posterior impingement of the ankle in ballet dancers by presenting the pathoanatomy of several causes of impingement syndromes found in the orthopaedic literature.

## Findings

Sources of ankle impingement include os trigonum<sup>1-3</sup>, intermalleolar ligament<sup>4</sup>, posterior talofibular ligament<sup>5</sup>, posteromedial talar ossicle<sup>6</sup>, os post peronei<sup>7</sup>, superior calcaneal tuberosity<sup>8</sup>, downward sloping posterior malleolus<sup>8</sup>, anterior tibiotalar exostosis<sup>9</sup>, accessory anteroinferior tibiofibular ligament<sup>10</sup>, and anterior or posterior soft tissue inflammation<sup>8,11,12</sup>. These can be categorised generally into anterior or posterior, and bony or soft tissue. These are among the most difficult conditions to manage in dancers because the mechanisms of the injuries involve repetitive movements that are fundamental to ballet performance. The forced dorsiflexion and hyper-plantar flexion of the ankle required for success in ballet, especially *demi-plié* and *en pointe*, lead to conditions that are seen more commonly in dancers than in non-dancers. Often healthcare professionals' relative unfamiliarity with the unusual demands of ballet and other types of dance results in inadequate care for dancers. But, dancers who suffer impingement syndromes cannot perform at full capacity unless the impingement is accurately identified and treated.

## Conclusions and Clinical Relevance

This paper broadens the understanding of dancers, dance educators, dance scientists, and dance medicine clinicians about the potential for ankle impingement. It also shows the need for practitioners interested in dance medicine to obtain specialised training in managing injuries that are primarily seen in dancers and which can be rather complicated.

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# The Physiological and Psychological Effects of a Two Week Rest Period on Full Time Dance Students

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Thesis completed in partial fulfillment of MSc Dance Science at the Laban Centre, London

## Introduction

The aim of this study was to assess the physiological and psychological effects of a rest period on dancers at the end of their first year of full time vocational dance training. The results hoped to determine whether or not dancers were suffering from aspects of overtraining at this time.

## Methods

Four dancers were examined at the end of their first year and again in the second week of their summer break, once consent and medical PAR Q forms had been obtained. The dancers' mean ( $\pm$ SD) age, height, weight and BMI were 21yrs ( $\pm$ 4), 157.7cm ( $\pm$ 7.7), 49.5kg ( $\pm$ 0.84) and 19.8 ( $\pm$ 0.84) respectively. The tests included the Profile of Mood States Questionnaire (POMS-A), the Wingate 30 sec bike test, the Maximal Oxygen Uptake ( $\text{VO}_2$  Max) test on a treadmill, 2 flexibility tests with goniometry, and the Takei handgrip strength test.

## Results

The results showed no difference in the mean handgrip strength tests (pre-test 27.5kg ( $\pm$ 5.5) and post-test 27.5kg ( $\pm$ 5.3)). There was a decrease in the mean peak  $\text{VO}_2$  Max (pre-test mean 51.22 ml.kg<sup>-1</sup>.min<sup>-1</sup> ( $\pm$  4.4) and post-test mean 48.48 ml.kg<sup>-1</sup>.min<sup>-1</sup> ( $\pm$  6.1)). There was a decrease in flexibility of the Straight Leg Raise (Right leg 99° ( $\pm$ 1.8) pre-test and 89.7° ( $\pm$ 4) post-test; left leg 99.5° ( $\pm$ 3.8) pre-test and 91° ( $\pm$ 4) post-test). An increase in the Thomas test post test was observed (right leg 4.75° ( $\pm$ 3.6) pre-test and 1.4° ( $\pm$ 4) post-test; left leg 2.25° ( $\pm$ 4.9) pre-test and 4° ( $\pm$ 5.8) post-test), and an increase in maximum anaerobic power (446.7W ( $\pm$ 107) pre-test and 515W ( $\pm$ 105) post-test), and in average anaerobic power (288.8W ( $\pm$ 65) pre-test and 327.7W ( $\pm$ 52) post-test) after the rest period. There was also an increase in fatigue (42% ( $\pm$ 9.7) and 50% ( $\pm$ 5.1) respectively). The POMS-A resulted in a decrease in vigour and a decrease in tension after the rest period. The results from the pre- and post-tests match the healthy 'Iceberg Profile' of an athlete.

## Discussion

Some of the results fit the suggestion that the dancers were experiencing aspects of overtraining at the end of their first year of vocational dance training. Further research should investigate when it is within the term that the dancers begin to over-train. A tapering period or periodisation of training could then be included in the training to prevent overtraining from occurring.

## Conclusion

This study did show evidence that some dancers in full time training were suffering from overtraining symptoms, therefore potentially impairing their performance standard.

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# What is the Role of Massage Therapy Before and After Dance Performance? Can it Enhance Performance or Help Prevent Dance-related Injuries? A Review

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## Introduction

Massage is used widely at athletic and sporting events to prepare athletes physically and psychologically before competition or performance; and to aid with removal of waste; to prevent delayed onset muscle soreness (DOMS); and to relax the athlete after competition or performance. Despite this use, uncertainty exists about its effectiveness, particularly in terms of physiological benefit. This literature review aimed to determine whether massage before and after dance performance may prevent injury, or enhance performance.

## Method

Computerised literature searches, including use of Ingenta, Select, PubMed, and SPORT Discus, located trials on massage use in sports such as cycling and boxing, and trials on the effects of massage on muscular temperature, flexibility and recovery from exercise. Literature was reviewed regarding performance stress and its effect on performance, and the onset of dance injuries.

## Results

Many of the studies reviewed were limited either by small sample size, or lack of suitable control group, therefore results were irregular and inconclusive. One randomized controlled trial showed some reduction of delayed onset muscle soreness (DOMS), but the effects on muscle recovery and deep muscular temperature appeared limited. However, other studies provided some support for the psychological benefit of massage. Dance specific papers reviewed indicated that performance can be influenced by anxiety and stress, and that dance injuries occur most frequently at times of stress.

## Conclusion

Due to conflicting evidence on the physiological benefits of massage, further study is warranted. However, there may be some benefits gained from using massage to reduce anxiety and stress, not only in terms of improving or enhancing performance, but perhaps even in prevention of stress related injury. Further study is therefore proposed to determine what effect pre- and post-performance massage may have on dancers, over a performance season.

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# How Psychological Skills and Techniques may be Beneficial in Dance Training and Performance

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## Introduction

Psychological issues that dancers face during training, rehearsal and performance, may have negative effects on their work. These may include low motivation, lack of self confidence, high levels of anxiety, psychological stress, concentration issues and depression. It is recognised within elite sporting populations that psychology can have an impact on sporting performance, and the health and wellbeing of athletes. Those working with athletes now use psychological skills training to address psychological areas which may be having negative effects on an athlete's performance.

## Literature review

Most dancers use imagery without even knowing it. However, the *type* of imagery used can alter performance (Monsma, 2004). A dancer might be able to maintain their optimum skill level by watching others dance, or by visualising others dance. This concept can be used both during training and rehearsal, or whilst injured, to maintain skill (Calvo-Merino *et al.*, 2005). Using clear goals, dancers may be able to measure and take more pride in their achievements. As self-confidence increases, anxiety may decrease. Nervousness and anxiety may be the most common challenge confronted by performers. Many try to manage their anxiety in different ways, such as adopting obsessive behaviours, superstition and drug mis-use. Relaxation techniques used by psychologists in anxiety management involve clearing the mind of all distractions, using slow, deep breathing. When a dancer is aware of a negative, unwanted, self-deprecating or unproductive thought or verbalisation, techniques may be used to reverse and replace the thought. It is hypothesized that this positive 'self-talk' can increase drive, confidence, focus and effort.

## Conclusion

Motivational techniques, goal setting, relaxation exercises, positive self-talk and imagery are widely used by sport psychologists to get the best possible performance from athletes. Studies have found that competitive sportspeople perform better when in positive mood states. Future research is suggested to determine whether, like in sports, dancers may learn more effectively, perform better, get fewer injuries and recover from injury more effectively if well equipped with a range of psychological skills that can be used within all aspects of dance participation. Research based on training existing and new dance teachers on psychosocial and behavioural principles is suggested. In doing so, by the time young dancers are professionally performing, they may be fully equipped psychologically as well as physically.

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## Body Characteristics and Injuries in Dance Students

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### Introduction

Many authors<sup>1-5</sup> have investigated the relationship between injuries in dancers and a variety of risk factors. However, these studies did not assess aspects of body composition. While genetics define some aspects of body composition, knowledge of these factors and how they might be associated with injury can help when devising preventive strategies<sup>6</sup>. This study aimed to determine if injury rates and types could be predicted by somatotype components and body fat percentage.

### Method

Sixty-seven (43 ballet, 24 contemporary) full-time dance students at two vocational schools volunteered. The Heath-Carter protocol and the Siri equation calculated somatotype and body fat (% BF), respectively. Injury rates and sites were assessed, along with the time taken to recover from injury, using an injury questionnaire.

### Results

Most students' %BF value fell between 12-20%, and in all groups except female ballet dancers the trend for mesomorphy was highest. However, for female ballet dancers the trend for endomorphy and ectomorphy was similar, with mesomorphy below both. Results showed a negative correlation ( $R=.303$ ,  $df=65$ ,  $p<0.05$ ) between length of time a dancer was affected by injury and %BF. Dancers with lower %BF were affected by injury for longer. A negative correlation ( $R=.245$ ,  $df=65$ ,  $p>0.05$ ) existed between the length of time dancers were unable to dance due to an acute injury, and %BF. The relationship between body fat and length of time dancers were incapacitated due to overuse injury was not significant, but there was a significant negative correlation ( $R=.343$ ,  $df=65$ ,  $p<0.05$ ) between the length of time a dancer was incapacitated due to an overuse injury, and mesomorphy rating. There were significant genre differences between endomorph and mesomorph ratings, %BF, acute injuries, and injury time off.

### Discussion and Conclusion

Body fat results support previous research<sup>7</sup>, but somatypes contradict previous work where meso-ectomorphic dancers were prominent<sup>8</sup>. This study shows body fat and mesomorphy are related to injuries, but explanation for this is speculative. Low body fat may result from low dietary fat and energy intake<sup>9</sup>, leading to nutrient deficiencies, and affecting wound healing<sup>10</sup>. Those with lower mesomorphy may have muscular weaknesses or imbalances, predisposing them to overuse injury<sup>6</sup>. Further study on dancers at different training stages and of different somatypes is recommended.

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# Proprioception and Balance Ability in Contemporary Dancers and Controls

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Thesis completed in partial fulfillment of MSc Dance Science at the Laban Centre, London

## Introduction

Balance is a key component of any dance technique, yet the extent to which dancers rely on proprioception to achieve balance is unclear. Previous studies have found contrasting results; some suggest that dancers rely on vision predominantly for balance control, while others report a stronger reliance on proprioception. The aim of this study was to add to the existing literature on sensorimotor dominance, and to provide data on contemporary dancers.

## Methods

Nine contemporary dancers and 9 non-dancers participated in the study. Once informed consent had been obtained, all participants were tested on one-legged balances on each leg with both the eyes open and closed. Electromyography (EMG) recordings were taken from the tibialis anterior and gastrocnemius muscles, and centre of pressure movements (COP) were detected via force plates or the Footscan. Data was analysed using t-tests, correlation analysis, and eta values.

## Results

Significant differences were found in EMG and force plate data between the two conditions for both groups, yet there was no significant difference between the groups. While the dancer group had smaller EMG and COP measurements in both conditions, particularly with the eyes closed, these were not significant. However, eta values showed a large effect size in the eyes open condition, implying that the dancers' skill had a strong effect in producing stable balances in this condition. With the eyes closed, the eta values were small, indicating that the dancers' abilities in this condition were comparable to those of the controls.

## Discussion

The dancers in this study maintained more stable balances than the non-dancers in the eyes open condition, which was expected due to the dancers' training. However, with the eyes closed, both groups experienced similar difficulties in maintaining balance. These results suggest that contemporary dance training does not improve proprioception, and that these dancers rely on visual afferences predominantly during balance tasks. Further research that investigates teaching methods is warranted.

## Conclusion

Contemporary dance training does not necessarily improve dancers' proprioceptive abilities, as contemporary dancers rely on vision to maintain balance.

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