Cardiff School of Sport

DISSERTATION ASSESSMENT PROFORMA:
Empirical

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<tr>
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<td>Programme:</td>
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<td>A study to investigate whether participation in a stretch programme improves performance in student dancers.</td>
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**Comments**

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<thead>
<tr>
<th>Section</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
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## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Tables</td>
<td></td>
</tr>
<tr>
<td>List of Figures</td>
<td></td>
</tr>
<tr>
<td>Glossary of Abbreviations</td>
<td></td>
</tr>
<tr>
<td>Acknowledgements</td>
<td></td>
</tr>
<tr>
<td>Abstract</td>
<td></td>
</tr>
<tr>
<td>Dissertation Assessment Proforma</td>
<td></td>
</tr>
<tr>
<td><strong>CHAPTER ONE</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction and literature review</td>
<td></td>
</tr>
<tr>
<td>1.1 Performance and Technique</td>
<td>3</td>
</tr>
<tr>
<td>1.2 Flexibility</td>
<td>4</td>
</tr>
<tr>
<td>1.3 Stretching</td>
<td>6</td>
</tr>
<tr>
<td>1.4 Static Stretching</td>
<td>6</td>
</tr>
<tr>
<td>1.5 Increase Range of Motion</td>
<td>9</td>
</tr>
<tr>
<td>1.6 Injury Prevention</td>
<td>10</td>
</tr>
<tr>
<td>1.7 Injury Rehabilitation</td>
<td>10</td>
</tr>
<tr>
<td>1.8 Relaxation</td>
<td>11</td>
</tr>
<tr>
<td>1.9 Lower Back Pain</td>
<td>11</td>
</tr>
<tr>
<td>1.10 Alignment</td>
<td>11</td>
</tr>
<tr>
<td>1.11 Pictures For Analysis</td>
<td>13</td>
</tr>
<tr>
<td><strong>CHAPTER TWO</strong></td>
<td></td>
</tr>
<tr>
<td>Methodology</td>
<td></td>
</tr>
<tr>
<td>2.1 Participants</td>
<td>15</td>
</tr>
<tr>
<td>2.2 Ethical Considerations</td>
<td>16</td>
</tr>
<tr>
<td>2.3 Research Design</td>
<td>16</td>
</tr>
<tr>
<td>2.4 Protocol</td>
<td>17</td>
</tr>
<tr>
<td>2.5 Data Collection</td>
<td>20</td>
</tr>
<tr>
<td>2.6 Pilot Study</td>
<td>24</td>
</tr>
<tr>
<td>2.7 Validity and reliability</td>
<td>25</td>
</tr>
<tr>
<td>2.8 Data Analysis</td>
<td>26</td>
</tr>
<tr>
<td>2.9 Angle Data Collection and Correct Alignment</td>
<td>27</td>
</tr>
<tr>
<td><strong>CHAPTER THREE</strong></td>
<td></td>
</tr>
<tr>
<td>Results</td>
<td></td>
</tr>
<tr>
<td>3.1 Questionnaire Results</td>
<td>32</td>
</tr>
</tbody>
</table>
CHAPTER FOUR
Discussion
4.1 Questionnaire 55
4.2 Stretch Diaries 58
4.3 Hard data discussion 58
4.4 Discussion of Theories 58
4.5 Limitations 62

CHAPTER FIVE
Conclusion
5.1 Approach to this study 65
5.2 Can a stretch programme enhance flexibility in university standard dancers in training? 66
5.3 Can an intervention stretch programme increase technical alignment and kinaesthetic awareness? 66
5.4 Does an intensive intervention stretch programme improve Performance 67
5.5 Future research 67

List of references
LIST OF TABLES

Table 1  Programme Design  7
Table 2  Participant one pre and post intervention questionnaire results  33
Table 3  Participant two pre and post intervention questionnaire results  35
Table 4  Participant two pre and post intervention questionnaire results  36
Table 5  Participant four pre and post intervention questionnaire results  37
Table 6  Participant five pre and post intervention questionnaire results  38
Table 7  Participant one angles of the four key movements in degrees pre and post- intervention results  41
Table 8  Participant two angles of the four key movements in degrees pre and post- intervention results  43
Table 9  Participant three angles of the four key movements in degrees pre and post- intervention results  44
Table 10 Participant four angles of the four key movements in degrees pre and post- intervention results  46
Table 11 Participant five angles of the four key movements in degrees pre and post- intervention results  47
Table 12 External adjudicators results in terms of flexibility and alignment  49
Table 13 Summary of all results, self-evaluation questionnaire, angles of leg data and external adjudicator  51
Table 14 Discussion of four key movements with analysis of results from the self-evaluation questionnaire and external adjudicators findings  55

LIST OF FIGURES

Figure 1  outline of the key methods used within this study, clarifying time periods and progression within the study  3
Figure 2  Instructions of the specific dance motif, including the four key
movements with directions and focus facings 17

Figure 3  Hexagonal dance space where the video data was collected 21

Figure 4  Where the hard data angles were taken from during each movement using studio code 27

Figure 5  Picture of correct alignment during high kick, movement one 29

Figure 6  Picture of correct alignment during splits, movement two 29

Figure 7  Picture of correct alignment during roundhouse kick, movement three 29

Figure 8  Picture of correct alignment during the side-lunge, movement four 30

Figure 9  Participant one Questionnaire results of participant perception of performance before and after the intervention stretch programme graph. 34

Figure 10  Participant two Questionnaire results of participant perception of performance before and after the intervention stretch programme graph 35

Figure 11  Participant three Questionnaire results of participant perception of performance before and after the intervention stretch programme graph 36

Figure 12  Participant four Questionnaire results of participant perception of performance before and after the intervention stretch programme graph 37

Figure 13  Participant five Questionnaire results of participant perception of performance before and after the intervention stretch programme graph 38

Figure 14  Participation one angle of leg flexibility graph pre and post-intervention Results 42

Figure 15  Participation two angle of leg flexibility graph pre and post-intervention Results 43

Figure 16  Participation three angles of leg flexibility graph pre and post-intervention Results 45

Figure 17  Participation four angle of leg flexibility graph pre and post-intervention Results 46

Figure 18  Participation five angle of leg flexibility graph pre and post-intervention Results 48
## APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Ethics Status</td>
</tr>
<tr>
<td>B</td>
<td>Informed Consent Form</td>
</tr>
<tr>
<td>C</td>
<td>Research Participant Information Form</td>
</tr>
<tr>
<td>D</td>
<td>Pre-intervention self-report questionnaire</td>
</tr>
<tr>
<td>E</td>
<td>Five week stretch programme</td>
</tr>
<tr>
<td>F</td>
<td>Stretch diary</td>
</tr>
<tr>
<td>G</td>
<td>Post-intervention self-report questionnaire</td>
</tr>
<tr>
<td>H</td>
<td>External adjudicator's empty analysis results table</td>
</tr>
<tr>
<td>I</td>
<td>Pilot study questionnaire completed by a pilot participant dancer</td>
</tr>
<tr>
<td>J</td>
<td>External adjudicator analysis of all participants in terms of flexibility, alignment and overall performance</td>
</tr>
</tbody>
</table>

## GLOSSARY OF ABBREVIATIONS

- ROM: Range of Movement
- PNF: Proprioception Neuromuscular Facilitation
- Q: Question
- CMU: Cardiff Metropolitan University
- ACSM: American College of Sports Medicine
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ABSTRACT

Since the fifteenth century dance has been defined by functional technique characterised, for example in ballet, by long aesthetic lines and high levels of flexibility. The purpose of this study was to determine whether progressive stretch programmes aid dancers in aesthetic technique and correct alignment during a pre-defined set of dynamic movements. This research was carried out to enhance knowledge of the links between dance, flexibility, alignment and technique. The study combined qualitative and quantitative research design. Analysis and observation of videos by an external unbiased adjudicator, self-evaluation questionnaires and quantitative data (angles of leg flexibility calculated through studio code V4.5.1) were the main means of data collection. Five female university student dancers performed a flexibility-specific dance motif, which was video recorded for analysis. All participants were classified as having received at least one year’s formal dance training with knowledge of the technique and style used within the research. The participants then took part in a five week intervention stretch programme, which included the five main leg muscles utilised within the motif (hamstrings, hip adductors, hip flexors, hip abductors and quadriceps). Pre and post-intervention videos and questionnaires were analysed and compared. The videos were analysed against the ‘perfect’ model by an expert external adjudicator in terms of improvements within flexibility, alignment and overall performance. The intervention stretch programme led to visual and self-evaluated improvements within flexibility and overall performance. Leg flexibility angles of the four key movements collected using studio code showed an increase in flexibility throughout the five participants. The high kick and splits movement showed the greatest improvements in flexibility angle (11.4 ± 1.2° and 7.2 ± 1.1°, respectively) whereas the side lunge and round-house kick showed a lesser amount of improvement (4 ± 1.6°). The self-evaluation questionnaires reflected these results correlating perceived enhancements in flexibility within the four movements. The self-evaluation score was inferior in terms of alignment; this correlated with the external adjudicator’s results which suggested that flexibility improved but not alignment. External adjudicator suggested that increased flexibility hindered correct alignment, misplacing the extra force used to utilise flexibility, forming incorrect alignment technique. Increase in muscular flexibility allows for greater ease of movement to assist in the performance of high flexibility movement aiding correct technical alignment.
In conclusion, stretch programmes appear to help to enhance flexibility to gain the optimum ROM. Flexibility needs to be trained alongside the dancer’s core strength and technique to ensure maximal flexibility can be applied correctly to create an aesthetic dance performance. Limitations of the study were that external training could also be occurring during the stretch intervention programme; the dancers have a high, but varying range of, flexibility at baseline. Finally previous research data collected is unclear on specific stretching protocol required for optimum gains in flexibility.
Chapter One

Introduction and literature review
A study to investigate whether participation in a stretch programme improves performance in student dancers.

This dissertation will focus on the potential of improving joint mobility within the major leg muscles which allows ease of movement around the joints. The principal interest within this study is to research potential improvements in aesthetic performance and increasing flexibility. This will be examined through a five week intensive training stretch programme, which will be focusing on the five main muscle groups used within high flexibility dance movements (hamstrings, hip adductors, hip flexors, quadriceps and hip abductors). Personal experience and joint mobility may have an effect on results gained. Flexibility is a core principle within dance training, enabling dancers to reach visual competence and correct bodily positioning. The common stereotype of dancers is that they have an increased level of flexibility or hyper-mobility which aids in technique therefore raising their level of performance. All professional dancers are trained to create aesthetically pleasing performances through their extensive knowledge base of technique and skill. As part of this they gain a high kinaesthetic awareness of body placement within space and the ability of correct alignment positioning. This idea is addressed by Deckerr, Barry, and Welsh (2008) who state that “Dance is an art form where perfection results from a delicate balance between artistry and physical skill, focusing on perfecting alignment”. Recently, attention has been placed more on correct technique, as it has been related to rehabilitation as well as aesthetic appeal.

This study aims to gain an insight into whether increased ease of movement due to heightened range of motion can improve the kinaesthetic feel of the movement to the dancer themselves through an intervention programme. Also whether enhanced joint mobility links with creating technically accurate aesthetic body shapes, facilitating alignment. It is important to explore this particular discipline as it will increase knowledge on the use of stretching programmes to enhance performance, investigating whether this advance in flexibility helps with alignment. This research will enable professional and non-professional dancers to enhance their personal aesthetic performance by suggesting how stretch programmes can aid in dance movement. It will contribute highly within the teaching industry and inform teachers to adapt their lessons to develop the dancer’s performance. Finally, it will help with future research in this discipline informing further studies, highlighting niches within existing research.
Figure 1- Shows an outline of the key methods used within this study, clarifying time periods and progression within the study

It is hypothesised that slight increases in flexibility will help improve performance. It is expected that an increase in muscular elasticity enables a larger range of movement allowing a greater ease of movement to aid in the performance of high flexibility work with correct technical alignment. The expectation within this study is that the five-week intensive stretch intervention programme will increase flexibility, enhancing overall aesthetics and kinaesthetic feel while performing gaining neutral alignment.

1.1 Performance and Technique

Technique is the framework all dancers learn; they then utilise it to create movement, Smith-Autard (2000, p.16-17) describes technique “as not being a mastery of skill and accuracy but having discipline of the art” and using it for personal development.
Knowledge of correct technique allows dancers to train their bodies to physically explore expression and generate aesthetically satisfying movement (H'Doubler, 1940). This is an important aspect for dancers and performers to gain, as correct technique and knowledge of safe alignment allows dancers and performer to experiment with their bodies. In agreement with this Glasstone (1999, p. 951) suggests that in order to “develop organically formed stylistic nuance the dancer must have technical clarity and precision as a foundation”. Therefore interaction of the mind and body allows the dancers to respond to its inherent expression, creating technically accurate aesthetic performance (H'Doubler, 1940). Technique that is enhanced by organic human emotion can direct “instinctive movement into a conditioned ideal”, creating a high level of performance (H'Doubler, 1940, p.11-12). Elite dancers are expertly trained in the aesthetic and technical side of the art, allowing them to be “psychologically prepared to handle the pressure they come under” while training and performing (Koutedaki, Hukam, Metsios, Nevi, Giakas, & Myszkewycz, 2007). In order for dance performers to learn the required technique it is important that they have an adequate range of flexibility and knowledge of their bodies in safe practice to support this (Svensson, 1994). Flexibility plays a key role within dance and is found to have functional links with technique and alignment, as the muscles allow for the movements to be generated. Low range of flexibility limits and restricts the flow of movement and can also alter alignment as a result.

1.2 Flexibility

Flexibility is defined in many ways; Provance, Heiserman, Bird, and Mayhew (2006, p. 21-26) suggest that flexibility is a combination of muscle capacity to move the joint. Stopka (2002) suggests that it refers to the functional stretching ability while performing activities without injury, while Koutedakis (2005, p. 45-49) states that it is the ability of the “joint to use its full range of movement which is correct and efficient to its art form”. Alter (1998) states in a study that flexibility is reliant on the body’s ability to transfer knowledge to practice. For this study flexibility is defined as the “range of movement possible at a joint... aiding its functional performance” (Gleim, & McHugh, 1997, p. 289-99). In relation to functional flexibility, technical ability is applied during performance to enhance and engage functional flexibility.
Deighan (2005) suggests dance is characterised by attractive shapes and body positions, which are due to high level flexibility. ‘Dance is communication through human movement, therefore optimum levels of flexibility are essential for maximizing the versatility of movements.’ (Deighan, 2005). Deighan (2005) also states that for dancers to continue onto the next stage of professionalism they must obtain optimum flexibility. Flexibility is valued within dance using aesthetics derived from a large range of motion. (Deighan, 2005). This suggests that to acquire a high standard of performance the dancer must recognise the significance of a high level of flexibility and implement it within training practice.

According to the ACSM (American College of Sports Medicine [ACSM], 2006) physical fitness is made up of five main components and among these, flexibility is an important variable, suggesting appropriate levels are required “not only for the health promotion and maintenance and functional autonomy but also safe and effective participation in sport”. Dancers flexibility and strength are considered more important than the other three components as it contribute highly to performance. Corbin (1984) suggests that at top level performance, the participant must have a high level of flexibility to be successful, and is stated as vital for all individuals; it is the “individual’s ability to move a joint through its entire range of motion without undue stress.” (Provance et al., 2006).

Corbin (1984) also points out that high-quality flexibility is optimal for sport performance, and that maximal flexibility is where tension begins to develop in the muscle (Koutedakis et al., 2007). Optimal joint mobility indicates no adhesions or abnormalities around the joint creating muscular limitations during movement, allowing for flow of movement (Koutedakis & Jamurtas, 2004). Bredejo, and Gonzalez (2010) describe flexibility as the desired level for ample, free flowing movement, determined by technique requiring appropriate elasticity of muscles, ligaments and tendons. Considered by Hein, and Vain (1998) coordination and movement is reliant on flexibility and the musculoskeletal system. Increasing the flexibility around a joint can promote performance and reduce risk of injury (Marek, Cramer, Fincher, Massey, Dangelmaier, Purkayastha, Fitz, & Culbertson, 2005). In concurrence to this Muyor, Lopes-Minarro and Casimiro (2012) suggest that suppleness is an important component and has a significant responsibility in protecting the spine from risk. Training in flexibility not only improves elasticity of muscles but minimises loss of strength, and is an indicator of dance talent (Walker, Nordin-Bates, & Redding, 2010; Berdejo, & Gonzalez, 2010). There are many ways in which flexibility can be increased within dance the main procedure is stretching the muscles to increase extensibility.
1.3 Stretching:

Stretching is a key component of general fitness; all other fitness components must be trained to a high level so that the body is as effective as possible. The word stretch in English means lengthening and refers to the action of holding certain segments of the human body; its purpose to prepare the muscle for incoming effort (Gherghiu, & Ioan, 2011). There are a number of different types of stretching for example; dynamic, static, ballistic and Proprioceptive Neuromuscular Facilitation (PNF), all with different objectives and methods of execution, occurring when a joint reaches the end of its passive range of motion (Bird, 2012).

There are wide ranges of stretches used within dance and sporting worlds, all looking at improving flexibility for different purposes. The main method of stretching used within dance, with supportive evidence from different studies is static stretching. As informed by literature from a range of studies by Harvey et al. (2012), Norris (1999), Lopez-Minarro, Muyor, Belmonte, and Alacid (2012), Stavropouios, Koutedekis, and Metsios (2005), Harvey, Herbert, and Corsbi (2002), Bird (2012), Chan (2000), Samson (2012), Stopka (2002) and Alter (1998).

1.4 Static Stretching:

Static stretching is used, as it requires little expenditure of energy and is the safest and easiest to perform (Arminger, 2010). Research by Samson (2012) concluded that, results in greater improvement in ROM compared to a dynamic stretch programme. Dynamic stretching is stated in many studies as superior to static stretching however studies by Torres, Kraemer, Vingren, Volek, Hatfield, Spiering, Fragala, Thomas, Anderson, Hakkinem, and Maresh (2008) suggests the opposite demonstrating that evidence is not unanimous. Researchers have found that a combination of static and dynamic stretching has the greatest impact in flexibility (Beham, & Chaouachi, 2011). During static stretching a limb is taken to a point of tension and tightness at its maximum range of motion, and this is sustained for a designated amount of time (Stopka, 2002; Norris, 1999). Longitudinal force is then applied to achieve muscle lengthening (Armiger, 2012), allowing adequate time to reset the sensitivity of the stretch reflex (Alter, 1999) elongating the inert structures of the muscles (Norris, 1999). This type of stretching allows for semi-permanent changes in length increasing the muscles ability to stretch (Beham, 2012) furthermore decreasing
muscular stiffness and viscosity (Samson, 2012). This area of research has little usable prior data as little work focusing on dance specific flexibility and training has been carried out. There are many components relating to the practice and implementation of static stretching which alters the efficacy with respect to execution. Duration, repetition and frequency in terms of number of times a week and overall time period, effect the efficacy of a stretch programme. There is a variance in the literature with regards to an optimal stretch programme design.

**Programme Design**

**Table 1 - Programme Design**

| Weeks: | Studies have provided evidence that programmes implemented over a period of four to six weeks has resulted in increased range of motion around the joints targeted (Armiger, 2010; Chan, 2000; Clarkson, & Skrinar, 1988). Chan (2000) suggests that flexibility can be effectively improved through static stretching over a four week protocol and additionally that an eight week programmes produce similar effects. Therefore a stretch programme to produce flexibility improvements must occur for a minimum of four weeks (Armiger, 2010; Chan, 2000). Within the research the periods of time spent completing a stretch programme and noticeable benefits also vary, showing an inconsistent pattern. Contemporary literature explores many different avenues of research and suggests that the period of weeks over which there is a noticeable difference within muscle flexibility could be affected by the mechanics of the participant's body. Literature informs a stretch programme over five weeks to increase flexibility. |
| Days: | General recommendations from the ACSM (2006) include stretching the major muscle groups of the body three to five times a week. In correlation to this research Muyor et al. (2012) suggests sets of exercise performed three days a week significantly improve extensibility and increasing this amount has no further effect over a four week period. ACSM (2006) further state that as a minimum stretching should be undertaken two to three days per week. In order to enhance elasticity of the muscles around the main joints, a specific stretching programme should be undertaken four to five days a week, with general stretching every other day of the programme for optimal results (ACSM, 2006). Contrary to this, Clarkson, and Skrinar (1988, p. 290) recommend training should take place two to three times a week to gain specific physical changes facilitating improvements in flexibility. Many studies focusing on improvements in flexibility via stretching suggests at least two rest days within a week programme to allow for the muscles to relax and repair (Clarkson, & Skrinar,1988, p. 290; Muyor et al., 2012; Provance et al., 2006).

The study methodology is based on the literature, stretching three times a week with rest days to allow for recovery, during the fourth and fifth weeks increasing it to four times a week. This allows for minimum of two days in the week, suggested by the ACSM (2006) and in recommendation of Clarkson, and Skrinar (1988, p. 290) for flexibility to be trained.

Many researchers have proposed the most effective stretch durations and repetitions to gain the greatest
effects in flexibility training (Cramer et al., 2004; Provance, 2001; Zakas, Doganis, Papkonstandinou, Sentelidis, & Vamvakoudis, 2006). Provance et al. (2001) suggests that different durations could offer varying degrees of improvement according to the type of flexibility training; initial gains could continue improving with shorter durations over the period of the programme. Zakas et al. (2006) determined that 360 seconds total volume of stretching, (four stretches all held for thirty seconds and repeated three times), was above the minimum time to achieve an adequate stretch to enhance flexibility. Limited research has been carried out regarding the adaptation in range of movement, varying throughout different studies. Previous studies have also shown that stretches held over a long period of time ranging from two minutes to sixty minutes can have a negative effect on muscular strength performance (Cramer et al., 2004; Avela, Kyrolainen, & Komi, 1999). Research mainly focuses on duration of stretch hold, with different conclusions, thus suggesting differing stretch periods for individually participants for optimal gains in joint mobility.

Stretches within a functional flexibility programme cause accumulative effects on muscle elasticity as the repetition count increases (Norris, 1999). Recent studies have found that the greatest change in the muscle tendon and effect of a stretch occurred during the first four stretches, with further repetitions failing to produce greater improvement (Taylor, Dalton, Seaber, & Garrett, 1990; Chan, Hong & Robinson, 2000). Chan et al. (2000) suggests that this correlates with the tissue slowly remodeling due to a biomechanical response triggered by the stretch force. Limited research has been carried out on this subject area, making it hard to comment further.

The effectiveness of a stretch on flexibility is also related to the amount of time the stretch is held. Bandy and Irion (1994, p. 83) found that "holding a stretch for between 30 and 60 seconds is more effective than 15 seconds". This is also evident in similar research from Ogural, Miyahara, Naito, Katamoto, and Aoki (2007) and Chan et al. (2000). Furthermore, in their research, they found that there was no significant difference between a 30 and 60-second stretch protocol in relation to flexibility improvements. In contrast the ACSM (2006) recommends holding stretches for 20-30 seconds to gain the best training effect. During static stretching, time enables the tension to subside and relaxation to occur within the muscle, this is due to the stretch reflex. This produces muscle electrical activation when the muscle reaches its threshold, leading relaxation of the muscle (Houk et al., 1981). Relaxation generally occurs within the first 15 seconds of a stretch. This suggests that longer durations allows for the viscoelastic properties of the musculotendinous units to become more compliant to the stretch and further elongate through relaxation (Ogura et al., 2007; McHughet, Mangnusson, Gleim, & Nicholas, 1992). Performers that are aware of the phenomenon of the relaxed tension in the muscle can improve the impact of the stretch by lengthening further to find the resistance, using biofeedback to enhance the stretch (McHugh et al., 1992). Biofeedback is a technique in which people control certain bodily processes to improve their health, such as heart rate and muscle tension (Ehrlich, 2011). A longer duration stretch allows for both elastic and muscular adaptions to occur counteracting overload, this enables the muscle to return safely to its original position after a high flexibility dance movement, allowing for coordinated unrestricted movement (Ford & McChesney, 2001). Stretching aids in many different sports and has numerous benefits if the protocol is followed correctly for specific improvements.

Little research has been completed to determine the potential relationships between flexibility and aesthetic dance performance across a range of genres and techniques. There is also a gap within the research exploring the possible associations between flexibility of muscles and range of motion in joints affecting alignment throughout dynamic movements. There is limited research addressing the connections between
dance, stretching, performance and flexibility of the muscles.

There are many other benefits arising from a specific stretch programme promoting flexibility and an increase in range of motion. Suggested by Mann, and Jones (1999) and Mitchell (1996), an increase in the body’s core temperature can lead to an increase in muscular elasticity enhancing the ability of the body to perform activities, reducing emotional tension and reduce the risk of injury. Emotional tension is the “psychological state of mental strain or suspense” (Vocabulary, 2003). Supporting this, Kokkonen, Neson, Eldredge, and Winchester (2007) suggest that stretching helps to reduce musculotendinous injuries and can also result in improvements in areas of muscular performance. The reduction in injuries also means that the dancer’s body is able to perform to its optimum. "Thus supporting the goals of the dance artist via increased movement efficiency and performance excellence" (Wilcosky, 2011; Stasinopulos, Stasinopoulou, & Manias, 2011).

1.5 Increased Range of Motion (ROM)

ROM is described as being the “amplitude of joint movement” (Gheorghiu & Ioan, 2011). The ROM within performers varies depending on the muscle’s ability to elongate within the physical limits of the joint (Hein & Vain, 1998). Static stretching increases the ability of the muscles to stretch (Roberts & Wilson, 1999) but ROM is limited by other bodily restrictions like “bony deformations, cartilaginous and ligament restrictions and tight muscles crossing over a particular joint” (Franklin, 1996, p. 115). Systematic stretching is needed to improve ROM (Muyor et al., 2012), which in turn aids in dance training affecting muscular flexibility and spinal flexion (Alricsson et al., 2003). Stretching is essential in helping the dancer assume more effective work postures and to perform tasks more efficiently with the best possible body mechanics. Promoting increased range of motion in dancers is vital as it reduces tightness and provides joint stability (Muyor et al., 2012). Greater ROM around joints permits larger peak muscle force production causing superior momentum and power (Ford & McChesney, 2007), allowing for greater technique and performance. Greater flexibility allows for longer time to adapt if the performer is placed in an unexpected position, decreasing the potential of risk (Bird, 2012). The stretch reflex must be “circumvented to permanently increase muscle length” (Franklin, 1996, p. 121). Increasing the length of muscles not only helps to aid in performance but also helps to aid in the protection of the body, preventing major and minor muscular injuries.
1.6 Injury prevention

Stretching is used as a form of injury prevention since it is reported that significant correlation exists between the use of sport specific stretch regimes and decrease in injury (Dadebo, White, & George, 2004). Witvrouw, Mahieu, and Martin (2004) found that injury prevention programmes should contain flexibility exercises as well as strength and conditioning to increase the elasticity of tendon units so more force can be absorbed. In contrast, many studies have also shown that stretching and the increases in range of movement due to enhanced flexibility may not reduce injury risk (Bird, 2012). Many studies have concluded that there is no significant link between flexibility and injury risk (Gleim & McHugh, 1997) while other studies have shown a relevant relationship suggesting flexibility may have an impact on reducing injury risk (Anderson & Bouke, 1991; Bandy & Irion, 1994; Shellock & Prentice, 1985; Smith, 1994). There is also relevant research suggesting that performers with restricted joint movement are more likely to gain injuries than their more flexible colleagues (Armiger & Martyn, 2010; Witvrouw, 2003). Static stretching by increasing flexibility of muscles attaching to a joint decreases the risk of musculoskeletal injury (Ogura et al., 2007), allowing for more vigorous activities to be performed with a smaller risk of injury (Verrall et al., 2005). Further research shows that high levels of flexibility can “reduce injury related to overuse, joint sprains or muscular strains as well as reducing muscular stiffness and tension” (Bird, 2012; Alter, 1998, p. 2). These types of injury are the main occurring injuries recorded within the dance industry, therefore increasing flexibility to reduce the incidences will enhance the production of healthy dancers (Bird, 2012; Alter, 1998; Verrall et al., 2005; Witvrouw, 2003)

1.7 Injury rehabilitation

Injury rehabilitation has the purpose of “restoring the body to normal or optimum functioning”; stretching is an essential and fundamental component of this procedure (Armiger & Martyn, 2010, p. 5). Stretching promotes the development of body responsiveness and awareness of tension within the injured area which can also affect the speed of rehabilitation after injury (Alter et al., 2010). Mechanical elongation produced through static stretching can promote rehabilitation from injury on a cellular level as the increased tensile force increases metabolic processes. This increase allows for “more efficient speed of cellular proliferation, differentiation, and matrix formation, increasing the healing process of tendons and ligament” (Armiger & Martyn, 2010, p. 6). Allowing for
rehabilitation of the muscles and promotion of increased body efficiency. Most dancers have had, or still have, recurring injuries, therefore stretching regularly is important.

1.8 Relaxation

An athlete’s “mental and physical state of relaxation” can be induced through systematic stretching producing a “pleasant relaxed feeling via an induced level of anaesthesia” (Armiger et al., 1998, p. 2). Intense stretching allows for “firing of Golgi tendon organs, which induces muscular relaxation” allowing the athlete to relax (Alter, 1998, p. 11). This relaxation of the mind and body allows dancers’ bodies to repair. The increased mobility of the joints allows for ease of movements during performance which allows the athlete to produce greater levels of aesthetic performance. Reciprocal inhibition from stretching causes relaxation of “antagonistic muscles due to the volitional contraction of the agonist.”(Ford & McChesney, 2007, p. 18-27). This relaxation during performance allows the muscles to relax creating a more effortless aesthetic performance.

1.9 Lower back pain

Lack of flexibility and muscle tightness leading to shortening of muscles affects the resting position of the spine causing chronic lower back pain (Armiger & Martyn, 2010; Alricsson, Harms-Ringdahl, Eriksson, & Werner, 2003; Chan, Hong, & Robinson, 2000). Dancers commonly adopt prolonged lordotic postures as an integral part of dance aesthetics causing tension to build up in the lower back (Smith, 2009). Flexibility in the hamstrings, quadriceps and hip flexors are seen as important within dance as they maintain stride length and restrictions in this area are commonly associated with lumbar pain; flexibility also needed to “sustain the peak strength of the muscles during explosive movement, and to prevent injuries in the leg and the lumbar area” (Berdejo, & Gonzalez, 2010, p. 13).

1.10 Alignment

Alignment is a key component this study, which is being analysed as an indicator of correct technique during performance. Correct alignment is described as the neutral position where the pelvis remains level (Norris, 2011), which retains a “positioning of the
skeleton that allows for optional functioning” of all its individual components (Armiger & Martyn, 2010, p. 37). Good alignment is an attribute of professional dancers, facilitating effective execution of high standard performance (Holt, Welsh, & Speights, 2011). Alignment is commonly associated with posture, which is the “relationship between the different parts of the body” (Norris, 1999, p. 52). Alignment and posture contributes to the consistency and persistence of the skeletal muscles in relation to the line of gravity of the body as it moves through the space (Smith-Autard, 2010; Franklin, 1996). While dancing dynamically, alignment requires extra control of the body to uphold correct posture as well as aesthetic lines (Minton, 2003). Bodily positioning can be analysed by using the plumb line. This is the line that passes by the center of the ankle, just anterior to the midline of the knee and then through the greater trochanter, bodies of lumbar vertebrae, bodies of the cervical vertebrae, shoulder joint and the lobe of the ear (Findlay, 2010). This line is used as a tool for correcting technique and aiding performance as neutral alignment maximises the function and efficiency of muscles and joints (Findlay, 2010; Hamilton, Weimar, & Luttgens. 2008). Smith-Autard (2010, p.73-78) states that “composers pay attention to the alignment of the dancer, in relation to aesthetics”. This correct alignment can facilitate efficiency and reduce injury in a number of dance genres (Holt et al., 2011), however classical ballet places emphasis on bodily position especially focusing on the pelvis to optimise dancers’ performance (Deckerr et al., 2008). Good alignment in the pelvis is especially emphasised in dance as it is a transition between torso and lower extremities, promoting balance, control, coordination and smooth locomotion (Holt et al., 2011). Kendall, McCreary, and Provance (2006) define neutral pelvic alignment as the point where two anterior superior iliac spines are on the same vertical plane as the symphysis pubis.

Misalignment can result in poor movement quality; the misplacement of the force created through movement can lead to the risk of injury and informs bad technique (Wilcosky, 2011). Postural muscles which are trained incorrectly through the use of bad technique and incorrect alignment can result in injury and restrict the dancer by producing non-aesthetically pleasing movement (Wilson & Kwon, 2008). Repetitions of this incorrect alignment can lead to recurring injures and change in kinaesthetic feel of the movement, generating bad habits and improper muscle memory. Postural muscles act as stabilisers, fixing a joint while the other muscles mobilise movement (Findlay, 2010), creating the intricate body positions of dance.
Flexibility and extensibility of muscles affect posture, hamstring elasticity influences spinal posture and trunk flexion (Muyor et al., 2012), related to sagittal alignment of the thoracic curve (Lopez-Minarro et al., 2012; Muyor et al., 2012). Hamstring flexibility is seen as a vital component of postural alignment as it plays a substantial role in protecting the vertebrae from potential hazard (Muyor et al., 2012). Without this specific flexibility performers will be unable to perform perfect alignment of the back during static and dynamic positions. This then prevents correct technique being displayed, leading to a performance that is not aesthetically pleasing and also may cause further harm to the performer through misalignment.

1.11 Pictures for analysis

External evaluation of alignment by an expert represents one method of data collection during this study. This research methodology is represented by Fitt, Sturman, and McLain (1993) and McLain, Carter, and Abel (1998) who had specialists evaluate body placement from photographs and videotapes taken pre and post application of specialised training technique. Deckerr et al. (2008) performed a study where four ballet instructors with knowledge of scientific alignment were shown images of dancers, then asked to categorise according to correct alignment.
Chapter Two

Methodology
Methodology

2.1 Participants:

Five female performers studying Dance at honours degree level at Cardiff Metropolitan University participated in the study. All participants were required to have a University standard level dance attainment, with at least one year's experience of established dance training and performance experience. The ages of the participants ranged from 18-19 years. Five students were enrolled, with a view to obtaining three sets of reliable data, taking into account potential drop outs and the incorrect completion of the intervention programme. A limitation noted during Holt et al. (2011) study was that they intensively studied two participant dancers; in which the conditions employed meets the lowest threshold for representing experimental control, they then go on to state that adding a third participant with the respective set of data results may have been more compelling. All participants were obliged to read and understand the requirements for this study on the information sheet and questions were encouraged to ensure that the participants had a complete understanding of the protocol.

All participants completed and signed consent forms before taking part in the study, indicating that they understood the requirements. By signing the consent form, participants confirm that the standard of research undertaken was ethically valid and agreed prior to involvement (Gratton & Jones. 2004). Gratton and Jones (2009) state that it is imperative that the participants were informed of how the data collected would be used, aims and intentions of the study. It was made clear from the beginning that the study was primarily concerned with performance and alignment when performing high flexibility movements.

The intervention stretch programme was introduced and briefly outlined to the volunteers, emphasising that the programme when created would be supervised and approved by appropriately qualified personnel. This was to ensure safe practice was adhered to and that all potential risks had been considered, implementing strategies, if necessary, to minimise potential hazards. Ethical authorisation was required from Cardiff Metropolitan University (CMU) and subsequently obtained.
2.2 Ethical Considerations

Before conducting data research it is vital that all ethical issues have been considered, focusing on the participants to ensure that the methodology is “socially and morally acceptable” (Gratton & Jones, 2009, p.121), assuring that all data collected and generated would be anonymous.

2.3 Research Design

Research is defined as an advancement of human knowledge through discovery (Gratton & Jones, 2004, p4). Gratton & Jones (2004) clearly state that a research question must be clearly formulated so that it is measurable and therefore can expand current human knowledge.

A mixed research design was used within the study. A qualitative approach was used through questionnaires to gain self-analysis of performance. A quantitative methodology approach was used when analysing the development of performance through a specific intervention programme, examined by an external adjudicator and performance analysed through biomechanical alterations. The external adjudicator, provided by Cardiff Metropolitan University, is an expert in the field of performance analysis and correct alignment, having a strong background and knowledge of dance performance and technique with respect to kinaesthetic of movements. Morse (2007) defines multi-method design as “qualitative and quantitative projects that are relatively complete but are used together to form essential components of one research programme”. Creswell and Clerk (2007) state that mixed methodology’s “central premise is that the use of qualitative and quantitative approaches in combination provides a better understanding of research problems than either approach on their own”.

Gratton and Jones (2004) explained that as a researcher when creating a research design may consider the use of “multiple” means of data collection to explore a single hypothesis (2004, p.119). This form of research examines the links between variables involved with explaining why and how outcomes occur (Gratton & Jones, 2010, P.7). Taken from previous research of Holt et al (2011) in which they used a two-dimensional video based
motion capture system in which to assess alignment during and following specific dance movements, the study follows similar protocol in data collection.

Experimental research design uses controlled tests to analyse clear patterns. One or more variables are altered to determine an effect on the dependent variable (Blakstad, 2013). Gratton and Jones (2010, p30) explain that qualitative research is “feelings, thoughts and experiences” which seeks to examine qualities that are not quantifiable.

2.4 Protocol:

The five participants were selected on a volunteer basis with the requirement of a good level of knowledge of dance technique and aesthetics of the body in movement. Once it was clear that all the participants understood the requirements and any arising questions answered, they were shown the specific dance motif. The participants were allowed to warm up in the space and prepare themselves before learning the dance motif. Any loose clothing which participants were wearing was removed so the body positions could be seen and captured clearly. This was to allow for a strong image for examination, enabling clear observation of alignment. The participants were then positioned for recording. The high range flexibility motif was taught to the dancers and they were given accurate and specific body angles and instructions on the performance of the movements that were required. They were then given time to perfect the movement, with a view to allowing them to adapt to the kinaesthetic feel and perfect their efforts to performance standard (dance figure 2).

Dance figure 2:

Step forward onto the left leg kicking the right in front of the body, directing the leg towards the right side of the room (so the body is side on towards the video camera). Bend down into a crouch position right foot in front of the other and push into splits with the right leg in front, facing the right side of the performance space. Push the weight over to the left hand side open hitch kick towards the back of the room; roll around to standing to face the front (facing the camera). Step again to the right side of the room onto the right foot, fanning the left leg around in a fan kick. Return the leg to meet the other in parallel, step onto the
left leg and turn to face the front. Step the right leg behind the left, crossing the legs then take a step into a deep side lunge on the left leg. Transfer the weight onto the left hand side creating a deeper lunge and a diagonal line with the body. (See figures 4,5,6 and 7)

Once all participants were confident with the motif, they were recorded performing the dance three times. This allowed for re-recording of any incorrect or imperfect performance with a view to creating meaningful data. The participants were able to re-record the motif if the movements were performed incorrectly. After all three performances were recorded and the participants were content with the standard of their individual performances, they filled out a specific self-report questionnaire [Appendix D].

The questionnaire was designed to focus on their views of their own performances. The questionnaire allowed each performer to evaluate performance against a perfect model picture of each of the four key movements. They were then able to rate themselves on an individual basis against each of the four key movements with respect to flexibility and alignment in relation to performance as a whole. The questionnaires were used to ascertain each participant’s kinaesthetic feelings during each performance, whether they felt confident during the dance and how they felt about their own personal performance. The questionnaire took around ten minutes to fully complete, allowing for reflection time and self-evaluation. The participants were asked to fill out the questionnaire on their own and in silence to enable personal reflection.

Once the participants had completed the questionnaires on individual performance, the five-week intervention programme was explained in detail. Participants were given a printed hand-out of the proposed five-week intensive stretch programme giving clear instructions on stretches, time of stretch hold and repetitions [Appendix E]. Components within the programme were intended to give the subjects increased flexibility in the main leg muscles used throughout dance concentrating on the five key muscles used within the motif during the study. Each stretch was specifically designed to enhance flexibility of the five different muscles (hamstrings, hip adductors, hip flexors and quadriceps) which are used in the performance of dance. All stretching exercises were demonstrated in considerable detail, giving key technique points, with a view to preventing incorrect techniques and reducing risk of injury.
Each stretch was demonstrated fully, allowing for each participant to practice and be confident of what was required, giving the safest, most effective stretch. Changes in intensities over the period of the intervention programme were explained in relation to the specific muscles, the stretch duration and the number of repetitions completed over each week. This was designed to enable complete understanding of the intervention programme and allow adherence to best practice for the successful completion of the five-week intervention.

Further to the above, it was deemed important to ascertain whether an increase in range of motion within specific joints aids performance during high flexibility movements using the muscles stretched, therefore allowing for improvement in performance through achievement of neutral alignment. The range of movement will be analysed using hard data collected through videos of the performers during the specific dance motif; the angles of the movements have been calculated using studio code, a computer based performance analysis programme, looking at flexibility suggesting range of movement. It was fully explained that each stretch session should take around ten minutes to complete, allowing for ten second rest periods between each repetition.

All participants were given a stretch diary to allow the programme to be monitored and document their adherence [Appendix F]. During the five weeks of the study, the participants were able to ask any questions, if clarification was required, to allow for accurate completion of the study.

After the five-week intervention programme the participants returned for the second data collection. The specific high flexibility motif was re-taught allowing the dancers again to find the kinaesthetic feel of the movements (figure 2). Time for practice was again allowed, enabling the volunteers to perfect their performance. The motif was recorded again under the identical protocol as the first series, keeping angles towards the camera identical to the first recording allowing for consistent comparison.
Each participant was again filmed in succession three times to allow for repeat recording if the movements were performed incorrectly and the participant was unhappy with a particular performance.

Once this phase was completed, the participants were invited to fill in an altered self-report questionnaire, again reflecting on personal performance in respect to the perfect model and performance as a whole. The altered questionnaire allowed for self-analysis against the first data collection performance as well as the ‘perfect’ model. [Appendix G]

The videos of both presentations were then sent to an external adjudicator, who analysed the difference in performance between the first and second routine videos, as well as in comparing these to a perfect model performance. This was to determine whether regular stretching enhances performance technique through improved alignment. The external adjudicator has expertise in performance analysis with an extensive knowledge of dance technique, alignment and performance. Using an external adjudicator to analyse the videos enabled an unbiased comparison increasing the validity of the data produced. The alignment was graded in correlation to the four key movements within the routine, which showed use of flexibility within the muscles stretched in the intervention programme. The performance was also graded on improvements of the performance as a whole, looking at aesthetics and ease of movement and placed in a table [Appendix H].

2.5 Data collection

The subjects performed in a hexagonal dance studio. The participants were comfortable dancing within this familiar performance space as all their University practical dance classes are taught there. The set-up of this data collection was designed to record and collect physical information about dancer’s performance technique in four key movements whilst identifying improvements through a specific intervention stretch programme. The participants were given time to physically prepare and warm their bodies for performance, allowing for their full physical potential to be met during the study. (Pagaduan, Pojskić, Užičanin, and Babajić, 2012). The camera was left recording throughout the whole of the process so all movement made and taught was captured.
Utilising the advice of Bartlett, et al. (1992), the lens while recording the performer was manually adjusted so that the performer was in the best possible position within the camera’s field of view. After the participants had been given time to practice and perfect the motif they were recorded in succession of three times.

Detailed measurements indicated that the camera filmed 80% of the room so a dance space was marked out allowing for clear collection of data. The filming space of the dance studio was a hexagonal space (figure 2), the field of view of the camera lens was measured allowing for a cone-shaped view field of the camera to be marked out in the dance studio. This allowed a five metre square performance space in which all movement could be captured. The space was clearly marked out by coloured tape so the dancers could see a distinct performance area.

![Diagram of the experimental set-up of the data collection space.](image)

Figure 3: Diagram of the experimental set-up of the data collection space. (S1= studio code V4.5.1 computer point and display site). The diagram also shows the dimensions of the set-up. X marks the origin of the centre of the performance space which is 5 metres square. The orange hexagonal outline represents the shape of the dance studio; the blue cone shows the view field which the camera picks up in the room. The red outline box corresponds to the outlined space the participants performed in allowing all movements to be captured.

Each participant performed the solo dance within the marked out space, performing the phrase three times and allowing for three clean attempts at the performance. All three videos were analyses and the average data was taken. This allowed for validity of data.
and highlighted any anomalies or minor mistakes. It was hoped that this would potentially create a larger sample size for reliable analyses achieving five complete datasets.

Using Studio code V4.5.1, as the participants began the dance motif the video was started allowing for a marker on the video to be created to capture the dance from start to finish. This allowed recognition of the end of the motif and cancelling out any dead space between each of the three trials per performer. Studio code is a system which processes an integrated environment using a real time operating system. The system allows the comparison of the recordings. It further allows the use of tools for analysis of information collected from the software, graphically analysing many variables from the video frames and still images.

The videos of the performers were then put in separate folders to then be analysed against the second data collection. During analysis all three pre and three post videos were analysed by the external expert observer to increased validity, being able to conduct an unbiased approach during performance analysis of the videos. Whereas throughout data analysis, all three videos were averaged in terms of data and examination. If the participants performed the motif incorrectly they were able to re-record, the intention being for them to perform at their optimum level of performance and technique.

The intention was to show a clear accurate reflection of their true ability and level of technique with respect to correct alignment. After the five-week period of the intervention programme the participants returned to the testing space, and were given the same protocol as the first data collection.

The phrase of the four key movements was re-taught, using the same focus and facings towards the camera to capture the same movements at the same angles. The dancers where then allowed a short period of time to practice, once satisfied the same data
collection was carried out. Each participant performed the motif, which was recorded three times, again allowing for the participants to re-record if unhappy with personal performance. Each of the five dancers was recorded in the same sequence as the previous data collection, saving only the three preferred performances.

Questionnaires are one of the most common systems of research, as they are easy to assess, but they have disadvantages which could affect validity and reliability of data collection if not considered. Therefore to reduce this possibility a pilot questionnaire was completed and alterations were made enable greatest validity and reliability possible. The “questionnaire allows for responses to questions given, to be recorded by the respondents” (Kumar, 2011, p.145). Open and closed questions are used within this study to set a baseline of knowledge and then to gain a personal response. A questionnaire, if well-designed allows for the limitation of biased results by using correct wording which does not lead to a specific answer (Gratton & Jones, 2004. P117). The questions need to be clear and considered allowing for correct understanding of what is being asked of the participants themselves (Gratton & Jones, 2004. P117)

Both sets of questionnaires were then compared. The comparison looked at the reflections of the participants before and after the intervention programme, comparing the differences in the feeling of performance of the motif.

The questionnaire was trialled during the pilot study, its effectiveness assessed and changes made accordingly, enabling better understanding of requirements. The questions provided were not leading allowing for the participants to consider their own feelings, without attempting to interfere with the research area of study. (Roulston, 2010). Justification was made for each question before it was placed within the questionnaire, hopefully identifying that it assisted in answering the questions of the study (Gratton & Jones. 2010, p.131). Each question was modelled on the earlier research and supported by the available literature.
The questionnaire was related to the short motif which was performed and contained four self-evaluative questions on personal performance, looking at the individuals’ own perception of their ability relating to alignment and flexibility. During the evaluation the participants compared their own personal performances in relation to the four key movements relative to the pictures given of the “perfect” model, allowing for a baseline of analysis. The questionnaire used visual analogue scales to give a clear rating, looking at performance though perception of alignment and overall performance.

2.6 Pilot study:

It was suggested by Flick (2007, p.65) that using a range of approaches when collecting data increases the validity and reliability of a study where there has been little previous research. Kumar (2005) suggests every process within a given collection cannot be 100% controlled; there are always aspects of inaccuracy or human error which means that a study will never attain 100% reliability. Gratton and Jones (2004) stated that pilot studies are needed as an example test in order to gauge the effectiveness of the questions and the participants’ abilities to understand the questions, thus allowing for alterations to be made before the study commences. The completion of a pilot study enabled the methodology to be amended, increasing data validity. The room measurements were marked out, and using the camera angles, viewpoint space was created enabling all dancers’ movement to be fully captured within the area available. This allowed for all motion to be captured and the whole movement to be seen on the video for analysis. The view angle of the camera allowed for a cone-shaped space to be created for the performers to dance within, allowing for an approximately five metre dance area, in which all movement could be observed and recorded. This was only a small concern as the dance motif was very contained and only used a small space. During the pilot the facing of the four key movements towards the video camera was altered allowing for alignment of the movements to be clear for analysis. For full analysis of the high kick the facing angle was placed on the side-view looking at the alignment and position of the back during the high flexibility kick.
For the completion of the second key component the facing was also side on to the view of the camera, looking at the flexibility within the hip flexors and the alignment of the back. The round house or fan kick movement was placed side-on allowing for the clear capture of the movement of the volunteer’s back during its performance enabling assessment of the alterations in alignment from the motion of the movement. The fourth element, the deep side lunge, was positioned facing forwards focusing on the angle and alignment through the hip, shoulder and ankle. Slight alterations were made to the motif containing the four key elements allowing for a flow of movement and the altered angles of the four key points to be changed for accuracy of analysis. Small travelling and linking steps were added enabling the positions and facing to be changed easily and allowing for exactness of each movement each performance with each participant. During the trial study it was realised that wearing tight and bright clothes made it easier to see the body positions of the subjects so the participants were asked to wear comfortable tight fitting dancewear so their bodies’ structures and movements could be seen clearly.

Time was given to the dancers to enable the movements to be transferred into kinaesthetic feelings, perfecting the motif before the recording of performance. This enabled the dancers to become comfortable with the movements and confident for performance. During the pilot study the dancer was also given time to complete the specific questionnaire, allowing for alterations and amendments to be made so that it was clear and easy to understand. This enabled the questionnaire to be filled out correctly and completely understood during the data collection [Appendix I].

2.7 Validity and reliability

Importance is placed on validity and reliability therefore the participants were recorded three times. If the dancer in question completed the performance incorrectly they were able to complete the motif again until the motif was performed correctly for the required three times. Holt et al. (2011) suggests that during a study performing a solo in front of the researcher, other participants and a video camera may influence the dancer’s performance, thus hindering the study. They then suggest that it would take time for the influences to subside sufficiently for the dancers to perform naturally and to their optimum, therefore the three videos allows for this time period This allowed for three performances
of the volunteers perceived highest standard only, to then be taken to the adjudicator for analysis. The external analyser assessed all six videos of each participant basing their decision on a pre-recorded ‘perfect’ model. Each participant was given a detailed hand-out of the stretch programme progressing over the period of the five weeks, showing repetitions and sets for each movement. Issuing clear instructions enables accurate implementation of the programme.

Each stretch movement which was implemented within the programme was demonstrated before the programme began, allowing for the demonstration of correct technique for each movement. The demonstrations were also verbalised giving key points of safety for each stretch to ensure the perfect technique and the stretch of the correct muscle group. By completing a stretch diary indicating completion of the specific stretch programme over the period of the five weeks adherence could be assessed. This hopefully allowed for complete use of the programme and the possibility for progression. This should have enabled the entire specific stretch programme to be accomplished by each participant, creating consistent data for collection over the five week period. In an attempt to help this, the participants were given weekly reminders of the requirements and the application of the programme over the duration, allowing for feedback.

It was intended that the method of the research was clear and reliable so that it could be repeated within the study to show progression through the intervention process but also so that it could be repeated in future studies by other researchers as outlined by previous workers (Gratton and Jones, 2010). The methodology was provided in detail enabling identical repetition of the protocol.

**2.8 Data analysis**

Gratton and Jones (2010) suggest that although there are many recognised ways of analysing the available data, there is no one specific or “better” approach to analysis of data. Each individual study should be related to the research question (2009, p.33)
Each of the six performances recorded for each participant, pre and post intervention programme were broken down into sub sections, which were labelled and sectioned out into the four key components of analysis to allow for easier comparison. Using studio code database the videos were played in parallel with one another pre and post intervention video. This allowed for the external adjudicator to analyse the data in considerable detail against the preconceived ‘perfect’ model. This included terms of performance focusing on correct alignment.

The external adjudicator was shown a “perfect” model video as this allowed for a reference against which to base analysis. The video was approved by a qualified university dance tutor as being a suitable measure of the correct technique. The video of the pre and post intervention stretch programme was played next to a video of the perfect alignment during the same dance motif, allowing for a basis for analysis and a correlation between dynamic alignment and incorrect postures. There is risk participants know that they’re being filmed and want to perform to their fullest display an improvement so try and force the leg up higher, hindering the back alignment.

2.9 Figure 4. Where the movement angles were taken from:

Using studio code the dances were able to be sectioned into the four key movements. The video was paused; still picture was captured when the participant reached their highest flexibility within each four movements. From the pictures using the studio code software, angles from each of the stills were calculate by drawing lines through the plumb lines computing angles of the leg movements.

Movement 1) high kick: angle origin is taken from plumb-line of the supporting leg, a line running through the ankle knee and hip. The other line forming the angle is taken through the plumb-line of the left leg performing the high kick, again running through the ankle, knee and finishes at the origin of the hip, showing the flexibility of the high kick
Movement 2) splits: angle origin is taken from the hip joint, plumb-line running from the ankle, knee then originating at the centre where the lines meet.

Movement 3) round-house kick: angle origin is taken from plumb-line of the supporting leg, a line running through the ankle knee and hip. The other line creating the angle, plumb-line of the right leg, performing the round-house kick, running through the ankle, knee and finishes at the origin of the hip.

Movement 4) side lunge: the origin of the angle is formed at the hips, plumb-line running through the ankle, knee and hip of the straight right leg to the hip, the from the hip centre to the left bent knee, showing the angle of the lunge

Analysis of data was recorded in a table for each participant looking for improvements within the four key movements, allowing for clear examination of data for each contributor [Appendix I].

Livesey (2003) stated that when analysing during research there is flexibility for the adjudicator as they cannot judge or make certain assumptions before completing the data as measures, responses and experiences will differ with each individual participant. Using an external adjudicator allows for unbiased results to be produced. The external adjudicator was given specific points on the body to appraise during the four key movements, looking at the correct alignment of these specific points. This enabled the adjudicator to focus on areas of common faults within each of the key movements, showing limitations in specific flexibility within the points of alignment specified. During the first key movement of the high kick addressing flexibility in the hamstrings the main area of focus was the alignment of the whole back as the leg reached its highest point observing whether neutral position was achieved and maintained (figure 5). The second key movement, pushing through front to back splits, focused on the hip flexors and hamstring extensibility. The main area of analysis relates to whether the hips are down to the floor and the back is in an upright neutral position (figure 6). The third key movement called a fan or round house kick, again assesses the correct alignment of the whole back from the side angle (figure 7). The final key movement, a deep side lunge, focuses mainly on the diagonal line of the lunge going through the plumb-line (figure 8).
Figure 5- key movement 1, shows the “perfect” model for the first key movement, the high kick. The red line represents the key focus areas of alignment the adjudicator observed for technique analysis.

Figure 6- key movement 2, push into splits shows the “perfect” model for adjudicator analysis.

Figure 7- key movement 3, round house/ fan kick showing the movement of the leg as the neutral spine alignment maintained. The external adjudicator looked mainly at back alignment during the high flexibility movements.
Figure 8 – key movement 4, deep side lunge showing flexibility in the hip adductors. The external adjudicator looked at the diagonal alignment of the movement through the ankle, hip and shoulder the plumbline.

Further analysis of the videos were looked at through the computer database studio code, angles of neutral alignment were measured for each of the four key movements against pre and post intervention programme determining differences. Data was also collected through measurements of the angles during the high kick, fan kick and the side lunge pre and post intervention identifying any improvements in flexibility in each of the muscle groups studied. Any increase in angle size collected from the high kick, fan kick and side lunge post intervention performance showed increased range of movement in the hip.

The flexibility data was analysed to monitor any changes in performance of four key movements between the pre and post intervention. It was also important to gauge how the participants felt about the flexibility performance motif and if the potential increased flexibility had helped to enhance any aspects within dance and if so which components within performance.
Chapter Three

Results
3.1 Questionnaire Results:

The results show that all the participants felt that the performance of the dance motif had improved as a result of the intervention study through self-analysis. They all also believed that they had stayed the same or improved when self-rating flexibility, alignment, the four key movements and overall performance. On average they perceived overall performance improved by two point scores on the visual analogue scale after the stretch regime.

During question one, the participant’s evaluated current personal performance in relation to alignment which they rated as an average of four point two using a scale of one to ten. After the stretch programme the participants were asked to re-evaluate themselves again in relation to alignment and the results showed an average of six point two, an increase of two point scores. The same question was asked of personal performance relating to flexibility at the beginning of the data collection. Initial figures averaged four point six. After the five week stretch programme this increased by an average of three point score to seven point six.

The participants were given images of the perceived ‘perfect’ models of the four key movements within the study. They rated themselves on a scale of one to ten in terms of alignment. Movement one, the high kick increased a mean range of one point score from five to six whereas during self-evaluation of the second key movement increased a mean of three point scores from three to six point scores. The third key movement of the round house kick was rated very low in the first data collection with an average of three point two, which then increased after the five week programme to four point six. The final key movement of side lunge was again initially rated low on the analogue scale as an average of four point zero. After the stretch programme this increased significantly supposed by statistics by over three point score to an average of seven point four.

The participants rated their own performance overall on the first dance video assessment. Three performers rated themselves at a point score three on the visual analogue scale, the other two as six on the scale. After the stretch programme during the final data collection
and self-analysis of performance the participants rated all their performances over five, the range being from five to eight.

During the course of this project participants described suffering from restriction in their movements. All of them reported that after the stretch regime these restrictions were lessened, indicating that further use of the programme would potentially increase performance and reduce restrictions.

The participants were asked in which ways they felt that they had improved in their performance. They stated that the movements felt more comfortable on their bodies and flexibility had increased. The general feeling was that, although there was still room for further improvements, all actions had a greater range of movement. This resulted in a superior self-evaluation of performance.

Participant 1 Questionnaire results:

Table 2: Questionnaire results for participant one, pre and post-intervention stretch programme analysing alignment, flexibility, overall performance and self-analysis of performance for the four key movements in relation to a ‘perfect’ model.

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Pre-intervention stretch programme</th>
<th>Post-intervention stretch programme</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. 1: Alignment</td>
<td>4</td>
<td>7</td>
<td>+3</td>
</tr>
<tr>
<td>Q. 1: Flexibility</td>
<td>4</td>
<td>9</td>
<td>+5</td>
</tr>
<tr>
<td>Q. 2: Movement 1</td>
<td>7</td>
<td>8</td>
<td>+1</td>
</tr>
<tr>
<td>Q. 2: Movement 2</td>
<td>4</td>
<td>9</td>
<td>+5</td>
</tr>
<tr>
<td>Q. 2: Movement 3</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Q. 2: Movement 4</td>
<td>8</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Q. 3: Overall performance</td>
<td>4</td>
<td>6</td>
<td>+2</td>
</tr>
</tbody>
</table>
Figure 9: Questionnaire results of participant perception of performance before and after the intervention stretch programme.

Self-assessment of perceived alignment during the motif over the two data collections increases on the scale by three point score, from four to seven. The perceived flexibility rating increased by five point scores. Compared to the perfect model the participant rated their alignment on a scale during each of the four key movements; movement one increased by one point score, movement two increased greatly by five point scores, movement three and four were both judged as equal during each collection. The participant rated their overall performance during the first data collection at a point score of four which then increased to a point score of six during the post stretch intervention data collection.

Participant 2 questionnaire results:

Table 3: Questionnaire results for participant two, pre and post-intervention stretch programme analysing alignment, flexibility, overall performance and self-analysis of performance for the four key movements in relation to a ‘perfect’ model.
Figure 10- Participant two, questionnaire results of participant perception of performance before and after the intervention stretch programme.

The participant's baseline perceived alignment was rated at a point score of three which increased by one point score, as well as perceived flexibility which also increased by one point score. Question two the movements were rated at point scores they felt they performed alignment against to the 'perfect' model; movement one was rated point score three which then increased by two point scores, movement two was rated at the low point score of one and increased during the second data collection to three. Movement three started at point score two increasing after the stretch programme to a point score of three. During movement four, alignment was rated point score four increasing by three point scores to seven. Overall performance was perceived to be rated at a point score of four during the pre-intervention data collection increasing to point score five post-intervention.
Participant 3 questionnaire results:

Table 4: Questionnaire results for participant three, pre and post-intervention stretch programme analysing alignment, flexibility, overall performance and self-analysis of performance for the four key movements in relation to a perfect’ model

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Pre-intervention stretch programme</th>
<th>Post-intervention stretch programme</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. 1: Alignment</td>
<td>5</td>
<td>8</td>
<td>+3</td>
</tr>
<tr>
<td>Q. 1: Flexibility</td>
<td>4</td>
<td>9</td>
<td>+5</td>
</tr>
<tr>
<td>Q. 2: Movement 1</td>
<td>6</td>
<td>7</td>
<td>+1</td>
</tr>
<tr>
<td>Q. 2: Movement 2</td>
<td>3</td>
<td>6</td>
<td>+3</td>
</tr>
<tr>
<td>Q. 2: Movement 3</td>
<td>4</td>
<td>7</td>
<td>+3</td>
</tr>
<tr>
<td>Q. 2: Movement 4</td>
<td>5</td>
<td>8</td>
<td>+3</td>
</tr>
<tr>
<td>Q. 3: overall performance</td>
<td>4</td>
<td>7</td>
<td>+3</td>
</tr>
</tbody>
</table>

Figure 11- Participant three, Questionnaire results of participant perception of performance before and after the intervention stretch programme.

The perceived baseline level of alignment was five initially. After the stretch programme it was rated at eight, a three point score increase. Flexibility was rated at four which increased to nine. Question two rated the movements according to alignment in comparison to the ‘perfect’ model. Movement one increased by one point score to a standard point score of seven after the stretch programme. Movement two doubled from
three to six. Movement three increased from four to seven, movement four was rated a point score of five during the pre-intervention and increased by three point score to eight. Overall performance of the motif was rated during the initial data collection at four which increased to seven.

Participant 4 questionnaire results:

Table 5: Questionnaire results for participant four, pre and post-intervention stretch programme analysing alignment, flexibility, overall performance and self-analysis of performance for the four key movements in relation to a 'perfect' model.

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Pre-intervention stretch programme</th>
<th>Post-intervention stretch programme</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. 1: Alignment</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Q. 1: Flexibility</td>
<td>5</td>
<td>7</td>
<td>+2</td>
</tr>
<tr>
<td>Q. 2: Movement 1</td>
<td>5</td>
<td>6</td>
<td>+1</td>
</tr>
<tr>
<td>Q. 2: Movement 2</td>
<td>4</td>
<td>5</td>
<td>+1</td>
</tr>
<tr>
<td>Q. 2: Movement 3</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Q. 2: Movement 4</td>
<td>5</td>
<td>6</td>
<td>+1</td>
</tr>
<tr>
<td>Q. 3: overall performance</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 12- participant four, Questionnaire results of participant perception of performance before and after the intervention stretch programme.

Perceived point score of alignment and flexibility were rated at five during the initial data collection, the alignment point score stayed the same whereas the perceived point score of
flexibility increased to seven. For question two the participant again graded perceived alignment in comparison to the ‘perfect’ model looking at the four key movements. In this case movement one, two and four increased by one point score, whereas movement three stayed at the same point score. Overall performance was also rated an equal point score during both data collection.

Participant 5 questionnaire results:

Table 6: Questionnaire results for participant five, pre and post-intervention stretch programme analysing alignment, flexibility, overall performance and self-analysis of performance for the four key movements in relation to a ‘perfect’ model.

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Pre-intervention stretch programme</th>
<th>Post-intervention stretch programme</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. 1: Alignment</td>
<td>5</td>
<td>7</td>
<td>+2</td>
</tr>
<tr>
<td>Q. 1: Flexibility</td>
<td>6</td>
<td>8</td>
<td>+2</td>
</tr>
<tr>
<td>Q. 2: Movement 1</td>
<td>5</td>
<td>8</td>
<td>+3</td>
</tr>
<tr>
<td>Q. 2: Movement 2</td>
<td>4</td>
<td>8</td>
<td>+4</td>
</tr>
<tr>
<td>Q. 2: Movement 3</td>
<td>3</td>
<td>6</td>
<td>+3</td>
</tr>
<tr>
<td>Q. 2: Movement 4</td>
<td>6</td>
<td>8</td>
<td>+2</td>
</tr>
<tr>
<td>Q. 3: overall performance</td>
<td>6</td>
<td>8</td>
<td>+2</td>
</tr>
</tbody>
</table>

Figure 13- participant five, Questionnaire results of participant perception of performance before and after the intervention stretch programme.
Self-assessment of perceived alignment during the motif over the two data collections increases on the scale by two point scores, from five to seven. The perceived flexibility rating of participant five increased from five to eight a difference of three point score. Question two the movements were rated at point score they feel they performed alignment in comparison to the ‘perfect’ model; movement one was rated at point score five initially increasing by three point score to eight, movement two increased by four point score again to eight, movement three's point score doubled from three to six, movement four increased by two grades from a point score of six to eight after the stretch programme. Overall performance of the motif was rated during the initial data collection at six which then during the post-intervention data collection increased two point scores to eight.

3.1 Data analysis of angles

3.2a Angle Data Flexibility Results: (pre stretch programme, initial data collection)

Flexibility parameters that were established for each participant before the stretch programme was implemented. All four key movements highlighted within the study were analysed, calculating leg angles from the three successional videos recorded during the data collection. Data collected from the initial study shows flexibility statistics ranging from 163 degrees within movement two to 100 degrees in movement three over the key movements with a variation of 63 degrees, adding range observed by movement. Movement two overall produced the highest flexibility data with a mean result of 155.7 degrees ranging from 141-163 degrees; suggesting high levels of flexibility in the hip flexor muscle at baseline. Movement three in the initial data collection proved the most demanding and difficult to perform producing the lowest mean results of 113.9 degrees with a range of 100-127 degrees.

Participant five produced the highest flexibility data movements over the range of the four key movements suggesting greatest range of flexibility in the legs whereas participants one and two produced overall the lowest range of flexibility data for the four key movements.
All participants had a comparatively small range of variability within the video data collection throughout the key movement variables with a range of 2-10 degrees of change within the angles. This shows a minor degree of change in flexibility across the four key movements, showing optimal performance was videoed; suggesting maximum flexibility was performed during the data collection showing consistency and enabling reliability.

There is a large difference between the angles correlated through the sports coda data system of the four key movements suggesting inflexibility or lower ranges of movements within the joint due to certain muscle extensibility. Movement one, the high kick with the right leg, provides knowledge on flexibility status of the hamstrings ranging from 109-154 degrees, with a mean of 132.7 degrees in all five participants. The median angle during the high kick was 127 degrees in comparison to movement two which has a greater median of 157 degrees. Movement two shows a higher flexibility range during right legged splits of 141-163 degrees with a mean of 155.7 degrees. Movement three, the round-house kick has the lowest mean calculation of 113.9 with a range of 100-130 degrees showing difficulty when performing this movement suggesting there is tension limiting the movement range. The median calculation of the round-house kick was 117 degrees in comparison to movement four which has a median of 118 degrees. Movement four, the side lunge, has a range of 105-150 degrees with a mean of 122.4 degrees.

3.2b Angle Data Flexibility Results: (post stretch programme, initial data collection)

Each of the four key movements highlighted within the initial data collection were again analysed post intervention. The same study protocol was applied enabling exact comparisons and permitting validity of analysis. Data collected from the post-intervention videos show that flexibility statistics ranges over the five dancers within the four key movements from a lower angle of 96 degrees to 166 degrees.

Movement one demonstrated data ranging from 120 to 159 degrees improving by five degrees from the highest angle recorded during the initial collection. This improved level of flexibility shown within the data suggests that hamstring extensibility within the right leg has increased, altering the motif performance. The high kick gave a mean of 140.8 degrees
over the five participants and a median angle of 134 degrees. Overall, movement two produced the highest data angles collected with a range of 155 to 167 degrees giving a mean of 163.1 degrees. The splits movements again demonstrated the greatest median angle of 165 degrees. In comparison, movement three demonstrated the lowest mean of 118.3 and a median result of 118.5 degrees. However the data collected did not produce the lowest data angle collected with a range of 107 to 131 degrees during the round-house kick in contrast to movement four which produced a range of 96 to 154 degrees. During the data collection of this movement, one of the participants performed the movement with the incorrect angle towards the camera, meaning that data could not be accurately taken and was therefore invalid. Movement four, the side lunge, demonstrated a mean of 126.4 degrees with a median of 122 degrees.

Participant 1 data collection results:

Table 7: shows the angles of the four key movements in degrees plus their standard deviations, from the origin of the hips, demonstrating alterations in flexibility over the five week stretch programme. Shows the three pre and post intervention video leg angles of the four key movements.

<table>
<thead>
<tr>
<th>Video number</th>
<th>Movement 1: high kick, leg angle (degrees)</th>
<th>Movement 2: angle of split (degrees)</th>
<th>Movement 3: round-house kick, leg angle (degrees)</th>
<th>Movement 4: side lunge, leg angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-intervention 1</td>
<td>123</td>
<td>161</td>
<td>100</td>
<td>105</td>
</tr>
<tr>
<td>pre-intervention 2</td>
<td>116</td>
<td>153</td>
<td>105</td>
<td>109</td>
</tr>
<tr>
<td>pre-intervention 3</td>
<td>119</td>
<td>163</td>
<td>102</td>
<td>105</td>
</tr>
<tr>
<td>Mean pre-intervention</td>
<td>119 ± 3.5</td>
<td>159 ± 5.2</td>
<td>102 ± 2.5</td>
<td>106 ± 2.3</td>
</tr>
<tr>
<td>post-intervention 1</td>
<td>134</td>
<td>165</td>
<td>109</td>
<td>110</td>
</tr>
<tr>
<td>post-intervention 2</td>
<td>133</td>
<td>164</td>
<td>112</td>
<td>114</td>
</tr>
<tr>
<td>post-intervention 3</td>
<td>134</td>
<td>166</td>
<td>112</td>
<td>116</td>
</tr>
<tr>
<td>Mean post-intervention</td>
<td>133 ± 0.6</td>
<td>165 ± 1</td>
<td>111 ± 1.7</td>
<td>113 ± 3.1</td>
</tr>
</tbody>
</table>
Figure 14: Leg angle data of four key movements during the three pre-intervention and three post-intervention data collections. Movement 1 high kick (blue), movement 2 splits (red), movement 3 round-house kick (green), movement 4 side lunge (purple).

Participant 1 results analysis

Participant one data results showed 100% improvement with increasing data angles of all four key movements from the initial data collection. Movement one showed the largest variability in angle improvement from the initial data collection starting from 116 degrees and increasing to 134 degrees. Increased consistency of movement one occurred, with a range of 133 to 134 which in turn meant movement variability increased. Movement two persistently improved in the height of flexibility by one degree each performance, from 155, 156 to 157, showing enhanced range of movement within that specific move. Movement three and four showed similar progression in visual flexibility improving by four to seven degrees over the three post-intervention. Movement three increased from a mean of 102.3 to 111, movement four showed an improved mean range from 105.3 to 113.3

Participant 2 data collection results:

Table 8: shows the angles of the four key movements in degrees plus their standard deviations, from the origin of the hips, demonstrating alterations in flexibility over the five
week stretch programme. Shows the three pre and post intervention video leg angles of the four key movements.

<table>
<thead>
<tr>
<th>video number</th>
<th>Movement 1: High kick, leg angle (degrees)</th>
<th>Movement 2: angle of split (degrees)</th>
<th>Movement 3: Round-house kick, leg angle (degrees)</th>
<th>Movement 4: side lunge, leg angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-intervention 1</td>
<td>117</td>
<td>141</td>
<td>104</td>
<td>115</td>
</tr>
<tr>
<td>pre-intervention 2</td>
<td>109</td>
<td>149</td>
<td>106</td>
<td>111</td>
</tr>
<tr>
<td>pre-intervention 3</td>
<td>111</td>
<td>147</td>
<td>103</td>
<td>121</td>
</tr>
<tr>
<td>Mean Pre-intervention</td>
<td>112 ± 4.2</td>
<td>146 ± 4.2</td>
<td>104 ± 1.5</td>
<td>116 ± 5.03</td>
</tr>
<tr>
<td>post-intervention 1</td>
<td>120</td>
<td>155</td>
<td>107</td>
<td>96</td>
</tr>
<tr>
<td>post-intervention 2</td>
<td>129</td>
<td>156</td>
<td>109</td>
<td>126</td>
</tr>
<tr>
<td>post-intervention 3</td>
<td>131</td>
<td>155</td>
<td>108</td>
<td>108</td>
</tr>
<tr>
<td>Mean Post-intervention</td>
<td>127 ± 5.9</td>
<td>155 ± 0.6</td>
<td>108 ± 1</td>
<td>110 ± 15.1</td>
</tr>
</tbody>
</table>

Figure 15: Leg angle data of four key movements during the three pre-intervention and three post-intervention data collections. Movement 1 high kick (blue), movement 2 splits (red), movement 3 round-house kick (green), movement 4 side lunge (purple).

Movement 1 showed the greatest improvement, presenting a 22 degree increase from minimum to maximum with a mean range of 111.3 to 126.6. Movement 2 showed a constant improvement of a minimum of six degrees, increasing in the angle measurements minimally throughout the three post-intervention trials from the pre-intervention with a
mean range from 145.6 to 155.3. Movement 3 showed low amplitude of improvements increasing the angles by one degree from the highest recorded data from the initial collection further improving from this in the two data points. The second performance of this moved showed a big increase in the angle of the flexibility; whereas the third result then dipped again lowering below the average from the pre-stretch intervention data collection fluctuate largely. This data suggests that a higher standard of flexibility can be reached but is not always used within performance with a mean ranging pre and post intervention from 104.3 to 108. This effectively gave inconsistent results which are unreliable and cannot be used in further research. Movement 4 this showed an anomaly within the data, during the first collection the movement angle had a range of 111-121, decreased from the initial data collection results the participant displayed data with a larger range with a low of 96 degrees and improving to 126 degrees with a mean range of 115.6 to 110.

Participant 3 data collection results:

Table 9: shows the angles of the four key movements in degrees plus their standard deviations, from the origin of the hips, demonstrating alterations in flexibility over the five week stretch programme. Shows the three pre and post intervention video leg angles of the four key movements.

<table>
<thead>
<tr>
<th>video number</th>
<th>Movement 1: High kick, leg angle (degrees)</th>
<th>Movement 2: angle of split (degrees)</th>
<th>Movement 3: Round-house kick, leg angle (degrees)</th>
<th>Movement 4: side lunge, leg angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-intervention 1</td>
<td>125</td>
<td>162</td>
<td>117</td>
<td>131</td>
</tr>
<tr>
<td>pre-intervention 2</td>
<td>129</td>
<td>152</td>
<td>118</td>
<td>125</td>
</tr>
<tr>
<td>pre-intervention 3</td>
<td>127</td>
<td>157</td>
<td>115</td>
<td>132</td>
</tr>
<tr>
<td>Mean pre-intervention</td>
<td>127 ± 2</td>
<td>157 ± 5</td>
<td>117 ± 1.5</td>
<td>129 ± 3.8</td>
</tr>
<tr>
<td>post-intervention 1</td>
<td>129</td>
<td>167</td>
<td>130</td>
<td>137</td>
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<tr>
<td>post-intervention 2</td>
<td>137</td>
<td>165</td>
<td>126</td>
<td>143</td>
</tr>
<tr>
<td>post-intervention 3</td>
<td>131</td>
<td>164</td>
<td>131</td>
<td>139</td>
</tr>
<tr>
<td>Mean post-intervention</td>
<td>132 ± 4.2</td>
<td>165 ± 1.5</td>
<td>129 ± 2.6</td>
<td>140 ± 3.8</td>
</tr>
</tbody>
</table>
Participant three showed improvements over the four key movements, improving from the initial pre-intervention stretch data collection by one degree in flexibility. Movement one showed an eight degree increase from the best data collected pre and post intervention programme with a mean range of 127 to 132.3. An average starting at 127 degrees increasing to 132 degrees with an average increase of five degrees. Movement two ranged from 152 degrees within the pre-stretch programme increasing by 12 degrees to 167 degrees after the programme was applied the mean ranged from 157 to 165.3. Movement three showed the greatest amplitude improvement, increasing from 115 to 131 with a mean improvement of 13 degrees over the six videos analysed with a mean range pre and post intervention 116.6 to 129. Movement four improved by four degrees of flexibility from the highest data collected from the pre programme data and the lowest recorded data from the post stretch videos. A mean improvement over all six videos analysed of ten degrees, with a height of a 143 angle during the side lunge movement with a mean pre and post intervention range of 129.3 to 139.6.
Participant 4 data collection results:

Table 10: shows the angles of the four key movements in degrees plus their standard deviations, from the origin of the hips, demonstrating alterations in flexibility over the five week stretch programme. Shows the three pre and post intervention video leg angles of the four key movements.

<table>
<thead>
<tr>
<th>video number</th>
<th>Movement 1: High kick, leg angle (degrees)</th>
<th>Movement 2: angle of split (degrees)</th>
<th>Movement 3: Round-house kick, leg angle (degrees)</th>
<th>Movement 4: side lunge, leg angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-intervention 1</td>
<td>154</td>
<td>157</td>
<td>125</td>
<td>118</td>
</tr>
<tr>
<td>pre-intervention 2</td>
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<td>111</td>
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<td>pre-intervention 3</td>
<td>146</td>
<td>155</td>
<td>125</td>
<td>112</td>
</tr>
<tr>
<td>Mean Pre-intervention</td>
<td>147 ± 6.5</td>
<td>157 ± 2</td>
<td>126 ± 1.2</td>
<td>114 ± 3.8</td>
</tr>
<tr>
<td>post-intervention 1</td>
<td>157</td>
<td>162</td>
<td>126</td>
<td>122</td>
</tr>
<tr>
<td>post-intervention 2</td>
<td>158</td>
<td>166</td>
<td>126</td>
<td>119</td>
</tr>
<tr>
<td>post-intervention 3</td>
<td>159</td>
<td>163</td>
<td>126</td>
<td>116</td>
</tr>
<tr>
<td>Mean post-intervention</td>
<td>158 ± 1</td>
<td>164 ± 2.1</td>
<td>126</td>
<td>119 ± 3</td>
</tr>
</tbody>
</table>

Figure 17: Leg angle data of four key movements during the three pre-intervention and three post-intervention data collections. Movement 1 high kick (blue), movement 2 splits (red), movement 3 round-house kick (green), movement 4 side lunge (purple).
Movement one the high kick showed an improvement of 18 degrees from lowest to highest collected data angles. There was an average increase of ten degrees over the three pre and post intervention data collections this movement showed a mean increase ranging from 147 to 158 degrees. Movement two showed a development mean of six degrees over the six data collection videos, ranging from 155 to 166 an overall enhancement of flexibility from lowest to highest of eleven degrees creating a mean range of 157 to 158. During movement three the participant incorrectly performed the specific move, preventing clear reliable data to be collected. This is due to in accurate facing of the movement towards the camera, meaning that a clear angle could not be calculated from the videos. Therefore a comparison of pre and post intervention programme cannot be made during this section. Movement four gave a mean angle of 113 over the three pre-intervention studies, improving to mean angle of 119 during the post-intervention data collecting giving an average enhancement of six degrees. The movement flexibility ranged from 111 to 122 giving an overall improvement of eleven degrees from lowest to highest.

Participant 5 data collection results:

Table 11: shows the angles of the four key movements in degrees plus their standard deviations, from the origin of the hips, demonstrating alterations in flexibility over the five week stretch programme. Shows the three pre and post intervention video leg angles of the four key movements.

<table>
<thead>
<tr>
<th>video number</th>
<th>Movement 1: High kick, leg angle (degrees)</th>
<th>Movement 2: angle of split (degrees)</th>
<th>Movement 3: Round-house kick, leg angle (degrees)</th>
<th>Movement 4: side lunge, leg angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-intervention 1</td>
<td>137</td>
<td>158</td>
<td>124</td>
<td>144</td>
</tr>
<tr>
<td>pre-intervention 2</td>
<td>146</td>
<td>160</td>
<td>119</td>
<td>147</td>
</tr>
<tr>
<td>pre-intervention 3</td>
<td>140</td>
<td>162</td>
<td>118</td>
<td>150</td>
</tr>
<tr>
<td>Mean pre-intervention</td>
<td>141 ± 4.6</td>
<td>160 ± 2</td>
<td>120 ± 3.2</td>
<td>147 ± 3</td>
</tr>
<tr>
<td>post-intervention 1</td>
<td>152</td>
<td>167</td>
<td>127</td>
<td>143</td>
</tr>
<tr>
<td>post-intervention 2</td>
<td>155</td>
<td>165</td>
<td>123</td>
<td>154</td>
</tr>
<tr>
<td>post-intervention 3</td>
<td>153</td>
<td>166</td>
<td>125</td>
<td>153</td>
</tr>
<tr>
<td>Mean post-intervention</td>
<td>153 ±1.5</td>
<td>166 ± 1</td>
<td>125 ± 2</td>
<td>150 ± 6.4</td>
</tr>
</tbody>
</table>
Figure 18- Leg angle data of four key movements during the three pre-intervention and three post-intervention data collections. Movement 1 high kick (blue), movement 2 splits (red), movement 3 round-house kick (green), movement 4 side lunge (purple).

Movement one showed a range of flexibility from 137 to 155 over the two data collections giving an increase from lowest to highest of 18 degrees. During the initial data collection the flexibility during this movement was calculated at a mean of 141 increasing to a mean of 153 after the implantation of the stretch programme giving an average increase of twelve degrees. Movement two showed that despite having a large flexibility angle from the initial testing flexibility has improved from a 160 to 166, an average increase of six degrees with a mean ranging pre and post intervention from 160 to 166 degrees. Movement three the roundhouse kick showed a mean calculation of 120 during the pre-intervention data collection increasing by five degrees on average to 125 degrees after the implementation of the programme. Calculated flexibility degrees range from 118 to 127 an increase of nine degrees with a mean range over the three pre and post videos of 120.3 to 125 degrees. Movement four the side lunge showed small improvement of three degrees of flexibility, 147 to 150. Range from lowest of 144 in the initial pre-intervention data collection to 154 during the collection, with an increase of ten degrees creating a mean range of 147 to 150.
3. 3 External adjudicator analysis [Appendix J]:

During this section is a conclusion of the results given by the external adjudicator, analysing all six videos of the participants in terms of flexibility and alignment in concurrence with the 'perfect' model video the movements. The results look at the three pre intervention videos in correlation to the three post intervention videos of all six participants focusing on alterations in performance of the four key movements and overall performance.

Table 12- External adjudicators results in terms of flexibility and alignment

<table>
<thead>
<tr>
<th>Participant number</th>
<th>External adjudicator analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1:</td>
<td>Showed improvement in overall flexibility sometimes by small margins, suggestions that the videos show the participant forcing the movement to gain consistent improvements across all videos. Movement one the high kick slight but significant improvement was seen but the technique was hindered as the heel left the ground to further enhance dynamic flexibility. The external adjudicator suggested shown improvements during the positioning of the splits and minimal improvements during key movement three the roundhouse kick, suggesting the participant using force and supporting bent knee to get the leg around and further increase flexibility. The side lunge showed improvement through flexibility the analyser suggested that the participant’s technique altered as pushing the straight leg away to again gain greater angle of flexibility in the movement.</td>
</tr>
<tr>
<td>Participant 2:</td>
<td>External adjudicator suggested significant improvement in flexibility form pre intervention video but the participant requires more control to further performance and gain higher aesthetic. The analysers of the performances states the participant shows force in the movement to gain greater range of movement within the key moves. Slight improvement is shown during the high kick as the heel post intervention is kept on the ground showing greater flexibility but the supporting leg bends, obstructing the body line creating an</td>
</tr>
</tbody>
</table>

Alignment overall during the performance analysed by the expert is stated as poor, suggesting the movements look forced instead of looking effortless. The participants does not maintain core stability therefore causes misalignment during the right high kick and lack of control. Over stretching in the upper body is suggested to be seen within the video during the side lunge preventing correct alignment to be maintained. During the split position, the second key movement alignment had advanced but still not conceived as technically accurate as the upper torso is leant over the front leg suggesting insufficient flexibility in the hip flexors. Gain during the round-house kick the movement looked forced to the outside adjudicator, poor movement and core stability showing lack of control. This could suggest that in future studies to gain greater knowledge, core stability exercises can also be used as well as kinaesthetic and visual stimuli of correct alignment of the specific moves to the enhance physical learning and performance.
incorrect aesthetics. splits positions shows augmented flexibility whereas the round-house kick only visually showed slight improvements. The side lunge showed no advancement, the performance analysis suggest over stretching of the torso to demonstration increase in flexibility.

Alignment over all suggest by the expert performance analysis did not improve overall, again over stretching in the lunge position but showing vast improvements and throwing away the movement instead of maintaining core stability hindering neutral alignment. During the high kick and round-house kick the pelvis was tilted and misaligned preventing efficient movement meaning the movement is forced. The split movement improved in alignment where the torso is more upright.

Participant 3:
Overall flexibility performance was initially at a good standard with slight improvements pre intervention. The main improvements were visually noticeable with the splits movement where flexibility greatly increased as well as side lunge flexibility enhanced. The high kick started with a high level of used flexibility but still showed slight improvements, whereas the knee slightly bent during execution suggesting inflexibility or misplaced force, the round-house kick showed similar visual results slight improvement from a good starting basis.

Alignment overall again was at a high initial standard with good core stability during high kick and round-house kick, greatest visual improvement was shown during the splits position as correct posture and neutral alignment was maintained. The lunge was again over stretched with the torso bending the aesthetic line using incorrect technique.

Participant 4:
Pre intervention video showed good flexibility during high kick, roundhouse kick and splits position, improvements were visually hard to see due to strong foundation from the offset. Slight improvements were seen, during the two kick movements the knee bends from misplaced force.

Overall alignment post intervention declines with force of movement meaning loss of control. Round-house kick showed poor control during the dynamic alignment and during the splits the torso hunches over creating an anaesthetic line. During the roundhouse kick the movement was not performed at the same angle therefore the movement was front on to the camera so hard to correctly analyse. The high kick pre and post intervention both showed good posture but control and body alignment improved as was better maintained. The side lunge stayed at the same performance level visually.

Participant 5:
Stated by the external analyser the overall performance had good flexibility pre and post intervention programme and improvements were hard to judge. The splits position, roundhouse kick and side lunge were all rated at the same standard and level during performance. Minor improvements were seen during the high kick suggesting a slight increase in flexibility or in the ability to use the flexibility dynamically.

No overall improvement in alignment was seen visually according the external adjudicator. The movements were all rated at the same level par and post intervention programme suggesting optimum flexibility and alignment for the specific key movements.
were already met before the implementation of the programme. General alignment initially was good, especially during the split position as the torso is held upright and core is stable, the supporting leg during the two kicks slightly bent suggesting misplaced force and failure to control the movement. During the side lunge the movement is over stretched in the torso is uncontrolled so the position is not held.

### 3.4 Summary of findings

Table 13- An overview summary of self-evaluation, hard data angle analysis and external adjudicator results for all five participants relating to performance.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Self-evaluation</th>
<th>Angle data analysis</th>
<th>External adjudicator analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant One</td>
<td>Improvements suggested during overall alignment, flexibility and performance but showed no felt improvements during movement three and four.</td>
<td>Showed improvements during all four key movements in terms of increased angles of flexibility.</td>
<td>Participant improved overall in flexibility performance whereas only the alignment during splits improved and the other moves showed no alteration in performance.</td>
</tr>
<tr>
<td>Participant Two</td>
<td>Improvements during all movements and overall performance, suggesting small advancements in flexibility and alignment; showing the highest rated improvement during key movement four</td>
<td>Showed improvements during key movements one, two and three whereas movement four showed no mean improvement of flexibility</td>
<td>Participant visually slightly improved in flexibility performance whereas alignment was set at the same standard pre and post intervention with slight improvements during movement two.</td>
</tr>
<tr>
<td>Participant Three</td>
<td>Self-evaluated improvements during all aspects of the study with greatest improvement in overall flexibility</td>
<td>Showed improvements within all four key movements in terms of flexibility</td>
<td>Flexibility improvements shown overall, greatest improvements show with movement two and four. Alignment slightly enhanced post intervention but had a good starting basis, splits alignment improved greatest.</td>
</tr>
<tr>
<td>Participant Four</td>
<td>Self-evaluated improvements during all movements except movement three in which had the same rating score as well as alignment and overall performance. Suggesting alignment performance was not</td>
<td>Showed improved flexibility during movement one two and four, movement three could not be calculated.</td>
<td>Small improvements shown within flexibility within all four key movements, with a high starting flexibility range. No improvement seen within alignment, flexibility hinders and declines alignment post</td>
</tr>
</tbody>
</table>
affected by the intervention programme.

| Participant Five | Self-evaluated improvements during all movements, overall alignment, flexibility and performance | Showed increased flexibility during all four key movements | Good flexibility base pre intervention, shows small improvements in flexibility post intervention. Good general alignment pre intervention small improvements also seen post intervention. |
Chapter Four

Discussion
**Discussion**

Data was analysed with particular emphasis on the themes and patterns which emerged during the project in an attempt to answer the research question.

The primary aim of this study was to examine specific kinetic and performance variables and establish whether variability of these parameters could influence alignment and flexibility in relation to a specific dance performance. Flexibility and alignment variables have been previously identified as factors related to both dance and performance (Smith-Autard, 2000). It is hypothesized that increases in flexibility will help improve performance, this study aimed to develop information of the most effective training mechanism which helps in enhancing performance of dance and the dancer's ability.

Overall, the results of all participants supported the hypothesis that a minor increase in flexibility helps to aid performance through improving aspects of the performance. Increase in muscular elasticity enables a larger measured range of movement, aiding in the performance. Results would appear to indicate that a greater range of movement facilitates greater ease of the performance of high flexibility movements. Results suggest that the stretching programme demonstrated enhancement of flexibility in the five key muscles used within the dance motif, as well as enhancing personal perception of performance given that all participants felt they had improved their performance following the stretch programme intervention.

It could be concluded that over emphasis on enhancing flexibility can result the detriment to some of the other aspects of performance.

It is possible that the participants, when using force to increase flexibility, misplace the force, which in turn hinders dynamic alignment. This has been suggested by Wilcosky (2011) who concluded that misalignments of the body can result in poor movement quality resulting in bad technique. The work of Wilson and Kwon (2008) would appear to back this up as they propose the result is non-aesthetic movements.

Specific intervention stretch programmes have many advantages on a dancer's performance as ultimately it is the aesthetic look and high flexibility lines created by the body that produces a high standard of performance.
Qualitative Key findings:

4.1 Questionnaire:

Self-evaluation of performance revealed that all participants believed that their personal level of performance led to an overall improvement in dance motif performance. Participants reported that flexibility improved more than alignment but both had improved up to the final performance. Boyd and Fales (1983, p.99-117) state during transformations in “professional practice, the ability to reflect purposefully develops the participant in self-awareness, critical analysis and evaluation”. Schon (1991) during research found similar results suggesting the learner is required to be self-aware, aware of interactions between themselves and the external environment, whether related to performance, practice or controlled situations.

During the study the participants assessed the four specific movements within the motif which the stretch programme was designed to enhance; these were measured against visual images of the ‘perfect’ models.

Table 13 - shows an analysis of questionnaire results and external adjudicator results in terms of the four key movements and overall performance in correspondence to flexibility, alignment and overall performance

<table>
<thead>
<tr>
<th>Movement Number</th>
<th>Discussion of four key movements with analysis of results from the self-evaluation questionnaire and external adjudicators findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movement One</td>
<td>High kick increased in terms of alignment on improving over a spread of +1 to +3 point scores, showing that all participants felt they improved during the movement. The external adjudicator suggested that several of the participants made this movement look forced instead of effortless. This was because participants tilted the pelvis to facilitate the required movement. In further analysis it appeared that the participants slightly bending the supporting leg or lifting the heel just off the ground to gain greater flexibility resulted in them hindering technique and aesthetics. Participants three and four showed slight improvements of alignment during key movement one, using the core to compensate for the greater force applied to gain the optimum flexibility. Both these participants started with an overall good initial alignment basis during pre-intervention data collection. Whereas visually all participants showed increased flexibility outcomes some appeared to hinder the technique not achieving an increase in dynamic flexibility. From this data it may be suggested that participants three and four benefited from greater kinaesthetic awareness of alignment and improved body placement. As stated within the literature this potentially relates to the “awareness of one’s own body in relation to its external surroundings while moving in concurrence with pressure, weight, balance, coordination and shape” (Bartal &amp; Ne’eman, 2001, p. 14).</td>
</tr>
<tr>
<td>Movement Two</td>
<td>Flexibility increased, giving an increased perceived level of alignment and performance, on average increased three levels. The data collected suggest that the participants felt that they had completed the movements with superior technique following the intervention. This suggests an improvement in the ability to execute the move and enhanced ease of</td>
</tr>
</tbody>
</table>
movement performance. Results reported by the external analyser suggests that participant one and three showed noticeably improved split flexibility, participants four and five showed slight improvements from a good starting baseline and participant two showed limited improvements.

In relation to the ‘perfect’ alignment, the external analysis used as a basis as well as expert judgement reported that participants’ one, two, three and five demonstrated significant improvements in pulling the torso into the correct upright position and creating neutral alignment holding in the ‘core’. Participant four in an effort to control movement of the torso hunched over, restricting the movement in performance qualities and hindering alignment.

**Movement Three**

The initial data collection reported was low, only reaching an average rating level of three with an improvement ranging from 0 differences to +3. This would suggest a lower self-motion when completing this movement. The external adjudicator’s results reported that flexibility during performance visually improved in the range of movement for all participants, but with the high kick the extra force applied was misplaced, hindering alignment and technique resulting in throwing the torso out of neutral alignment. In relation to alignment the external adjudicator reported that lack of core stability and dynamic body awareness prevented the participants from achieving optimal performance, creating a forced movement with misalignment of the torso and hip.

**Movement Four**

The final key movement gained the greatest measured improvements in alignment, increasing a range on +1 to +3, producing the greatest mean improvement of three point scores. This links to the findings of Minton (2003, p.103) that when a subject is “immersed in the feeling of the movement, it creates an authentic dance”. Furthermore Koutedakis et al. (2007) reported that perfection during dance comes from focus on correct alignment in which dancers must be an expert as well as other key performance and technical qualities. The adjudicator evaluated flexibility of participants one, three and four significantly visually improved from the initial level in the pre intervention data collection.

Participants two and five showed no overall improvement in flexibility related to this movement. The adjudicator believed that poor alignment was to blame. The fact that no overall improvement was achieved was reported (by who??) to be due to incorrect technique in that the torso being tilted over to a greater extent than necessary, impeding aesthetic performance. Two of the participants (which ones?) performed the lunge movement correctly at first but then extended the straightened leg further away, to achieve increased flexibility. This extension did not have the desired effect resulting in hindering correct performance of the lunge.

During the side-lunge, all participants showed a lack of kinaesthetic awareness for the correct alignment, over stretching their torsos over the bent leg to increase the look of flexibility. It would seem this bend in the aesthetic line hindered the performance of the movement, suggesting lack of body awareness in space.

Participant five showed a correct alignment during the side lunge, but lacked core stability and control to hold the correct position, impeding performance.

**Overall performance**

In relation to alignment and flexibility the participants then re-evaluated themselves after the intervention stretch programme. The re-evaluation demonstrated an increase, on average, of two point scores for alignment and three point scores for flexibility. This corresponded with the participants reporting that they all felt that their performance of the motif had improved both through flexibility and alignment. Suggested by the external adjudicator’s analysis overall, only three of the participants visually improved in flexibility and alignment whereas the final two participants only visually improved in flexibility.

Reported by the external adjudicator all dancers showed visual signs of flexibility improvement and one participant showed visual improved dynamic alignment through the key movements. Participants three and five alignment visually did not differ over the data collections.

During the initial test three participants self-rated at a level of three and the other two rated at a level six. This was then re-graded after the five week intervention programme during the second data collection. The second collection involved the participants re-grading their perceived performance. Results showed an improved point score ranging from +1 to +3 point scores with participant four suggesting no overall improvements. It is clear from this that the four out of five of the participants felt they had developed in performance and enhanced aesthetic skill when performing the motif.
During self-evaluation and reflection on performance the participants reported less restrictions during movements allowing for ease of the movements which they previously found difficult. The participants suggested that they improved due to increased ease and comfort during the required movements. The participants through self-evaluation suggested further use of the stretch programme would aid in performance further.

The external analysis suggests alignment may be incorrect, due to forcing the movements to demonstrate improvements in flexibility. The effort and force generated prevents the participants from adhering to correct technique, creating misalignment in the motif. Given the focus on flexibility of the specific movements, the participants when they danced appeared to put all effort and work on this approach potentially losing the discipline of correct technique through neutral alignment inhibiting performance of the motif.

The external adjudicator stated that the performers both improved and diminished in performance ability, suggesting that the specific stretch regime was well designed in method but could be executed differently but not fully aligned with the required performance. It has been reported by Koutedakis et al. (2004) that any exercise to aid in dance practice, which is not directly connected to a specific dance act could potentially reduce the dancer’s aesthetic appearance. This suggests that the intervention stretch programme was specific to the four key movements but did not take into account dynamic performance. As the stretches were performed when the participants were static there appears to be no clear kinaesthetic correlation when then translated into dynamic movements.

It has been reported that hamstring extensibility influences spinal posture (Muyor et al., 2012). The results of this study would appear to support this. Participants one, two and three improved in performance technique through correct alignment during the second key movement. The correct technique during this movement allows for the back to be in the upright neutral position, to aid hamstring and hip flexor flexibility and allow for a technically correct position to result. Muyor et al. (2012, p, 167) suggest that hamstring extensibility is linked with “lower thoracic angle and greater hip flexion”, It could therefore be proposed that the movement has improved as an impact of greater hip flexor and hamstring extensibility, which work adjacently to complete the movement correctly.
Diaries:

If the individuals completed stretch diaries are to be believed, participants two and five showed high adherence to the study. This is obviously difficult to check, but it would be hoped that the diaries were completed correctly. Participant five showed that despite having a large flexibility angle from the initial testing, this demonstrates that high performance may be further improved.

4.3 Quantitative data discussion

Within the group participant three had middle range of variability within leg flexibility but made the greatest measured improvement in movement three. This could suggest that the participant’s muscles were not at the optimum level of flexibility and the stretch programme helps to enhance this or that this participant worked these muscles over their normal range more significantly.

During the study participants four’s full results could not be analysed, this was due to incorrect performance of the movement meaning a clear angle could not be analysed. Therefore improvements within this movement could not be correlated preventing a full set of reliable data being created.

During the video this participant’s specific movement looked aesthetically pleasing and gave high performance potential. Participant two showed an anomaly within the results during the post intervention data collection during the final move the side lunge. The first angle collected during the second data collection was an angle of 96 degrees diminishing from the previous initial data collection, within the two succeeding videos the data was increased to 126 degrees and then lowered slightly again to 108 degrees. Participant two showed an ability to reach greater flexibility level but was not able to facilitate this during performance. This data anomaly could be due to level of confidence initially when recording the first collection and readiness of the body to perform.

4.4 discussion of theories

Provance et al. (2006, p. 21) suggest different durations of stretch may affect the improvement in varying degrees within different participants, they then go on to state that “after initial gains of a stretch programme differing durations of hold might then continue the improvements.”
Deckerr et al. (2008) state perfection in dance results as a delicate balance between artistry and physical skill. These supports the theory that during training dancers should have already reached and maintain optimum flexibility to optimise performance and movement ability.

Suggested by the external adjudicator, to utilise gained flexibility the dancers increased power output, visually showing greater speed of leg movements during the high kick and round-house kick. This increased dynamic flexibility potential, allowing the participant to throw the body into positions. Work carried out by Ford and McChensey (2007) reported this, stating that increasing range of movement surrounding specific joints permits greater peak muscle force production, causing greater speed of movement. Kokken et al. (2007) also reached similar conclusions, declaring stretch regimes have caused developments in parameters of muscular performance. The participants were focused on increasing their range of movement to show improvement, hindering performance and the aesthetic look through the force created being misplaced and exerted incorrectly affecting alignment.

Force applied during the high kick and round-house kick to meet the demands of the high flexibility movements and to meet the expectations of dancers to have a high level of flexibility may create misalignment of the back and body during the movements. This placed force then pulls the heel off the floor and bends the knee to compensate for the increased flexibility inhibiting perfect technique.

The Hamstring originates at the ischia tuberosity of the pelvis, meaning tension in the hamstring muscle influences pelvic posture (Congdon et al., 2005) therefore influencing spinal alignment. Svensson (1994) reported that a good range of motion is an important factor in order to learn good technique. “Good alignment can facilitate movement efficiency” (Holt, Welsh, and Speights, 2011, p. 226) increasing the flexibility of specific muscles allowed for ease of movement, preventing the participants from applying effort into the movement. Misalignment can occur when too much force and effort is applied to the move, this is shown during the two kick, high kick and round house kick, misalignment prevents the movement from naturally flowing, aiding in poor technique and hindering performance. Throughout the study the participants showed differing levels of
enhancement in performance through alignment, flexibility and kinaesthetic feel of the movement.

As stated by Gheorghiu and Ioan (2011, p. 114) stretching exercises increase the bodily performance by “first enhancing elasticity of the muscle unit, which in turn increases muscular strength creating equilibrium of contrition between the antagonistic pair of muscles.” Bodies throughout this process progress at different speed, adapting to the external forces applied. During the post intervention data collection the participants could be at different points within the adaption process. Norris (1999, p. 17) suggests that to achieve adaption during training the body must be exposed to a “greater physical stretch than that during normal movements”. The levels of enhancement could also correlate with the intensity in which the participants exerted the specific muscles to over which it would normally be.

The study demonstrates a heterogenous response to the stretching intervention programme. These results support individualised theory given that participants are all unique and ideally require a personalised or individualised programme to develop more efficiently in performance.

Observed study results could suggest that no performance enhancements due to increased flexibility and alignment could suggest that optimum performance skill has already been achieved. Participants showing great enhancements within any aspect of this study could indicate that there is inefficient flexibility and alignment training aligned with practice.

Deighan (2005, p.13-17) states that “optimum levels of flexibility, are essential for maximizing the versatility of movements.” and further suggests that dance is bodily communication and if personal optimal levels are not achieved that communication is lost and the dance becomes misread.
The participants demonstrated a high level of understanding during the study or technique being based on correct alignment. As flexibility increased dynamic alignment was altered to compensate. This appeared to hinder technique for three participants during the four key movements, versus an increase in performance for the other two participants. Wilcosky (2011, p. 31-33) stated that “poor movement quality can result in incorrect alignment and body positioning.” The two improved participants started with a high baseline technique and flexibility level pre-intervention, therefore, suggesting they the skill to handle the increased force and flexibility through greater control of the movement and limited force displacement. Furthermore Hamilton et al. (2008) suggest that correct alignment allows the skeleton higher movement efficiency resulting in increased mechanical advantage.

It has been suggested that an elite dancer must have a high awareness of performance aesthetics and knowledge of technique (Koutedakis et al., 2007). Therefore the participants through and high level of training should have a high level of bodily awareness, neutral and dynamic alignment. The participants should also be able to alter bodily movements to reach the intended kinaesthetic and aesthetic outcome. Walker et al. (2010, p.377) suggest this concept is an “indicator of dance talent” and Corbin (1984) states that performance at top level is impossible to reach without this high level of self-awareness. In conjunction to this, Alter et al. (1998, p.58) suggest that stretching “can further promote development of body awareness.”

The participants in this study, due to being dancers have an enhanced range of movement through previous technical training and experience, which could imply smaller ability for gains in performance. It may also be suggested that further improvements from this study intervention highlights this part of fitness may not be being implemented properly to gain optimum levels for high standard dance. Provance et al. (2006) suggest the ceiling effect where participants had small probability for improvements due to baseline level of flexibility, stating that changed lengths of stretching could offer differing degrees of flexibility developments. Low levels of gains expected from the participants as they are in a high level of physical dance training during the completion of the study, suggesting a higher intensity stretch needed to show improvements.
During training dancers should reach and maintain optimum physiological and fitness levels to develop skill level (Koutedakis & Jamurtas, 2004) without a high level of fitness and flexibility skill development cannot form and therefore performance is not at its greatest. The participants within this study are at a stage in training where these standards should be met, requiring flexibility as a prerequisite of training. ‘Flexibility is often included as a major adjunct’ (Provance et al., 2006, p. 24). Hamelton et al. (1992) and Alricsson et al. (2003) further propose dance training has a positive effect on muscle extensibility, speed and agility.

It is suggested in the literature review that discovering the ‘sensations of movements brings an aesthetic value to practice when giving attention to the movement’ (H'Doubler, 1998). During this study attention is placed on flexibility and alignment to then enhance personal performance. Throughout this study, physical flexibility increased as well as perceived personal performance but alignment was suggested as being lost through narrowing of focus.

4.5 Limitations

The protocol within this study did not take into account other external exercise, on-going fitness/work programmes or stretching regimes that the participants may have been involved in over the five week intensive stretch programme. Before testing began baseline flexibility the participants were not measured thus disabling statistical analysis to be obtained for any improvements in flexibility through the intervention programme.

The testing protocol implemented in this study allowed the participants to warm-up before the video recording but did not take into account the temperature conditions of the room. The room temperature was below the maximum of sixteen degrees which is needed for optimum performance. It is therefore possible that the participants’ extensibility of muscle may not have reached their optimum or maximum stretch during the data collection period. This could indicate that the protocol was unable to identify a true performance environment, due to this; the data collected cannot provide true validity.
During the testing protocol, the performers were recorded three times as a for data collection purposes. However in a performance situation there is only one chance to achieve the correct technique during each performance. Therefore this cannot be a fully accurate account of the nature of dance performance, however it must surely still be considered useful as an indication.

Within the literature review it was stated that flexibility can be limited due to a number of factors concerned with individuals’ body composition and any previous injury suffered. A preliminary screening questionnaire was not included in this study to account for this. This may have affected the results produced by the participants.

A main limitation within this study is incorrectly completing the stretch programme by participants, producing data which is unreliable as the intervention was not followed as protocol.

Research data provided by other workers is not standardised. Different researchers have used differing criteria. It is therefore not possible to exactly replicate previous studies. For example, on how many days a week to stretch for and for how many weeks over all to see an improvement.

As the camera is not a stationary object within the performance space, the camera angle on the two different data collection days may vary showing slightly altered angles, giving an imprecise comparisons.

These particular stretches were carried out with a view to improving technique. This could indicate that the muscles in question are easier to train or develop flexibility in. Alternatively the other stretches weren’t hard enough, performed correctly, or the time and intensity where not great enough to gain a measurable improvement (may need longer time period to develop). In agreement with this Arminger et al. (2010) found that stretching can improve performance of particular movements required within the specific sport.
Chapter Five

Conclusion
Conclusion And Summary Of Findings

5.1 Approach to this Study

This study investigated the effects of a specific intervention stretch programme on university level student dancers with the aim of investigating whether developing flexibility would improve performance skills further in terms of dynamic alignment. It focused on the dancer’s development through the improvement of flexibility within a specifically choreographed motif, addressing four key high flexibility movements; high kick, splits, round-house kick and side lunge.

The area of investigation considered for this study is under-researched since few studies are specific to highly trained dancers. The approach of this study used a mixed methods approach incorporating both qualitative and quantitative datasets to capture participant’s personal perspectives on performance as well as quantitative measurement of flexibility angles. Boyd and Fales (1983) suggest the ability to reflect purposefully develops the participant in self-awareness assisting in performance. The participants during the study were asked to self-evaluate performance in terms of flexibility, alignment and overall performance compared to a given ‘perfect’ model. It was expected that post-intervention data collected from the participants would demonstrate an improvement in overall kinaesthetic awareness and aesthetic performance. The research question was answered positively in terms of relationship between enhanced flexibility and performance. The results generated valuable data to consider potentially enhancing future dance practice. The stretch diaries, kept by participants demonstrated compliance with the study intervention. An external adjudicator provided independent analysis of improvements and developments in performance. In addition, analysis was not performed using techniques such as Spearman’s Rank Correlation coefficient, all three data collections were simultaneously assessed allowing for a correlation between the results and enabling greater depth of interpretation and understanding.
5.2 Can a stretch programme enhance flexibility in university standard dancers in training?

Results showed that a specific stretch programme improved the dancer’s development of movement aesthetics, this supports Deighan (2005) which suggests dance aesthetic is characterised by attractive shapes and high levels of flexibility. Throughout the stretch programme the participant’s flexibility and dynamic flexibility potential increased over the five week study, in agreement with results obtained by Armiger (2010), Chan (2000) Clarkson and Skrinar (1988) that suggest a period of four to six weeks results in optimum flexibility improvements. However, for some participants, the improvements were not as substantial, suggesting that optimal flexibility had already been reached or that the stretch programme intensity was not individually able to enhance flexibility. This is in agreement with Hein and Vain (1998) stating that ROM can vary in improvements within performers depending on muscle ability to elongate and physical joint limitations. Sample size is small so difficult to say that they show something rather than suggesting for a larger cohort. Additionally improvements are sought for both form and function in this research. This result replicates work carried out by Alricsson et al. (2003) and Muyor et al. (2012) which suggested systematic stretching increases ROM which in turn aids in dance training and performance ability.

5.3 Can an intervention stretch programme increase technical alignment and kinaesthetic awareness?

Results suggest minor development of improved kinaesthetic awareness, both observed and reported through the self-evaluation questionnaire. As suggested by Holt, Welsh, and Speights (2011) correct technical alignment facilitates effective accomplishment of dance performance to a high standard. External adjudicator results reported that alignment did not visually improve and the higher range of dynamic flexibility occasionally hindered correct alignment. This hindrance is suggested by the external adjudicator, increased flexibility can result in range of movement to a level at which it is not possible to maintain neutral alignment. Correct technique is the framework all dancers use to perform technically accurate and aesthetically pleasing performances, without this frame work suggested by Smith-Autard (2000), high levels of alignment and performance cannot be
It could be concluded from this finding that a specific stretch programme neither increases nor decreases overall technical alignment.

5.4 Does an intensive intervention stretch programme improve performance?

Results indicated that performance was enhanced through increased flexibility whereas observed correct alignment was not affected. This supports Deighan (2005) who states that dance is communicated through visual performance, where optimum flexibility is essential for maximising versatility of the movements. Performance improved but not to its optimum, as dynamic alignment stated by the external adjudicator could further develop to further improve technical performance. Welsh and Speights (2011) suggest correct alignment is a quality which enables professional level performance. Participants suggested through their questionnaires that the stretch programme enhanced personal performance both in alignment and flexibility, contributing to an enhanced overall performance. These results indicate self-evaluated progression by the participants during the post-intervention data collection. In conclusion, a specific stretch programme improves performance to a level at which a higher technical understanding and increased core stability is needed to progress further. Koutedaki et al. (2007) suggest that elite dancers are expertly trained in the aesthetic and technical side of the art, this knowledge grows through training and is a processes of learning, as the participants are still in training this skill has probably not fully developed. This theory agrees with Svensson (1994) who states that, for dance performers to learn the required technique, it is important that they have a high knowledge base. Flexibility needs to be trained so that the dancer can optimally use it to create an aesthetic dance performance. This corroborates the theory stated by Minton (2003) which suggests that dynamic dancing requires extra control of the body to withhold correct posture and create aesthetic lines.

Future Research

This study could be developed further by a using a larger sample size of dance participants, improved data integrity. Consequently, a larger dataset would be collected and provide a more scientific approach to data analysis and conclusions from a statistical perspective.
In addition, this study protocol allows for the participants to perform the specific motif in a series of three attempts, this results in a learning effect since during each data collection the participant learns and improves from their previous video. To better control the study variables, the participants should first be confident with the motif, allowing for learning and improvements during practice; therefore during data collection the optimum performance will be demonstrated. This means that during the video collection only one video needs to be taken to gain the greatest validity in data collection. Potential future research could focus on using the stretch programme as part of a performance enhancement plan and not just on its own. Linking specific stretching with core stability and strength training allows for the gains within flexibility to be utilised, thus allowing for the adaptations within the body due to increased range of motion to be facilitated by the strength needed to optimally perform and core stability to control the movement and force created. The participants require a heightened kinaesthetic awareness of their body within the performance space to allow for correct alignment post intervention, so to further this study in the future correct alignment classes could be delivered to develop a greater bodily awareness during dynamic movement. It is shown through results that increased flexibility through the specific stretch programme improves performance; however this is to be discovered through additional investigation.
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American Collage of Sport Medicine. (1998) ACMS’s Position Stand: The Recommended Quantity And Quality Of Exercise For Developing And Maintaining Cardio-respiratory And Muscular Fitness, And Flexibility In Healthy Adult, 30,pp 975-91


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[2nd Nov 2013].


APPENDICES
Date: 6th March 2014

To: Taryn Young

Project reference number: 13/05/415U

Your project was recommended for approval by myself as supervisor and formally approved at the Cardiff School of Sport Research Ethics Committee meeting of 27th November 2013.

Yours sincerely

Dena Digweed

Supervisor
APPENDIX B

PARTICIPANT CONSENT FORM

Reference Number:
Participant name or Study ID Number: st20007027
Title of Project: **Does a regular specific stretch program improve technique (as determined by maintenance of neutral alignment)**

Name of Researcher: Taryn Kate Young

---

**Participant to complete this section:**  Please initial each box.

1. I confirm that I have read and understood the information given to me about the study I will be taking part in. I have also had the chance study the information and consider the circumstances of taking part. I had the opportunity to ask any questions I have had and have gained a satisfactory answer.  

2. I understand that I am able to withdraw from this study when I like as I am volunteering to be involved.

3. I agree to take part in the above study and adhere to protocol for my own and others safety.

4. I agree to record my participation in this study.

5. I agree that I am able to be videoed and allow the videos to be used in external evaluation.

---

______________________________   ____________________
Signature of Participant                             Date

______________________________   ____________________
Name of person taking consent                        Date
APPENDIX C

PARTICIPANT INFORMATION SHEET

Does a regular specific stretch program improve technique (as determined by maintenance of neutral alignment)

Participant Information Sheet

This project aims to investigate whether increased muscular flexibility improves dance training and technique. The main focus of the investigation will study the correlation between flexibility and correct neutral spine alignment. An individual student of Cardiff Metropolitan University, under supervision of the Cardiff Metropolitan BA (Hons) Dance and School of Sport, is undertaking it.

In brief, this study aims to explore the developments of flexibility and its impact on dance training. The main area that the project examines:

(i) Whether using a regular stretch program, which is aimed at increasing flexibility, can improve personal technique and correct spine alignment.

The evaluation will be presented as a report in the form of a dissertation which may also be published.

You are being chosen as you fit the specification of the study and are understood to be at a university standard level of dance training with over a year's experience within dance. We think that you could learn a lot about flexibility in dance training and use the study to further education in personal dance technique.

This study is a six week stretch intervention programme. At the start of the programme you will be taught a short dance routine, which will then be performed and video recorded for future analysis. The stretch program will then be initiated; the stretches will be demonstrated with safe practice in mind. You as a participant will be asked to complete this programme three times a week for a six-week period and asked to keep a diary to record engagement with the programme. After the six-week intervention the dance motif will again be performed and recorded. The two recordings of the dance motif will then be sent of to an external adjudicator for analysis.

There is no obligation for you to participate in this study; if you feel during the study you cannot carry on with the programme you will not be forced to continue. In the instance, please speak to the programme facilitator to address any issues you may have.

Once this study is finished the information will be analysed and a report formed with the final results.

Have you got any questions?
If you require any further information or wish to ask questions just contact us. You can email or phone use or ask us personally.
Phone number:
Email address:
APPENDIX D

PRE-INTERVENTION SELF-EVALUATION QUESTIONNAIRE

Taryn Kate Young, (St20007027), self report questionnaire

Questionnaire

This questionnaire relates to the short motif that was just performed and these questions are to self-evaluate personal performance. During this questionnaire you are required to fill in all questions.

Participant name:

Student number:

Q1. In order to self-evaluate personal performance as a baseline please assess your current ability relating to alignment and flexibility using the visual analogue scale below (where 1 = lowest and 10 = highest ability) by circling your answers;

<table>
<thead>
<tr>
<th>Alignment</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

Q2. On the back of this questionnaire are four images of what is perceived as a "perfect" model of alignment during each four specific movements to be self-evaluated within the performance.

In comparison to the "perfect" model how do you feel you performed in terms of alignment, looking at all movements completed?

<table>
<thead>
<tr>
<th>Movement 1</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movement 2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Movement 3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Movement 4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

Q3. Please rate how you feel you performed overall throughout the motif in terms of alignment on visual analogue scale.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
</table>
   Bad | moderate | excellent
Q3. Did you feel any restrictions in certain movements due to inadequate flexibility which prevented you from performing them with correct technique and alignment? (Please circle one answer)

Yes              No

Q4. If so, in which moves did you feel restrictions? Please indicate whether your performance was affected and, if so, describe how.

------------------------------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------------------------------

1. High kick.
2. Splits
3. Round house kick
4. Side lunge
## Appendix E

### Five Week Intervention Stretch Programme

**Stretch Dairy 5 week intervention Stretch regime:**

<table>
<thead>
<tr>
<th>Stretch</th>
<th>Weeks 1-3</th>
<th>Weeks 4-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamstring</td>
<td>Sit on the floor with both legs extended in front of you</td>
<td>Sit on the floor with both legs extended in front of you</td>
</tr>
<tr>
<td></td>
<td>Exhale: keep your legs straight, extend your upper back, bend forwards at the hips, and lower your trunk onto your thighs,</td>
<td>Exhale: keep your legs straight, extend your upper back, bend forwards at the hips, and lower your trunk onto your thighs,</td>
</tr>
<tr>
<td>Hip Adductors</td>
<td>Sit on the floor; bring the feet together at the front knees out to the side in a butterfly position.</td>
<td>Sit on the floor and place the legs out straight to the side as far as they will open.</td>
</tr>
<tr>
<td>one</td>
<td>Inhale and place the elbows to the knees</td>
<td>Keeping the knees up to the ceiling</td>
</tr>
<tr>
<td></td>
<td>Exhale, keeping in a flat back position, pushes the knees to the floor with the elbows and hold for specific time.</td>
<td>inhale push up onto the heels exhale and push the pelvis to the floor, placing some of the weight onto the elbows, using the rest to increase the stretch.</td>
</tr>
<tr>
<td>Hip flexors</td>
<td>Quadriceps</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>• Stand with your legs hip width apart, stretch on leg forward, bend the knee and lower your body, place the opposite knee to the floor.</td>
<td>• Get into the same position as previous weeks; raise the back into a neutral upright position.</td>
<td></td>
</tr>
<tr>
<td>• Lean the body weight slightly forward and roll the back foot under so the instep is in contact with the floor.</td>
<td>• Inhale and raise the arms up by the ears exhale and push the hips deeper into the floor.</td>
<td></td>
</tr>
<tr>
<td>• Place your hands on your hips, exhale and push the hip into the floor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abductors</td>
<td>One hand.</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>- Lay on your back with hips square to the ceiling, bring one leg up into the chest then drop it over to the opposite side of the body allowing it to rest on the floor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Keep both shoulders on the floor, to increase the stretch pull the leg to the floor, looking away from the stretch.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- From all fours, slide one shin forward and parallel to the front of the mat as you lengthen your opposite leg long behind you.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Walk your hands forward and breathe in to the outer hips and lower back.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX F

#### STRETCH DIARY

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Stretches</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
<th>Session 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Hamstring</td>
<td>30s x 2 rep</td>
<td>30s x 2 rep</td>
<td>30s x 2 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Hip Adductors</td>
<td>30sx2 rep</td>
<td>30s x 2 rep</td>
<td>30s x 2 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Hip Flexors</td>
<td>30s x 2 rep</td>
<td>30s x 2 rep</td>
<td>30s x 2 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Quadriceps</td>
<td>30s x 2 rep</td>
<td>30s x 2 rep</td>
<td>30s x 2 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Abductors</td>
<td>30s x 2 rep</td>
<td>30s x 2 rep</td>
<td>30s x 2 rep</td>
<td>X</td>
</tr>
<tr>
<td>Week 2</td>
<td>Hamstrings</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Hip Adductors</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Hip Flexors</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Quadriceps</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Abductors</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>X</td>
</tr>
<tr>
<td>Week 3</td>
<td>Hamstrings</td>
<td>30s x 4 rep</td>
<td>30s x 4 rep</td>
<td>30s x 4 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Hip Adductors</td>
<td>30s x 4 rep</td>
<td>30s x 4 rep</td>
<td>30s x 4 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Hip Flexors</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Quadriceps</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Abductors</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>X</td>
</tr>
<tr>
<td>Week 4</td>
<td>Hamstring</td>
<td>45s x 4 rep</td>
<td>45s x 4 rep</td>
<td>45s x 4 rep</td>
<td>45s x 4 rep</td>
</tr>
<tr>
<td></td>
<td>Hip Adductors</td>
<td>45s x 4 rep</td>
<td>45s x 4 rep</td>
<td>45s x 4 rep</td>
<td>45s x 4 rep</td>
</tr>
<tr>
<td></td>
<td>Hip Flexors</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
</tr>
<tr>
<td></td>
<td>Quadriceps</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
</tr>
<tr>
<td></td>
<td>Abductors</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
<td>30s x 3 rep</td>
</tr>
<tr>
<td>Week 5</td>
<td>Hamstring</td>
<td>60s x 5 rep</td>
<td>60s x 5 rep</td>
<td>60s x 5 rep</td>
<td>60s x 5 rep</td>
</tr>
<tr>
<td></td>
<td>Hip Adductors</td>
<td>60s x 5 rep</td>
<td>60s x 5 rep</td>
<td>60s x 5 rep</td>
<td>60s x 5 rep</td>
</tr>
<tr>
<td></td>
<td>Hip Flexors</td>
<td>60s x 5 rep</td>
<td>60s x 5 rep</td>
<td>60s x 5 rep</td>
<td>60s x 5 rep</td>
</tr>
<tr>
<td></td>
<td>Quadriceps</td>
<td>60s x 3 rep</td>
<td>60s x 3 rep</td>
<td>60s x 3 rep</td>
<td>60s x 3 rep</td>
</tr>
<tr>
<td></td>
<td>Abductors</td>
<td>60s x 3 rep</td>
<td>60s x 3 rep</td>
<td>60s x 3 rep</td>
<td>60s x 3 rep</td>
</tr>
</tbody>
</table>
APPENDIX G

POST-INTERVENTION SELF-EVALUATION QUESTIONNAIRE

Taryn Kate Young, (St20007027), self report questionnaire

Questionnaire

This questionnaire relates to the short motif that was just performed and these questions are to self-evaluate personal performance. During this questionnaire you are required to fill in all questions.

Participant name:
Student number:

Q1. In order to self-evaluate personal performance as a baseline please assess your current ability relating to alignment and flexibility using the visual analogue scale below (where 1 = lowest and 10 = highest ability) by circling your answers:

<table>
<thead>
<tr>
<th>Alignment</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

Q2. On the back of this questionnaire are four images of what is perceived as a “perfect” model of alignment during each four specific movements to be self-evaluated within the performance. In comparison to the “perfect” model how do you feel you performed in terms of alignment, looking at all movements completed?

| Movement 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Movement 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Movement 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Movement 4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Q3. Please rate how you feel you performed overall throughout the motif in terms of alignment on visual analogue scale.

0 1 2 3 4 5 6 7 8 9 10

Bad moderate excellent

Q4. Did you feel any restrictions in certain movements due to inadequate flexibility which prevented you from performing them with correct technique and alignment? (Please circle one answer)

Yes No

Q4a. If so, in which moves did you feel restrictions? Please indicate whether your performance was affected and, if so, describe how.

------------------------------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------------------------

A-10
2. High kick.

3. Round house kick

4. Side lunge

2. Splits
## APPENDIX H
### EXTERNAL ADJUDICATOR’S RESULTS TABLE

<table>
<thead>
<tr>
<th>Participant</th>
<th>Does the post intervention video demonstrate an improvement in performance as a result of increased flexibility?</th>
<th>If yes, please explain in relation to the four key movements and the performance as a whole.</th>
<th>Does the post intervention video demonstrate an improvement in performance as a result of altered alignment?</th>
<th>If yes, please explain in relation to the four key movements and the performance as a whole.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>YES/NO</td>
<td>Four key movements:</td>
<td>YES/NO</td>
<td>Four key movements:</td>
</tr>
<tr>
<td></td>
<td>Overall performance:</td>
<td></td>
<td>Overall performance:</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX I
PIOLTE QUESTIONNAIRE

Taryn Kate Young, (St20007027), self report questionnaire

Questionnaire

This questionnaire relates to the short motif that was just performed and these questions are to self-evaluate personal performance. During this questionnaire you are required to fill in all questions.

Participant name: Rachel Connew
Student number: st2009842

Q1. In order to self-evaluate personal performance as a baseline please assess your current ability relating to alignment and flexibility using the visual analogue scale below (where 1 = lowest and 10 = highest ability) by circling your answers;

<table>
<thead>
<tr>
<th>Alignment</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
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</table>

Q2. On the back of this questionnaire are four images of what is perceived as a “perfect” model of alignment during each four specific movements to be self-evaluated within the performance.

In comparison to the “perfect” model how do you feel you performed in terms of alignment, looking at all movements completed?

| Movement 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Movement 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Movement 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Movement 4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Q3. Please rate how you feel you performed overall throughout the motif in terms of alignment on visual analogue scale.

Bad                                                                      moderate                       excellent
Q3. Did you feel any restrictions in certain movements due to inadequate flexibility which prevented you from performing them with correct technique and alignment? (Please circle one answer)

Yes  No

Q4. If so, in which moves did you feel restrictions? Please indicate whether your performance was affected and, if so, describe how.

In each of the 4 movements I felt like my movement was limited because of my flexibility but this effected my aliment most in the splits as it meant that I was leaning my chest forward.

2. splits
3. High kick.
4. side lunge
3. Round house kick
<table>
<thead>
<tr>
<th>Participant</th>
<th>Does the post intervention video demonstrate an improvement in performance as a result of increased flexibility?</th>
<th>If yes, please explain in relation to the four key movements and the performance as a whole.</th>
<th>Does the post intervention video demonstrate an improvement in performance as a result of altered alignment?</th>
<th>If yes, please explain in relation to the four key movements and the performance as a whole.</th>
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| 1          | YES minimal                                                                                     | Four key movements:  
HK- Minimal improvement however heel of ground  
SP- Improved  
RHK- Minimal improvement, participant using force and supporting bent knee to get the leg around and higher  
LU- Improved- however not lunging into position participant is simply pushing straight leg away | YES/NO  
Four key movements:  
HK- Force of movement not maintaining alignment  
SP- alignment is better but still in a forward position over front leg, no period of being upright  
RHK- Force of movement again, no control in movement failing keep core strong to produce movement  
LU- Overstretching not control and aesthetics | Overall performance:  
Alignment is poor and the movements takes effort instead of looking effortless. The participant does not hold the core strong and therefore loses the movement in the RHK due to lack of control. Lunge not maintaining end position instead shortening one side and over stretching. Alignment not maintained |
| 2          | YES slight                                                                                      | Four key movements:  
HK- bending leg in execution- slight improvement as now keeping heel on ground  
SP- increased flexibility into splints  
RHK- improved slightly  
LU- participant over stretching torso no improvement in leg lunge | Overall NO  
Four key movements:  
HK-posterior tilt of pelvis and forcing movement  
SP- torso more upright. improved  
RHK- hitching of hip- no control in back, poor alignment  
LU- overstretching not keeping torso upright and controlled. | Overall performance:  
General alignment improved during splits. Over stretching in lunge position and throwing away movement instead of maintaining alignment. Still requires more control during kicks. |
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<tr>
<td>3</td>
<td>YES</td>
<td>Four key movements:  HK- slight bend in knee in execution- slight improvement- good flexibility to start  SP- increased flexibility in splits- needs to tuck back foot under  RHK- slight improvement- again good basis to begin with  LU- Improved</td>
<td>YES in splits but generally good to start with</td>
<td>Four key movements:  HK- much the same  SP- torso position improved. Upright whilst in splits  RHK- much the same  LU- over stretching with torso not controlling movement</td>
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<tr>
<td>Overall performance:  Overall flexibility was good to start with so slight improvement from pre intervention. See this improvement during splits and lunge</td>
<td></td>
<td>Overall performance:  Alignment was good to start with participant controlling torso in HK and RHK. Alignment greatest improvement during splits as posture maintained.</td>
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<td>4</td>
<td>YES small improvements</td>
<td>Four key movements:  HK- Slight improvement  SP- improved back leg straighter- however participant could get into splits before but did not maintain form of back leg  RHK- post intervention kick was to the front- no side view so hard to tell if improved  LU- no improvements</td>
<td>NO</td>
<td>Four key movements:  HK- Good posture, control and body alignment maintained  SP- got worse starting to bend forwards over front leg instead of maintain upright position  RHK- got worse, can not tell alignment of torso from this angle  LU- much the same</td>
</tr>
<tr>
<td>Overall performance:  Really good flexibility to start, pre intervention video, in HK, RHK and Splits. Lunge could do with more work. Hard to see improvements due to strong foundation to begin with, I believe that slight improvements were made. Needs to ensure knee does not bend during kicks from force of getting the leg ‘up there’</td>
<td></td>
<td>Overall performance:  Okay alignment to begin with but I feel post intervention it declines- RHK poor control of movement and body alignment not as good during splits, hunching over</td>
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</tr>
<tr>
<td></td>
<td>NO</td>
<td>Four key movements: HK- minor improvements SP- same RHK- same LU- same</td>
<td>NO</td>
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<td>Overall performance: Participant had good flexibility to start so hard to see if there are improvements in flexibility</td>
<td></td>
<td>Overall performance: General alignment good to start, especially in splits positions as holds upright position. Fails to control supporting leg and core during HK, RHK. Overstretches and fails to control torso position in lunge position with the aim for flexibility rather than control.</td>
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