

An investigation of the effects of *Popping For Parkinson's*® dance on mood and quality of life of people with Parkinson's.

SIMONE SISTARELLI

Submitted in partial fulfillment of the requirements of the University of Hertfordshire for the degree of MSc by Research

July 2020

# ABSTRACT

**Objective:** The aim of this study is to investigate the effects of one *Popping For Parkinson's*® dance session on mood and quality of life of people with Parkinson's.

**Design:** This study employed a within-subject repeated measures design.

**Participants:** Fortyseven people with mild to moderate Parkinson's participated in the study. Mean age of 68.6 (SD 10.3), mean Parkinson's stage of 2.0 (SD 1.7).

**Setting:** The dance intervention took place in four different locations: Hatfield (UK), London (UK), New York City (USA) and Torino (IT).

**Interventions:** Participants took part in one *Popping For Parkinson's*® dance class. The dance class lasted one hour, and it followed the official *Popping For Parkinson's*® methodology. The dance style practiced was Popping dance, one of the Hip Hop dance techniques, based on contracting specific muscle groups in perfect synchrony with the tempo and rhythm of the music.

**Main Outcome Measures:** Mood and quality of life were measured at four time points: immediately before the dance class, immediately after the dance class, 24 hours after the dance class occurred, and one week after the dance class occurred. Questionnaires used to collect data were the Profile Of Mood Scale questionnaire and the Parkinson's Disease Questionnaire.

**Results:** The mood and quality of life reported by participants significantly improved immediately after the dance intervention, regardless of gender, location, previous

dance experience, tremor, DBS surgery or stage of Parkinson's. The mood and quality of life reported by participants did not show any significant difference compared with baseline both 24 hours and one week after the dance class occurred.

Conclusions: Participating in *Popping For Parkinson's*® dance classes improves both mood and perceived quality of life of people with Parkinson's in the short term. Significant improvements are registered immediately after participation, and they last less than 24 hours.

# ACKNOWLEDGEMENTS

I would like to thank my supervisors for their support and interest in my research.

I would like to thank my family for the continuous support in this process. None of this would have been possible without them.

I would like to thank my partner Hanna Wroblewski for her immense support, her patience and fundamental presence throughout the years.

I would very much like to thank the people who have supported and informed the research – Mark Morris Dance Center, Maria Portman Kelly, Sarah Webb, South London Younger Parkinson's Network, The Wimbledon Club, University of Hertfordshire, Associazione Italiana Parkinsoniani Onlus Sez. "G. Cavallari", Claudio D'Ambrosio, Giovanna Russo, Graziella Palermo, and anyone I forgot to mention but contributed to the process. A special thanks to David Leventhal, for sharing his expertise and insight yet remaining a student at heart.

Thanks to all the participants in the study and all of the students worldwide - you are the very reason why I am doing *Popping For Parkinson's*®.

# CONTENT

<b>ABSTRACT</b>	<b>2</b>
<b>ACKNOWLEDGEMENTS</b>	<b>4</b>
<b>1. INTRODUCTION</b>	<b>7</b>
1.1 Parkinson's Disease	7
1.2 Parkinson's and exercise	9
1.3 Dance for Parkinson's	10
1.3.1 Dance for Parkinson's: motor symptoms	11
1.3.2 Dance for Parkinson's: non-motor symptoms	12
1.3.3 Dance for Parkinson's: programmes	13
1.3.4 Limitations of past research	16
1.3.4.1 Physical activity and statistical significance	16
1.3.4.2 Dance formulation and posology	17
1.3.4.3 Dance dosage	18
1.3.4.4 Interleaving effect / Spacing effect	19
1.3.4.5 Study design	20
1.3.4.6 Measuring tools	23
1.3.4.7 Dance and cultural relevance	25
1.3.4.8 Sample size	26
1.3.4.9 Dance programmes and scientific research	27
1.3.5 Dance for Parkinson's: Popping For Parkinson's ®	28
1.3.5.1 Introduction	28
1.3.5.2 Popping technique	28
1.3.5.3 General common elements	29
1.3.5.4 Unique elements	30
1.3.5.5 Introduction to scientific study, rationale and predictions	32
<b>2. METHODS</b>	<b>35</b>
2.1 Ethics	35
2.2 Participants	35
2.2.1 Requirements	35
2.2.2 Recruitment	36
2.2.3 Location	36
2.2.4 Dance experience	37
2.3 Materials	38
2.4 Class structure	40
2.4.1 Structure	40
2.4.2 Class intensity	41
2.4.3 Music	41
2.4.4 Atmosphere	42

2.4.5 Teacher	42
2.4.6 Teaching methods	43
2.4.7 Reverence	43
2.5 Procedure	43
2.7 Statistical analysis	47
<b>3. RESULTS</b>	<b>48</b>
3.1 Introduction	48
3.2 T1 and T2 Data Set - 47 participants	49
3.2.1 Descriptives	49
3.2.2 POMS	49
3.2.3 PDQ-39	52
3.3 T1, T2, T3 and T4 Data Set - 33 participants	55
3.3.1 Descriptives	55
3.3.2 POMS	55
3.3.3 PDQ-39	59
3.3.4 Qualitative Feedback	63
<b>4. DISCUSSION</b>	<b>66</b>
4.1 Mood	66
4.2 Quality of life	68
4.3 Limitations	70
<b>5. FUTURE STUDIES</b>	<b>77</b>
<b>6. CONCLUSION</b>	<b>82</b>
<b>7. REFERENCES</b>	<b>83</b>
<b>8. APPENDIXES</b>	<b>107</b>
8.1 Appendix I – List of Songs	107
8.2 Appendix II – POMS	108
8.3 Appendix III – PDQ-39	110
8.4 Appendix IV – Hoehn & Yahr Staging	112
8.5 Appendix V – Demographic Information	113
8.6 Appendix VI - PARQ	119

# 1. INTRODUCTION

## 1.1 Parkinson's Disease

Parkinson's is a progressive neurodegenerative disease that typically develops in people above the age of 50, and no cure has been found to date. It is the world's second most common neurodegenerative disorder (de Lau, 2006; Lew, 2012) and more than 127000 people in the United Kingdom alone live with the condition (Parkinson's UK, 2018).

Main symptoms include but are not limited to muscle rigidity, slowness of movement (bradykinesia) and tremors (Pedersen, Oberg, Larsson, & Lindvalet, 1997), altered mood (Brown et al., 2011), psychological and social concerns and decreased quality of life (Cummings, 1992).

Specific motor symptoms include tremor, freezing, dyskinesia, bradykinesia, rigidity, dystonia, reduced balance (NHS, 2019), gait disturbance (Morris, Iansek, Matyas & Summers, 1994), postural instability and risk of falling (Gray & Hildebrand, 2000).

Other physical symptoms include loss of sense of smell, nerve pain, urinary incontinence, constipation, erectile dysfunction, dizziness, hyperhidrosis and dysphagia (NHS, 2019).

Non-motor symptoms include depression, mood disorders, sleep disorders, anxiety, apathy, anhedonia, hallucinations, complex behavioural disorders (Chaudhuri & Schapira, 2009; Park & Stacy, 2009; Poewe, 2008).

Parkinson's disease affects patients' brains (Hornykiewicz, 1981). The disease creates a disturbance of the function of the basal ganglia, a group of interconnected structures in the brain concerned with the selection and control of action. More specifically, Parkinson's disease affects the substantia nigra, the area of the basal ganglia in which dopamine neurons are found: it is the loss of dopamine neurons from the substantia nigra, and consequent loss of the neurotransmitter dopamine from the striatum in the basal ganglia that is thought to underline the difficulties initiating movement (Lees et al., 2009).

Traditionally, Parkinson's therapeutic interventions are based on augmenting striatal dopaminergic activity through the administration of levodopa (Di Stefano, Sozio, Serafina Cerasa & Iannitelli, 2011; Yahr, 1978). A more invasive yet effective therapy is undergoing a Deep Brain Stimulation (DBS) surgery (Okun & Foote, 2010), which involves electrical stimulation of the subthalamic nucleus and consequent adjustment of the activity of neural circuits in the basal ganglia that are otherwise affected and compromised by the disease.

Traditional pharmaceutical therapy lessens the impact of symptoms, yet does not change the course of the disease (Chaudhuri, Healy & Schapira, 2006; Jankovic & Stacy, 2007), therefore it is relevant to find supplementary forms of therapeutic intervention.



## 1.2 Parkinson's and exercise

Past studies evidence the positive effect of movement activities and physical exercise as therapeutic interventions for people with Parkinson's (Crizzle & Newhouse, 2006; Goodwin, 2008).

Parkinson's UK guidelines include recommendations for physical exercise activities, specifying that exercise is as important as pharmaceutical medications to control and manage symptoms (Parkinson's UK, 2017). Examples of activities and exercise programmes included in the recommendations are: walking, running, cycling, tennis, circuit training, Yoga, dance, Pilates, Tai Chi, table tennis, chair-based exercises.

In more detail, research suggests that cycling can have a positive effect immediately after a single intervention on tremor and bradykinesia (Ridgel, Peacock, Fickes & Kim, 2012; Uygur, Bellumori, LeNoir, Poole, Pretzer-Aboff & Knightet, 2015), as well as gait and cognitive inhibition in a longitudinal intervention (Nadeau et al., 2017), yet it is unclear if improvements persist after the interventions. Yoga can have a positive effect on quality of life (Sharma, Robbins, Wagner & Colgrove, 2015), balance, strength, posture and gait (Colgrove, Sharma, Kluding, Potter, Imming & VandeHoef, 2012), bradykinesia and rigidity (Ni, Mooney & Signorile, 2016), yet all studies report improvements in the short term only and more research is required to fully appreciate and understand the long term implications of Yoga interventions on people with Parkinson's. Tai Chi has been shown to have a positive effect on balance and postural stability (Li et al., 2012) and mobility (Hackney & Earhart, 2008), and it is suggested that improvements are present even 3 months after a long term intervention. Lastly, a recently conducted preliminary study suggested that table

tennis might improve speech, rigidity, slowness of movement and tremor of participants (AAoM, 2020).

Out of all the recommended activities, dance in particular has been shown to be a possible useful activity to help alleviate symptoms of Parkinson's.

### 1.3 Dance for Parkinson's

Previous research indicated that dance may be an excellent form of therapeutic intervention for people with Parkinson's (Earhart, 2009). This is because dance has been indicated to be a form of exercise that is overall more beneficial than physical exercise alone (Fancourt & Finn, 2019; Westbrook & McKibben, 1989), and participants tend to report strong feelings of engagement, hence the very high compliance and very low drop-out rates (Allen, Sherrington, Suriyarachchi, Paul, Song & Canninget, 2011; Earhart, 2009; Hackney & Earhart, 2009). This last aspect is particularly relevant when considering that compliance and regular participation in non-dance based exercise programmes are often insufficient (Heiberger et al., 2011).

Dance offers auditory, visual and sensory stimulation, musical experience, musicality, social interaction, memory, motor learning, emotional perception and expression, emotional interaction, creating an "enriched environment" which influences general everyday competence (Kattenstroth, Kolankowska, Kalisch & Dinse, 2010).

It is also suggested that a consequence of participating in dance activities may be reorganization of neural processes (Sacco Cauda, Cerliani, Mate, Duca & Geminiani, 2006), and therefore bypass brain connections that are directly affected by Parkinson's as well as improve neuroplasticity (Muller et al., 2017; Teixeira-Machado, Arida & de Jesus Mari, 2019).

Dance appears to be beneficial to physical, mental and emotional states (Kudlacek, Pietschmann, Bernecker, Resch & Willvonseder, 1997), effectively targeting both motor and non-motor symptoms.

### 1.3.1 Dance for Parkinson's: motor symptoms

Research suggests that dance therapy for people with Parkinson's can be a safe, inexpensive and effective method in improving motor symptoms including general walking (Hashimoto, Takabatake, Miyaguchi, Nakanishi & Naitou, 2015), gait and stride (Ashoori, Eagleman & Jankovic, 2015), balance (Hackney & Earhart, 2010), functional mobility (Shanahan, Morris, Bhriain, Saunders & Clifford, 2015), endurance (Hackney & Earhart, 2009) and fall prevention (de Natale et al., 2017).

It is suggested that dance may be particularly beneficial for people with Parkinson's because it includes music, which can serve as an external cue to facilitate movement, and task-specific training of difficult movements like turning and backward walking (McNeely, Duncan & Earhart, 2015). Music can facilitate action production, leading to greater automaticity and fluency in sequential motor tasks (Karageorghis, 2020). Research also shows that music helps people with

Parkinson's maintain entrainment, the capacity to move the body to a specific pace, and it is better than metronomes (Rose, Delevoeye-Turrell, Ott, Annett & Lovatt, 2019). It is worth noting that movement performance is impacted by style of music (Janata, Tomic & Haberman, 2012; Stupacher, Hove, Novembre, Schütz-Bosbach & Keller, 2013); in particular, high-groove music, which is music with a high ratio of syncopation over predictability, elicits better gait synchronization and faster gait velocity in people with Parkinson's (Leow, Parrott & Grahn, 2014).

### 1.3.2 Dance for Parkinson's: non-motor symptoms

Evidence suggests that people with Parkinson's benefit psychologically from participating in dance classes, leading to improvements in mood and quality of life (Shanahan, Morris, Bhriain, Saunders & Clifford, 2015). This is relevant for people with Parkinson's, as being affected by the disease may lead to lower mood and reduced quality of life (Grover, Somaiya, Kumar & Avasthi, 2015).

Specifically regarding mood, previous studies have shown that people with Parkinson's that participated in dance classes reported improved mood after participating in a 10 week course of dance classes and after having shared the dance experience with others (Lewis, Annett, Davenport, Hall & Lovatt, 2014; Sharp & Hewitt, 2014). In addition to that, other studies have reported a reduction in negative mood state of people with Parkinson's after participating in dance classes (Heiberger et al., 2011; Westheimer et al., 2015). Furthermore, dance interventions have been shown to regulate mood by increasing positive mood and reducing negative mood (Hansen, Stevens & Coast, 2001; Kennedy & Newton, 1997; Steinberg et al., 1998). It has to be acknowledged that it is still unclear how persistent these changes are over time.

Specifically regarding quality of life, research suggests that participating in long term dance interventions may have a positive effect on quality of life or perceived quality of life (Lewis, Annett, Davenport, Hall & Lovatt, 2014; McRae, Leventhal, Westheimer, Mastin, Utley & Russell, 2018; Shanahan, Morris, Bhriain, Saunders & Clifford, 2015; Sharp & Hewitt, 2014), yet it is unclear how long improvements persist after the intervention, with studies registering changes only up to a week after conclusion of dance interventions.

Dance interventions have also been shown to reduce symptoms of depression (Blandy, Beevers, Fitzmaurice & Morris, 2015), lessen feelings of anger (Lewis, Annett, Davenport, Hall & Lovatt, 2014), reduce social isolation (Bognar et al., 2017), and improve social life (Zafar, Bozzorg & Hackney, 2017). People with Parkinson's experience an increased mental engagement and strategy development when dancing, regardless of the dance style or technique (Hackney & Bennet, 2014).

Dance appears to promote feelings of competence and confidence in movement even if no improvements in motor skills are detected (Houston & McGill, 2013). As a study conducted by Hackney (2007) concluded, participants will feel better if their symptoms improve, but feeling better tends to improve symptoms consequently.

### 1.3.3 Dance for Parkinson's: programmes

The offer of programmes of dance for people with Parkinson's is ever growing (Houston, 2011) and it includes but is not limited to: Dance For PD®, Ballet, Argentine Tango, Contact Improvisation, Irish dance, Salsa, Ballo Sardu, folk dancing, generic Dance for Parkinson's classes and Popping. The scientific research that investigates the effects of dance on people with Parkinson's is expanding alongside the dance offer. The range of different dance styles and techniques are suggested to offer a range of different benefits.

For instance, research to date has shown that Dance For PD®, the original dance for Parkinson's programme based on the contemporary dance work of choreographer Mark Morris, can have several positive effects on participants. Benefits affect gait and tremor as well as reported physical, social and emotional levels (Westheimer et al., 2015), balance and mobility (McNeely, Mai, Duncan & Earhart, 2015), functional mobility, self-efficacy and quality of life (McRae, Leventhal, Westheimer, Mastin, Utley & Russell, 2018). These benefits are present in both the short term and long term and in both short and long interventions. Research also suggests that longitudinal Ballet dance interventions can have positive effects on people with Parkinson's, more specifically on balance, rigidity and confidence, as well as reported feelings of beauty, gracefulness and freedom (Houston & McGill, 2013). Longitudinal studies on Argentine tango dance interventions on people with Parkinson's have highlighted a positive effect on balance, locomotion and backward stride length (Earhart, 2009), functional mobility (McNeely, Duncan & Earhart, 2015), spatial cognition, executive functions (McKee & Hackney, 2013), gait velocity, step length and stance (Hackney & Earhart, 2009) of participants, yet no indication has been given as to how long benefits persisted after the last dance class occurred.

Contact Improvisation, a partnered improvisational dance based on weight-sharing and weight-baring, can have a positive effect on balance and generic motor skills of participants (Marchant, Sylvester & Earhart, 2010). Even Ballo Sardu, a Sardinian folk dance, has been shown in a recent study to have a positive effect on balance, gait, locomotion, as well as depression and apathy of people with Parkinson's (Solla, 2019), even though the findings still have to be replicated outside the regional area. Lastly, studies have suggested that longitudinal Irish dance interventions can have a positive short term effect on balance, gait (Volpe, Signorini, Marchetto, Lynch & Morris, 2013) and quality of life (Shanahan, Morris, Bhriain, Saunders & Clifford, 2015; Shanahan, Morris, Bhriain, Volpe, Lynch & Clifford, 2017) of people with Parkinson's.

Previous studies have also compared in more detail the effects of different dance styles on participants. For example, Tango has been shown to provide greater improvements in motor sign severity and functional mobility when compared to Dance For PD® (McNeely, Duncan & Earhart, 2015). Tango has also been shown to better target deficits associated with Parkinson's when compared with Waltz and FoxTrot (Hackney & Earhart, 2009). Irish dance has been indicated to better improve motor impairment, dynamic balance, functional mobility and quality of life when compared to generic exercise classes (Volpe, Signorini, Marchetto, Lynch & Morris, 2013).

It has to be noted that all of the studies mentioned above, both ones investigating single dance techniques and ones comparing two or more techniques, even if they

all suggest that dance has beneficial effects on people with Parkinson's, present limitations that could substantially impact the results.

#### 1.3.4 Limitations of past research

In this section, limitations of past research will be explored in more depth. There are several recurring limitations in the research that has been conducted in the field to this day. Most of them might be caused by lack of resources, whereas some might be caused by flawed or inappropriate study designs. Most, but not all, limitations are usually explicitly expressed within the research studies themselves.

##### 1.3.4.1 Physical activity and statistical significance

Various studies have tried to capture the benefits of dance on people with Parkinson's focusing on physical symptoms of the disease, utilizing tools such as the Timed Up and Go (TUG), Unified Parkinson's Disease Rating Scale (UPDRS-III) or the Freezing of Gait Questionnaire (Batson, 2010; Hackney & Earhart, 2010; Marchant, Sylvester & Earhart, 2010; McKee & Hackney, 2013; Volpe, Signorini, Marchetto, Lynch & Morris, 2013). Focusing on physical changes might have happened for understandable reasons, such as the desire of people with Parkinson's and clinicians to identify treatments and interventions that might ameliorate the physical symptoms of Parkinson's, the availability and accuracy of the tools mentioned as well as the ease of measuring physical factors over psychological, social or spiritual ones. By doing so, dance interventions are considered to be beneficial or successful only if and when statistically significant improvements in physical activity are observed.

Although dance is intrinsically a physical activity, the focus of any dance class is intrinsically not one of pure physical fitness and improvements. Quoting Sara Houston's work: "*Contrary to the emphasis in research on dancing as a tool to adjust*



*gait, dancing with Parkinson's is first a social activity, not a solitary exercise regime. (...) Dancing is meaningful to Parkinsonian dancers because it gives them a moment of choice, creativity, and responsibility over their bodies"* (Houston, 2015, p. 38). The effect of dance interventions on people with Parkinson's on a psychological level has not been explored in full depth yet, even though psychological adjustment to the effects of Parkinson's can have greater impact on quality of life than the severity of the disease itself (McNeely, Duncan & Earhart, 2015; Suzukamo, Ohbu, Kondo, Kohmoto & Fukuhara, 2006).

To summarise, the impact of physical activity schemes should not be measured by physical activity alone (Riddoch, Puig-Ribera & Cooper, 1998).

#### 1.3.4.2 Dance formulation and posology

Most of the previous studies and publications fail to detail or even mention fundamental aspects of the components of any dance class, regardless of the style or technique. If those dance interventions were to be compared to a pharmaceutical intervention, the ingredients of the dance classes that were subscribed and delivered are not specified, therefore not replicable or debatable.

These include but are not limited to: who the teacher of the dance class is and what training/knowledge he/she has on dance and/or Parkinson's, what music is played during the class, what kind of atmosphere and teaching environment is created, how gentle or strenuous the dance classes are, if refreshments are offered at the end of class or not, how well participants engage with the class and undertake the movements and directions and more. This limitation could be avoided by implementing the use of the Template for Intervention Description and Replication (TIDieR; Hoffman et al., 2014).

#### 1.3.4.3 Dance dosage

Most of the studies conducted to this day are based on long term cycles of interventions, usually between 10 and 12 weeks, with the dosage of an average of one 60 minutes dance class per week (Hackney & Earhart, 2010; McKee & Hackney, 2013; Volpe, Signorini, Marchetto, Lynch & Morris, 2013; Lewis, Annett, Davenport, Hall & Lovatt, 2014). The effective practice ratio of these studies is of 1:168 (1 hour of dance every 168 hours): it would then seem very unlikely that one single 60 minutes dance session of any style or technique could have a week-long impact on the physical symptoms of participants. For example, a previous meta-analysis of therapeutic exercise for older individuals indicated that gait speed was positively affected only if programs were of high dosage (minimum 180 minutes per week) (Lopopolo, Greco, Sullivan, Craik & Mangione, 2006). Reasonable effects that participants might experience in a long term cycle of interventions are the desire and anticipation for the following session, which could potentially affect mood and subsequently affect physical symptoms, although to this day the correlation between mood and physical symptoms in people with Parkinson's has not been explored in full detail, so this case would be arguable to predict. Other benefits on physical symptoms might arise if participants practice dance in their own personal time outside of the dance class (in which case, the ratio of the dosage of the dance intervention would be higher than 60 minutes to 1 week). It also has to be taken in consideration that even thinking about dancing could be considered as a valid form of practice (Pillay, 2010), so if participants think about the movements practiced during the dance class they are effectively activating the same parts of the brain involved when learning the dance steps and performing them, ultimately augmenting the dosage of the dance intervention.

#### 1.3.4.4 Interleaving effect / Spacing effect

It is possible that beneficial effects on motor skills acquisition registered in previous studies could have been present because of two cognitive biases: the interleaving effect (Bangert, Wiedemann & Jabusch, 2013) and the spacing effect (Cepeda, Vul, Rohrer, Wixted & Pashler, 2008; Kornell & Bjork, 2008).

Regarding the interleaving effect, it has been noted by the study conducted by Bangert, Wiedemann and Jabusch (2013) that variability of movement practice increases benefits in motor skills. In other words, it has been evidenced that exploring a variety of movement patterns allows people to perform a specific movement task better than people that only practiced that one specific movement task. The line of research has been successfully extended to music training, yet no study to date has considered this aspect applied to dance training and practice. This is particularly relevant, as dance, regardless of style or technique, offers a varied movement exploration which could be the effective explanation to reported benefits in motor skills. The interleaving effect could potentially explain why dance has been noted by a recent WHO review on arts and health to be more beneficial than physiotherapy on balance for people with Parkinson's (Fancourt & Finn, 2019), as dance offers more movement variety than physiotherapy alone, as well as potentially developing more movement patterns, scenarios and strategies that participants can utilize in real life situations and everyday tasks. To be more specific, movement variety does not relate or depend on specificity of offered dance style: in other words, style-generic dance classes do not necessarily offer increased movement variety, and style-specific dance classes do not necessarily offer reduced movement variety.

The spacing effect refers to the concept that memory is enhanced when learning events are spaced apart in time rather than in immediate succession. It is relevant to

note that this aspect has not been mentioned in previous research in the field nor in the field of dance per se, yet it could have been the effective cause of registered benefits in long-cycle dance interventions. Dance training often requires learning a specific movement vocabulary, which could be considered a form of vocabulary learning, and studies have frequently observed the presence of the spacing effect within motor or linguistic vocabulary learning in different populations, from primary school children learning a new set of words (Goossens, Camp, Verkoeijen, Tabbers & Zwaan, 2012) to adults learning golf putting (Dail & Christina, 2004). When considering this particular bias in combination with the very low dance dosage discussed earlier, it would be plausible to consider that the registered benefits in the studies could have been caused by the spacing effect itself rather than by the dance intervention.

#### 1.3.4.5 Study design

Some studies show a lack of understanding of basic dance technique principles, which consequently causes studies to either fail to consider key aspects or overstate final results. A clear example of this is the study conducted by Hackney and Earhart (2010). In this particular study, the aim was to understand if there was any difference between partnered and non-partnered dance interventions for people with Parkinson's in regards to benefits in motor skills. To achieve this, two different groups were both prescribed tango classes as a dance intervention, with one group practicing the dance with a partner and the other group practicing the dance without a partner. Results showed that partnered tango classes were reported to be more enjoyable than non-partnered tango classes. The study then concluded that, overall, partnered dancing is more beneficial than non-partnered dancing for people with Parkinson's. There is a fundamental issue in the conception and design of this study,

which is that Tango as a dance technique is intrinsically a partnered dance. It is therefore consequent that the partnered classes were more successful and beneficial, as the group practicing a partnered dance technique with no partner was effectively deficient for the whole process. In addition to that, the partners in the partnered group were not affected by Parkinson's, so it is arguable that they were able to act as external cues and support for participants with Parkinson's. Even though some research finds external cues not to help movement of people with Parkinson's (Almeida, Wishart & Lee, 2002), various studies and meta-analyses suggest that external cues do aid and improve movement performance (Georgiou, Bradshaw, Iansek, Phillips, Mattingley & Bradshaw, 1994; Praamstra, Stegeman, Cool & Horstink, 1998; Rocha, Porfirio, Ferraz & Trevisani, 2014). It would be relevant to replicate the study with two different dance techniques (one that is intrinsically partnered and one that is intrinsically non-partnered) compared within the same group in order to have a better understanding of which dance style is more beneficial and/or enjoyable.

Another example that lacks consideration of key dance-related aspects is the study by McNeely, Duncan and Earhart (2015). In this particular study, the aim was to compare two different dance techniques (Tango and Dance For PD®) and investigate whether different dance styles target different motor impairments of people with Parkinson's. Two separate but comparable groups of participants with Parkinson's were given a 12-week dance intervention, with one group participating in tango sessions and the other participating in Dance For PD® sessions. Results showed that Tango dance classes were more beneficial to participants with Parkinson's compared to Dance For PD® dance classes in regards to motor sign severity and functional mobility. In the discussion of the results, two key aspects

have not been considered. Firstly, it is arguable that the Tango dance classes were more beneficial because they were style-specific (meaning only Tango technique was explored and only Tango appropriate music was played) which allowed greater in-depth artistic discovery compared to the Dance For PD® dance classes (which were style-generic, meaning various movement techniques were explored and different music genres were played). Secondly, it is arguable that the benefits might have been caused by the fact that the Tango dance classes were mostly performed standing (whereas Dance For PD® dance classes are mostly performed sitting) and were overall more physically active, intense and strenuous compared to the Dance For PD® dance classes. Even though the correlation between strenuousness of specific dance interventions and study outcomes has not been explored to date, it is possible that the intrinsic dosage of the dance class could be a factor in the results of any research in the field, in addition to the overall dosage of the dance intervention itself. In regards to intensity of physical exercise within the general population, it is worth mentioning that the intensity of the exercise needs to be self-selected in order for it to promote greater positive affect (Ekkekakis, Parfitt & Petruzzello, 2011), which might impact results in studies, including this specific one, with self-selected participants with Parkinson's.

The general point stemming from the examples above is that many different factors that could potentially influence the extent of any effects observed in studies are not always well controlled.

#### 1.3.4.6 Measuring tools

Various studies strongly express that the lack of dance-specific scientifically validated measuring tools can have a huge impact on any research in the field

(Houston, 2015; McGill & Houston, 2014; McRae, Leventhal, Westheimer, Mastin, Utley & Russell, 2018).

One particular study by Houston (2015) highlights aspects and characteristics that are intrinsic and unique about dancing and dance interventions that have not been analyzed before, such as the sense of beauty, the increase in a sense of community and support within participants as well as the reduction of social isolation. It is also suggested that dance offers support and benefits to participants in ways that are not measurable with validated scientific tools yet.

This particular study by Houston has a lot of potential for future developments, and it is a first step towards finding innovative approaches to measure the impact of dance on people with Parkinson's. To quote: "*In the instance of dance for people with Parkinson's, the focus is on moving, creativity, artistic interpretation, and social interaction, not on disease and disability*" (Houston, 2015). Such a point is of incredible value, and understanding the effects of not feeling disabled thanks to dancing might unlock valuable answers and deepen our understanding of what dance is and what it can offer to people with and without a degenerative disease. In addition to that, dancing as an art form inherently focuses on the body as a tool for artistic expression, which might allow participants to alter the perception of their bodies and their entire being, seeing themselves as moving souls rather than patients trapped in a degenerating body, which might bring feelings of freedom and empowerment to participants and ultimately a beneficial impact. Research supports this consideration, as dance has been shown to empower different populations, including sex trafficking survivors dealing with trauma (Bernstein, 2019) and adults participating in Movement Medicine meditation practices (Kieft, 2013), ultimately offering positive changes that participants can integrate and experience not only

during the practices themselves but in their general daily life. To date, there still are no validated dance-specific measuring tools that can test for meaningful changes in feeling of empowerment or self-esteem in people with Parkinson's participating in dance interventions. Some studies have investigated the changes in self-esteem in populations participating in dance activities, both positive (Downs, James & Cowan, 2006; Kalliopuska, 1991; Nordin-Bates et al., 2011) and negative (Bakker, 1988; Bettle, Bettle, Neumarker & Neumarker, 2001), and they could potentially be replicated in the dance for Parkinson's field or be considered as starting points for similar studies in the field. Furthermore, there are existing non dance-specific validated tools that are utilized to measure aspects such as empowerment or self-esteem in other fields of research, such as diabetes (Anderson, Funnell, Fitzgerald & Marrero, 2000), mental illness (Hansson & Bjorkman, 2005), schizophrenia (Yamada & Suzuki, 2007), caregivers of people suffering traumatic brain injuries (Degeneffe, Chan, Dunlap, Man & Sung, 2001), that could provide a starting point for a deeper understanding of the power of dance for people with Parkinson's. Therefore, more attention needs to be given to develop dance-specific measuring tools that focus on the multifaceted aspect of dance; these tools could then supplement the existing validated measuring ones to deepen our understanding of how dance interventions might impact participants with Parkinson's.

#### 1.3.4.7 Dance and cultural relevance

It is needed to acknowledge that factors such as location and culture can have an impact on the results of the studies (Hackney, Earhart, 2009; Houston, 2011; Houston & McGill, 2015; McNeely, Duncan & Earhart, 2015). Previous studies that focused on style-specific dance interventions, such as Irish dance (Shanahan, Morris, Bhriain, Saunders & Clifford, 2015) or Ballu Sardu (Solla, 2019), and were



found to be beneficial for people with Parkinson's, were held in locations where the selected dance technique is culturally bound and relevant. To expand, the studies were not designed to explore cultural relevance of a specific dance style within a certain population, hence this particular aspect was not mentioned in either study, yet it is arguable that those same dance interventions might not be as effective or as beneficial if replicated in locations where the dance style is not culturally bound and/or relevant.

#### 1.3.4.8 Sample size

It is worth noting that there are many other practical limitations when it comes to research on dance and Parkinson's, including sample size (Hackney & Earhart, 2008; Lewis, Annett, Davenport, Hall & Lovatt, 2014; McRae, Leventhal, Westheimer, Mastin, Utley & Russell, 2018; Shanahan, Morris, Bhriain, Saunders & Clifford, 2015; Sharp & Hewitt, 2014). Unfortunately, this is mainly due to the lack of resources that both dance for Parkinson's programmes and scientific researchers have in the first instance. These limitations substantially impact the power of all studies in the field, including the present study, raising the risk of overstating the results and creating false positives. In order to deepen our understanding of the relationship between dance and people with Parkinson's it is needed to enlarge the sample size of scientific studies.

#### 1.3.4.9 Dance programmes and scientific research

Not all existing forms of dance have been scientifically investigated to date, and most of the dance programmes offered to people with Parkinson's have not been researched yet (Shanahan, Morris, Bhriain, Saunders & Clifford, 2015). The gap in the literature is worsened by a publication bias, in which most published papers

available report statistically significant findings and successful outcomes (Easterbrook, Gopalan, Berlin & Matthews, 1991; Rothstein, Sutton & Borenstein, 2005). Very little scientific research has been done exploring the positive effect of Hip Hop on the wellbeing of the wider population, and it has been focusing on adolescents (Crooke, Comte & Almeida, 2020; Travis, Gann, Crooke & Jenkins, 2020). No studies to date have explored either the impact that Hip Hop has on populations other than adolescents or the effects of Hip Hop based dance interventions for people with Parkinson's. The present study is the first scientific study exploring the potential benefits of *Popping For Parkinson's*®, a Hip Hop based style-specific dance programme for people with Parkinson's.

### 1.3.5 Dance for Parkinson's: Popping For Parkinson's ®

#### 1.3.5.1 Introduction

*Popping For Parkinson's* ® is an innovative programme that offers weekly Popping dance classes in various locations in the UK and Italy as well as one-off workshops and classes all around the world. The weekly dance classes offered are free of charge for participants, and the project is funded by both the National Lottery and by the Mayor of London Sadiq Khan. The dance technique offered in the programme is Popping, making the project style-specific. Popping is a form of Hip Hop dance technique originated in the 1970s in California, hence the programme is Hip Hop based (Slusser, 2018). For a visual reference, here is a video example of a regular *Popping For Parkinson's* ® dance class: <https://youtu.be/i59IMMa8i1c> (Sistarelli, 2020).

#### 1.3.5.2 Popping technique

The technique of Popping dance is based on rhythmic, voluntary and instant contraction and release of all the muscles of the body to the tempo and rhythm of the music. This muscle-activating action to the music is in order for the dancers to reach the desired effect of physicalizing the music; what effectively happens in the dancers' bodies are quick but repeated intense vibratory accents in perfect synchrony and harmony with the sound. The action of popping the body to the beat of the music is done vigorously and it results as an energetic yet quite strenuous activity.

A typical *Popping For Parkinson's* ® dance class differs from a general Popping dance class on aspects including class structure, emphasis on self-expression, accessibility and adaptability. The Popping technique per se is not different between a general Popping dance class and a *Popping For Parkinson's* ® dance class,

therefore adaptation refers to movement material, movement delivery and class structure rather than movement technique per se.

### 1.3.5.3 General common elements

*Popping For Parkinson's* ® and other dance for Parkinson's programmes share common elements, practices and knowledge, including:

- Inclusivity: everyone is invited to take part in the class. All class participants are considered and referred to as students, therefore the difference between patients and carers/family members is not evident during the practice. This is relevant, as research suggests that caregivers suffer significant emotional and social distress including depression, tiredness and sadness (Aarsland, Larsen, Karlsen, Lim & Tandberg, 1999) and that patients and caregivers participating together in dance classes can enhance a strong supportive relationship (Heiberger et al., 2011).
- Accessibility: anyone, regardless of conditions, abilities, age, gender, location, Parkinson's stage or DBS surgery should be able to access and enjoy dance.
- Adaptability: every dance class is adaptable. All the movement material that is offered within the class can be adapted to different needs, such as seated versions of standing exercises, without judgement.
- Practice and experience: dance can be enjoyed by participants regardless of their previous dance experience. This is supported by previous research that shows that both the general population and professional dancers benefit from dancing in aspects such as mood (Hansen, Stevens & Coast, 2001; Lane, Hewston, Redding & Whyte, 2003).

#### 1.3.5.4 Unique elements

*Popping For Parkinson's*® features key elements that are unique when compared to all other dance techniques offered to people with Parkinson's. These aspects and their combination create a new and enriched environment that is worth investigating.

These elements include:

- Style offer: even though *Popping For Parkinson's*® is not the only dance programme that is style-specific (meaning it exclusively focuses on and offers one particular dance technique), no other programme offers Popping as a dance style.
- Music: the music played during *Popping For Parkinson's*® classes is style-specific. Genres of music include but are not limited to funk, g-funk, electro and Hip Hop. These genres are classified as high-groove music, as they have a high ratio of syncopation over predictability. As mentioned earlier, research shows that high-groove music generates considerable pleasure and urge to move (Witek, Clarke, Wallentin, Kringelbach & Vuust, 2014), and specifically in people with Parkinson's it elicits better gait synchronization and faster gait velocity (Leow, Parrott & Grahn, 2014).
- Music physicalization: as mentioned earlier, the desired outcome of Popping dance is to physicalise the music, as in moving in perfect synchrony and harmony with sound. In order to achieve this, the technique itself involves learning to contract muscles to timed musical cues. By doing so, the body becomes a ticking metronome, physicalising the auditory cues of the songs. It is plausible that this unique physical response to the external auditory cues could potentially enhance the power of the cues themselves, which are known to be beneficial to people with Parkinson's (Howe, Lövgreen, Cody, Ashton &

Oldham, 2003; McIntosh, Brown, Rice & Thaut, 1997; Suteerawattananon, Morris, Etnyre, Jankovic & Protas, 2004).

- Strenuousness: Popping as a dance technique is energetic, uplifting and strenuous. Even though either a thorough comparison of strenuousness of different dance techniques or the correlation between strenuousness of specific dance interventions and study outcomes has not been explored to date, it is arguable that the intrinsic high dosage of the Popping dance class could lead to a higher overall effect of the dance intervention.
- Vibrations: the Popping dance technique is based on intense repeated whole body vibrations. Interestingly, a study conducted by Haas (2006) showed that a series of random whole body vibrations applied to people with Parkinson's improved their tremor by 25% and rigidity by 24%. It is possible that the vibrations induced by Popping, even if voluntary and non-random, might have a similar effect on tremor and rigidity.
- Cultural relevance: historically, Popping dance originated in Fresno, California (USA) in the late 1970s (Slusser, 2018). Since then, it became an internationally renowned dance thanks to mainstream media platforms such as TV shows, movies and music videos as well as public figures such as Michael Jackson (a Popping dance student). Popping is practiced all over the world, and its relevance is not necessarily geographically bound.

#### 1.3.5.5 Introduction to scientific study, rationale and predictions

From all of these points and reflections, it is clear that an investigation of *Popping For Parkinson's*® and its effects on people with Parkinson's is worth undertaking. Several aspects could be investigated, including changes in physical symptoms such as tremor, rigidity, gait, balance as well as changes in psychological states such as mood, quality of life, empowerment and social engagement.

The aim and purpose of this particular study is to explore, exclusively using validated scientific scales and methods available to date, whether participating in one single *Popping For Parkinson's*® dance class leads to changes in mood and quality of life of people with Parkinson's in the short-term (from immediately after up to a week after the dance class occurred). Factors such as age, gender and previous dance experience will be recorded to explore whether they might influence any psychological effects on mood and quality of life. The researcher chose to focus on mood and quality of life as they are elements that are reasonably predicted to be affected by one single dance class. In this instance, mood is predicted to change, and quality of life, or its perception, is predicted to vary; given that only one class is provided, changes in physical symptoms are not predicted and therefore not measured in this study, although they could be measured in future longer term studies.

This is the first ever research in the field to date to measure the impact of the *Popping For Parkinson's*® methodology on people with Parkinson's, and the first one exploring a Hip Hop based style-specific dance intervention for people with Parkinson's. It is also, to the researcher's knowledge, the first study to investigate mood changes over time following a dance class, as past studies in the field have measured mood as a one off test (Hansen, Stevens & Coast, 2001; Heiberger et al., 2011; Kennedy & Newton, 1997; Lewis, Annett, Davenport, Hall & Lovatt, 2014; Shanahan, Morris, Bhriain, Saunders & Clifford, 2015; Sharp & Hewitt, 2014; Steinberg et al., 1998; Westheimer et al., 2015).

### 1.3.5.6 Hypotheses

It is predicted that:

- There will be a positive difference in mood between T1 and T2; this is because the dance intervention might be able to boost participants' mood.
- There will be a difference in mood between T1 and T3; it is plausible and probable that the effects of the dance intervention might last up to 24 hours.
- There will be no difference in mood between T1 and T4; the effect of the dance intervention will be exhausted, which will bring participants back to baseline.
- There will be no difference in quality of life between T1 and T2: participants will not have the opportunity to experience daily living between immediately before and immediately after the dance class;
- There will be a difference in quality of life between T1 and T3, but no specific directionality of difference is predicted;
- There will be a difference in quality of life between T1 and T4, but no specific directionality of difference is predicted.

Potential co-variates will be considered for interaction with registered changes (if any).

These are:

- Gender. It is predicted that gender will not interact with outcomes;
- Presence of tremor. It is predicted that presence of tremor will not interact with outcomes;
- Age. Participants will be divided into two groups based on their chronological age, one being younger people with Parkinson's and the other being older people with Parkinson's. Cutoff point is below 65 years of age. It is predicted that age will not interact with outcomes;



- Location. Participants will be divided into four groups, one for each location in which data is collected (Hatfield, New York City, Torino, London). It is predicted that location will not interact with outcomes;
- Previous dance experience. Participants will be divided into four groups, one for each level of experience. These levels are: no previous dance experience, generic dance experience but no *Popping For Parkinson's*® specific dance experience, *Popping For Parkinson's*® dance experience but no generic dance experience, both generic dance and *Popping For Parkinson's*® experience. It is predicted that previous dance experience will not interact with outcomes;
- Deep Brain Stimulation surgery. Participants will be divided into two groups, one for participants that have undergone Deep Brain Stimulation surgery and the other for those who have not. It is predicted that this factor will not interact with outcomes;
- Self-assessed Parkinson's stage. Participants will be divided into two groups, one being for participants experiencing mild symptoms (Stage 1-2 in the Hoehn and Yahr scale) and the other for those who experience moderate to severe symptoms (Stage 3-4-5 in the Hoehn and Yahr scale). It is predicted that Parkinson's stage will not interact with outcomes.

## 2. METHODS

### 2.1 Ethics

The study was approved by the University of Hertfordshire Ethics Committee (Protocol Number: LMS/PGR/UH/03670).

### 2.2 Participants

Fortyseven participants with Parkinson's were recruited and took part in the dance class. Fourteen of these participants only completed the required questionnaires immediately before and immediately after the dance class, and thirtythree did complete all of the required questionnaires, immediately before, immediately after, 24 hours after and one week after the dance class occurred. Dropout rate of 29.78% between immediately after and one week after the dance class occurred.

#### 2.2.1 Requirements

The only requisite to be a participant in the study was to have Parkinson's. No other requisites were needed, as the prediction was that dance interventions could benefit anyone regardless of conditions, age, background or experience. No exclusion criteria were implemented, as the prediction was that anyone can participate in dance activities.

#### 2.2.2 Recruitment

Recruitment of participants was done using different platforms, including visiting local Parkinson's networks, distribution of flyers in physical format and via social media, and callouts by research partners (such as University of Hertfordshire and Mark Morris Dance Center/Dance For PD®).

### 2.2.3 Location

The study was conducted in four different geographical locations, spread across two continents and three states, to limit as much as possible any bias in cultural background differences, both in terms of historical background as well as cultural relevance of a dance technique in a specific country or region.

The specific locations were: London (UK), Hatfield (UK), New York City (USA) and Torino (IT). These locations were chosen because the researcher had the opportunity to conduct research and deliver *Popping For Parkinson's*® dance classes in collaboration with local institutions and support groups.

To be more specific, venues were different across locations: in London (UK) the class was held in a privately rented room, in Hatfield (UK) the class was held in a sports hall at the University of Hertfordshire, in New York City (USA) the class was held in a dance studio, and in Torino (IT) the class was held in the local Parkinson's network office space.

### 2.2.4 Dance experience

Out of all participants, there was a different level of experience in terms of dance training and in *Popping For Parkinson's*® training specifically. To be more specific:

- All participants in London (UK) were regular participants of the *Popping For Parkinson's*® dance course: they had knowledge of what a *Popping For Parkinson's*® dance class is, and they have been attending the course for a period that varies between 6 months and 4 years;
- Most participants in Torino (IT) were regular participants of the Italian *Popping For Parkinson's*® dance course: they had knowledge of what a *Popping For Parkinson's*® dance class is, and they have been attending the course for a period of maximum 1 academic year;

- Most participants in Hatfield (UK) had knowledge and/or experience in dance but not of *Popping For Parkinson's*® dance class specifically;
- Most participants in NYC (USA) had knowledge and/or experience in dance but not of *Popping For Parkinson's*® dance class specifically.

There were fifteen participants in the study spread across the four locations that had no prior knowledge of dance and/or of *Popping For Parkinson's*® dance class specifically. A limited number of three participants had experience in both dance for Parkinson's classes and *Popping For Parkinson's*® dance classes.

## 2.3 Materials

Scientifically validated tools to measure the impact of the dance intervention were selected.

In order to measure mood, the Profile Of Mood States (POMS) was utilized (see Appendix II), in line with previous studies in the field (Hackney, Earhart, 2010; Lewis, Annett, Davenport, Hall & Lovatt, 2014). It is a 65-item questionnaire measuring the mood of people with Parkinson's. It is composed of six subscales, of which five negative subscales (tension-anxiety, depression, anger-hostility, fatigue, confusion) and one positive subscale (vigour). The score is calculated by adding the five negative subscales and subtracting the positive one. A higher total score indicates a greater degree of mood disturbance. This questionnaire has tested positively for validity and reliability in previous research in sport and exercise settings (Grove & Prapavessis, 1992; Kaye et al., 1988) as well as for older adults, with excellent internal consistency levels and very good test-retest variability (Gibson, 1997).

In order to measure quality of life, the Parkinson's Disease Questionnaire (PDQ-39) was selected (see Appendix III), in line with previous studies (Jenkinson, Fitzpatrick, Peto, Dummett, Morley & Saunders, 1998). It is a 39-item questionnaire measuring the quality of life of people with Parkinson's. It is composed of eight subscales (mobility, activities of daily living, emotional well-being, stigma, social support, cognition, communication and bodily pain). Total score is calculated by the sum of scores of each item in the subscale divided by the maximum possible score of all the items in the subscale, multiplied by 100. A higher total score indicates a greater degree of reduced quality of life. This questionnaire has tested positively for validity and test-retest reliability in previous research on people with Parkinson's (Jenkinson, Fitzpatrick, Peto, Greenhall & Hyman, 1997), and it has a Cronbach's alpha score of 0.89 which indicates very high internal reliability (Peto, Jenkinson & Fitzpatrick, 1998; Bushnell & Martin, 1999).

In order to establish participants' stage of Parkinson's, the Hoehn and Yahr scale was chosen (see Appendix IV), in line with other studies (Hackney & Earhart, 2007; Lewis, Annett, Davenport, Hall & Lovatt, 2014). This scale offers 8 levels of disease severity, ranging from no symptoms to complete lack of independence. It is worth mentioning that in this study the registered stage of the disease is self-selected by the participants rather than recorded by an external practitioner.

Participants' demographics information was recorded (see Appendix V) after written consent of participation was signed. Data collected included age, gender, previous dance experience, presence of tremor, DBS treatment, and all data was anonymised.

The Physical Activity Readiness Questionnaire (PARQ) (see Appendix VI) was completed by participants. It is a questionnaire that evaluates the ability of a participant to carry out physical activity by checking whether they live with certain health problems that could prevent them from safely being active.

Lastly, participants were asked two open qualitative questions at the end of the study: "How did you find the class?" and "Anything else you would like to add?". The requested feedback was not compulsory and it was not meant to be formally analysed, rather it was implemented to better inform the evaluation and discussion of the results of the study and offer an insight in understanding the registered changes (if any).

## 2.4 Class structure

The *Popping For Parkinson's*® dance class that was offered to participants was the same for all locations and levels of experience.

### 2.4.1 Structure

The structure of the class consisted of:

- gentle warm up, focusing on mobilising the joints and waking up the body as well as establishing good practice and minimising the risk of injuries;
- body rocking/party dancing, to raise the heartbeat in a style-specific way;
- Popping technique was explained and practiced through Popping basic steps;
- Popping technique “drills”, which consisted of simple technical exercises repeated for a sustained amount of time, focusing on embodying the Popping technique;
- travelling across the floor, focusing on moving in space together with other participants;
- short routine, practiced on songs with an augmenting speed/BPM;
- freestyle session/improvisation, focusing on self-expression through the Popping technique;
- cool down/stretching, to normalise the heart rate and minimise risk of injuries;
- reverence to finish, in which participants celebrate the end of the dance class and thank the teacher and fellow participants.

The class was designed to be performed standing. Seated adaptation of the class was always offered in a non-judgemental way, encouraging participants to actively participate for the whole class regardless if they were standing or seated.

The class, in line with the project, was designed to be style-specific: only Popping exercises, Popping routines and Popping appropriate music were explored and proposed.

#### 2.4.2 Class intensity

The dance class was substantially intense; this is because of the intensity of the actual Popping technique involved and because participants were encouraged to fully perform at the best of their abilities at all times. The fast-paced learning and performing of the dance, together with the encouraging atmosphere created, allowed participants to push their personal limits and boundaries. It has to be acknowledged that intensity may depend on participants' physical mobility as well as the severity of their symptoms.

Participants were given short breaks throughout the duration of the class, and they were advised to take additional breaks as needed. Water was available for participants in all locations; refreshments were offered only in Hatfield, but only after having completed the required questionnaires immediately after the dance class.

#### 2.4.3 Music

The music used in the dance class for this particular study was high-groove style-related music. Half of the playlist was composed of funky pop songs that participants might be familiar with (from Janet Jackson to Funkadelic), whereas the other half was composed of funky songs made specifically for Popping dance that participants might not be familiar with.



It has to be considered that the familiarity of personally meaningful music may assist in the internal generation of cues to motivate, initiate and regulate movement (FBASES, 2020; Leow, Rinchon & Grahn, 2015).

Musical genres in the selection included Funk, G-Funk, Electro and Hip Hop, with the tempo of the songs in the playlist ranging from 91bpm to 126bpm. A list of the songs used during the dance class is included in Appendix I.

#### 2.4.4 Atmosphere

The atmosphere during the *Popping For Parkinson's*® dance class was encouraging, uplifting, friendly and accessible; a safe space was created in which participants were encouraged to practice at the best of their abilities at all times, regardless of ability, experience, age or any other factors.

The atmosphere was similar in all locations, despite the difference in physical venue settings.

#### 2.4.5 Teacher

The teacher of the dance class was Simone Sistarelli (the researcher), founder of the *Popping For Parkinson's*® project and methodology, with an extensive background in dance and teaching and specialized in community dance and dance for Parkinson's.

#### 2.4.6 Teaching methods

The teaching methods included verbal instructions (such as “Contract the arm muscles to the music”), imagery (such as “Opening the body like a morning yawn”), repetition, and variations on movement (such as “Change speed”, “Change levels”, “Change direction”). This is in line with the principles of previous research (Batson, Hugenschmidt & Soriano, 2016), which are non-judgement (“There is no right or wrong when expressing yourselves through dance”), non-competitiveness (“Express yourself, do not try to be or look like someone else”), curiosity and playfulness (“Play with the task, be cheeky!”) and risk taking (“Fully commit to the task and see where it takes you”).

#### 2.4.7 Reverence

The class ended with a style-specific reverence called “Pass the Pop”, inspired by the traditional Dance For PD® reverence, in which participants gathered in a small circle and passed a Pop (one singular muscle contraction) around the circle.

### 2.5 Procedure

At the beginning of the study, participants received an information sheet and consent form. After the consent form was signed, participants answered the Demographics Questionnaire, the Physical Activity Readiness Questionnaire and the Hoehn and Yahr self-assessed Parkinson’s stage questionnaire.

Regarding data concerning mood and quality of life, both the Profile Of Mood States questionnaire (POMS) and the Parkinson’s Disease Questionnaire (PDQ-39) were answered by participants at four different times over a period of one week:

- Time one (T1) recorded at the beginning of the research, immediately before the *Popping For Parkinson's* ® dance class, in order to establish baselines;
- Time two (T2) recorded immediately after the *Popping For Parkinson's* ® dance class;
- Time three (T3) recorded 24 hours after the *Popping For Parkinson's* ® dance class;
- Time four (T4) recorded one week after the *Popping For Parkinson's* ® dance class.

At each time point, participants were asked to answer questionnaires in full. Questionnaires were provided both on paper and online format using Qualtrics, a survey software that allows participants to complete questionnaires on their computer or mobile devices. Participants could choose their preferred method of data input.

If participants chose paper format, questionnaires were handed out on the day of the research, T1 and T2 were collected by the researcher on the same day, and prepaid envelopes were distributed to participants in order to collect the data from T3 and T4. For merely practical reasons, in the New York City location, only T1 and T2 questionnaires were handed out and collected on the same day, and a leaflet with instructions on how to answer T3 and T4 online was handed out.

If participants chose the online format, an email was sent to them at appropriate times with the link to the relevant online questionnaire page.

The dance sessions were held:

- in Hatfield (UK) between July 26th and August 2nd 2019;
- in New York City (USA) between September 11th and September 18th 2019;

- in Torino (IT) between September 23rd and September 30th 2019;
- in London (UK) between October 17th and October 24th 2019.

At the end of the study, participants received a debrief sheet.

## 2.6 Statistical analysis

Analyses were conducted using the software SPSS Statistics 26.

The methods used to analyse data were:

- T-tests to compare measures for the two time points T1 and T2;
- Repeated measures ANOVAs to compare measures at all four time points.

Between subject factors including gender, location, previous dance experience, previous *Popping For Parkinson's*® experience, presence of tremor, DBS surgery and self-selected Parkinson's stage were analysed through mixed ANOVAs. Effect sizes will be calculated accordingly by using Cohen's *d* for the T-tests and eta-squared for the ANOVAs. When calculating Cohen's *d*, effect size will be considered small (.02), moderate (.05) or large (.08). When calculating eta-squared, effect size will be considered small (.01), moderate (.06) or large (.14).

## 3. RESULTS

### 3.1 Introduction

Completed questionnaires were returned by 47 participants for T1 and T2. Of these, 33 participants also completed and returned the questionnaires for T3 and T4. Reasons for the drop in response may have included internet access and technical difficulties answering questions, as discussed in section 4.3.

Therefore, in order to explore with more accuracy the changes that the dance intervention might have brought and augment the power of the study, the decision was taken to run analysis on two separate data sets:

- T1 and T2 data for 47 participants - mood and quality of life changes between immediately before (T1) and immediately after the dance class (T2) for 47 participants;
- T1, T2, T3 and T4 data for 33 participants - mood and quality of life changes between immediately before (T1), immediately after the dance class (T2), 24 hours after the dance class (T3) and one week after the dance class (T4) for 33 participants.

There are no significant differences in either baseline scores or demographics between the two sets of participants.

## 3.2 T1 and T2 Data Set - 47 participants

### 3.2.1 Descriptives

A total of 47 participants, 20 male and 27 female, mean age of 68.6 (SD 10.3), 16 participants below 65 years of age and 31 participants over 65 years of age, mean Parkinson's level of 2.0 (SD 1.7) in the Hoehn and Yahr scale, 32 participants with mild Parkinson's and 15 participants with moderate to severe Parkinson's, took part in the study and responded to both questionnaires at T1 and T2.

Of them, 22 had previous experience in dance, 7 had previous experience in *Popping For Parkinson's*® dance, 3 had previous experience in both dance and *Popping For Parkinson's*®, and 15 had no previous experience at all.

Location wise, 7 of them participated in Hatfield (UK), 16 in New York City (USA), 17 in Torino (IT) and 7 in London (UK).

Regarding tremors, 31 out of 47 reported a tremor caused by Parkinson's and 8 out of 47 had previously undergone DBS surgery.

### 3.2.2 POMS

Participants' mood significantly improved immediately after the dance class.

A paired sample *t*-test between POMS total scores revealed a significant difference between immediately before (T1) and immediately after (T2) the dance class (see Table 1), registering a large effect (Cohen's  $d = 0.7$ ). The POMS total score significantly decreased, which signifies improved mood.

A significant difference was also registered for all of the POMS subscales. In more detail, there was a significant decrease in Tension, Depression, Anger, Fatigue and Confusion, and a significant increase in Vigour (see Table 1).

Participating in a *Popping For Parkinson's*® dance class significantly improved general mood, reduced feelings of tension, depression, anger, fatigue, confusion and increased vigour.

**Table 1**

*POMS results - T1-T2 Data Set*

	Mean Value T1 (SD)	Mean Value T2 (SD)	<i>t</i> value	<i>p</i> value	Effect size
POMS: Tension - Anxiety	8.43 (5.36)	4.89 (3.26)	6.40	<i>p</i> < .001	<i>d</i> =0.80
POMS: Depression - Dejection	7.53 (9.06)	3.28 (5.41)	4.50	<i>p</i> < .001	<i>d</i> =0.57
POMS: Anger - Hostility	5.11 (6.21)	3.47 (4.50)	2.67	<i>p</i> = 0.01	<i>d</i> =0.30
POMS: Vigour - Activity	15.68 (5.73)	18.79 (6.61)	-3.91	<i>p</i> < .001	<i>d</i> =0.50
POMS: Fatigue - Inertia	7.38 (4.99)	5.87 (4.38)	2.49	<i>p</i> = 0.01	<i>d</i> =0.32
POMS: Confusion - Bewilderment	6.60 (4.13)	4.38 (3.01)	5.20	<i>p</i> < .001	<i>d</i> =0.61
POMS: Total score	19.36 (26.67)	3.11 (19.20)	6.08	<i>p</i> < .001	<i>d</i> =0.70

In order to investigate whether co-variates such as gender, previous experience, location, registered tremor, Parkinson's stage and DBS surgery had any impact on total mood scores, separate mixed design ANOVAs were run for each factor. The results for all co-variates were not significant ( $p > .05$ ). No interaction between co-variates and time resulted significant.

To expand, gender did not significantly interact with results ( $F = 0.63$ ,  $p = 0.43$ ), suggesting that participants' mood improved regardless of their gender. Age did not

significantly interact with results ( $F = 0.49, p = 0.49$ ), suggesting that the registered improvements in mood did not differ between participants with younger onset Parkinson's and participants with regular onset Parkinson's. Participants' previous dance experience did not influence results ( $F = 0.69, p = 0.57$ ), suggesting that improvements in mood can occur at any level of dance experience. Presence of tremor did not influence results either ( $F = 3.44, p = 0.70$ ), suggesting that mood improvements are not linked to participants' reported tremor. Undergoing a Deep Brain Stimulation surgery had no impact on the registered mood changes ( $F = 2.10, p = 0.15$ ), suggesting that mood improves regardless of it. The self-assessed stage of Parkinson's did not interact with the results ( $F = 1.28, p = 0.29$ ), suggesting that participants' mood improved whether their Parkinson's was mild, moderate or advanced. Lastly, location did not interact with results ( $F = 0.92, p = 0.44$ ), suggesting that participants from different cultural backgrounds and geographical locations all experience improved mood after participating in one single *Popping For Parkinson's*® dance class.

### 3.2.3 PDQ-39

Participants reported improved quality of life immediately after the dance class. Paired sample *t*-test for PDQ-39 total scores showed a significant difference between immediately before (T1) and immediately after (T2) the dance class (see Table 2).

A significant difference was registered on the Mobility, Activity of Daily Living, Emotional wellbeing and Cognition subscale scores (see Table 2). No significant difference was registered on the Stigma, Social, Communication and Bodily subscales (see Table 2).

Participating in a *Popping For Parkinson's*® dance class has a statistically significant effect on the perception of quality of life immediately after participation in the class.



**Table 2***PDQ-39 results - T1-T2 Data Set*

	Mean Score T1 (SD)	Mean Score T2 (SD)	<i>t</i> value	<i>p</i> value	Effect size
PDQ-39: Mobility	30.32 (20.48)	26.76 (21.91)	2.69	<i>p</i> = 0.01	<i>d</i> =0.17
PDQ-39: Activity	24.20 (17.21)	20.75 (17.92)	2.64	<i>p</i> = 0.01	<i>d</i> =0.20
PDQ-39: Emotional	28.63 (18.52)	24.12 (17.70)	3.28	<i>p</i> = 0.002	<i>d</i> =0.25
PDQ-39: Stigma	16.25 (18.10)	15.71 (19.59)	0.30	<i>p</i> = 0.76	<i>d</i> =0.02
PDQ-39: Social	16.49 (18.35)	15.78 (18.97)	0.44	<i>p</i> = 0.66	<i>d</i> =0.04
PDQ-39: Cognitions	31.28 (21.26)	26.35 (19.72)	3.83	<i>p</i> < 0.001	<i>d</i> =0.24
PDQ-39: Communication	25.35 (22.52)	21.45 (17.62)	1.79	<i>p</i> = 0.08	<i>d</i> =0.19
PDQ-39:Bodily	37.94 (24.38)	34.75 (25.74)	1.39	<i>p</i> = 0.17	<i>d</i> =0.13
PDQ-39: Total score	26.30 (12.86)	23.20 (13.02)	3.49	<i>p</i> = 0.001	<i>d</i> =0.24

Furthermore, separate mixed design ANOVAs were run to investigate whether co-variates such as gender, previous experience, location, registered tremor, Parkinson's stage and DBS surgery had a relevant impact on total quality of life measures. Results for all co-variates were not significant ( $p > .05$ ). No interaction between co-variates and time resulted significant.

In more detail, gender did not significantly interact with results ( $F = 3.54, p = 0.08$ ), suggesting that participants' perception of quality of life improved regardless of their gender. Age did not significantly interact with results ( $F = 0.99, p = 0.33$ ), suggesting that the registered improvements did not differ between participants with younger onset Parkinson's and participants with regular onset Parkinson's. Participants' previous dance experience did not influence results ( $F = 0.67, p = 0.57$ ), suggesting that improvements can occur at any level of dance experience. Presence of tremor did not influence results either ( $F = 0.05, p = 0.83$ ), suggesting that improvements are not linked to participants' reported tremor. Undergoing a Deep Brain Stimulation surgery had no impact on the registered changes ( $F = 0.37, p = 0.54$ ), suggesting that perception of quality of life improves regardless of it. The self-assessed stage of Parkinson's did not interact with the results ( $F = 3.78, p = 0.40$ ), suggesting that participants' perceived quality of life improved whether their Parkinson's was mild, moderate or advanced. Lastly, location did not interact with results ( $F = 1.17, p = 0.33$ ), suggesting that participants from different cultural backgrounds and geographical locations all experienced improved perceived quality of life after participating in one single *Popping For Parkinson's*® dance class.

### 3.3 T1, T2, T3 and T4 Data Set - 33 participants

#### 3.3.1 Descriptives

A total of 33 participants, 14 male and 19 female, mean age of 67.5 (SD 10.3), 13 participants below 65 years of age and 20 participants over 65 years of age, mean Parkinson's level of 1.8 (SD 1.6) in the Hoehn and Yahr scale, 24 with mild Parkinson's and 9 with moderate to severe Parkinson's, completed the study by responding to all questionnaires at all four data entry points.

Regarding previous experience, 12 had previous experience in dance, 7 had previous experience in *Popping For Parkinson's*® dance, 3 had previous experience in both dance and *Popping For Parkinson's*®, and 11 had no previous experience at all.

In terms of location, 6 of them participated in Hatfield (UK), 3 in New York City (USA), 17 in Torino (IT) and 7 in London (UK).

Of them, 19 reported a tremor caused by Parkinson's; 7 out of 33 underwent the DBS surgery.

#### 3.3.2 POMS

The results of the repeated-measures ANOVA with a Greenhouse-Geisser correction showed that there was a significant difference in total mood scores between all four time points (see Table 3). Post hoc tests using the Bonferroni correction revealed that mood differed between immediately before (T1) and immediately after (T2) the dance class occurred ( $p < .001$ ) and between immediately after (T2) and 24 hours after (T3) the dance class occurred ( $p = .005$ ), but no significant difference in mood was registered between T1 compared with T3, between T1 compared with T4,

between and between T3 compared with T4 (see Figure 1). Mood improved immediately after the dance class, and then went back to baseline levels within 24 hours. The effect size was large ( $\eta^2 = .186$ ).

Regarding POMS subscales, results highlighted a significant difference in Tension, Depression, Vigour and Confusion, but no significant difference in Anger and Fatigue, between the four time points (see Table 3). Post-hoc tests using Bonferroni correction revealed that the changes in values in the Tension, Depression, Vigour and Confusion subscales occurred between immediately before (T1) and immediately after (T2) the dance class occurred and between immediately after (T2) and 24 hours after (T3) the dance class occurred, but no significant difference was registered between T1 compared with T3, between T1 compared with T4, between and between T3 compared with T4 (see Table 3).

Participating in a *Popping For Parkinson's*® dance class significantly improved general mood, reduced feelings of tension, depression, confusion and augmented vigour immediately after the dance class. The effect of the intervention lasted less than 24 hours.

**Table 3***POMS results - T1 - T2 - T3 - T4 Data Set*

	Mean Value T1 (SD)	Mean Value T2 (SD)	Mean Value T3 (SD)	Mean Value T4 (SD)	Fvalue	<i>p</i> value	Effect size
POMS: Tension - Anxiety	7.36 (4.61)	4.45 (2.49)	7.21 (5.30)	7.06 (5.54)	5.89	0.001	.155
POMS: Depression - Dejection	6.79 (7.66)	2.58 (3.81)	6.36 (8.01)	7.67 (10.30)	5.17	0.003	.139
POMS: Anger - Hostility	4.76 (5.14)	2.88 (3.25)	4.18 (4.09)	5.24 (6.30)	2.36	0.09	.069
POMS: Vigour - Activity	14.61 (5.50)	18.03 (6.93)	14.42 (5.91)	13.97 (6.17)	8.44	0.001	.209
POMS: Fatigue - Inertia	6.94 (4.54)	5.64 (4.58)	6.97 (5.11)	6.79 (4.97)	1.52	0.22	.045
POMS: Confusion - Bewilderment	6.24 (3.39)	3.97 (2.83)	5.15 (3.22)	5.85 (4.04)	5.73	0.003	.152
POMS: Total score	17.48 (21.59)	1.48 (16.07)	15.45 (24.24)	18.64 (31.97)	7.32	0.008	.186

## Figure 1

*POMS changes - T1 - T2 - T3 - T4 Data Set*

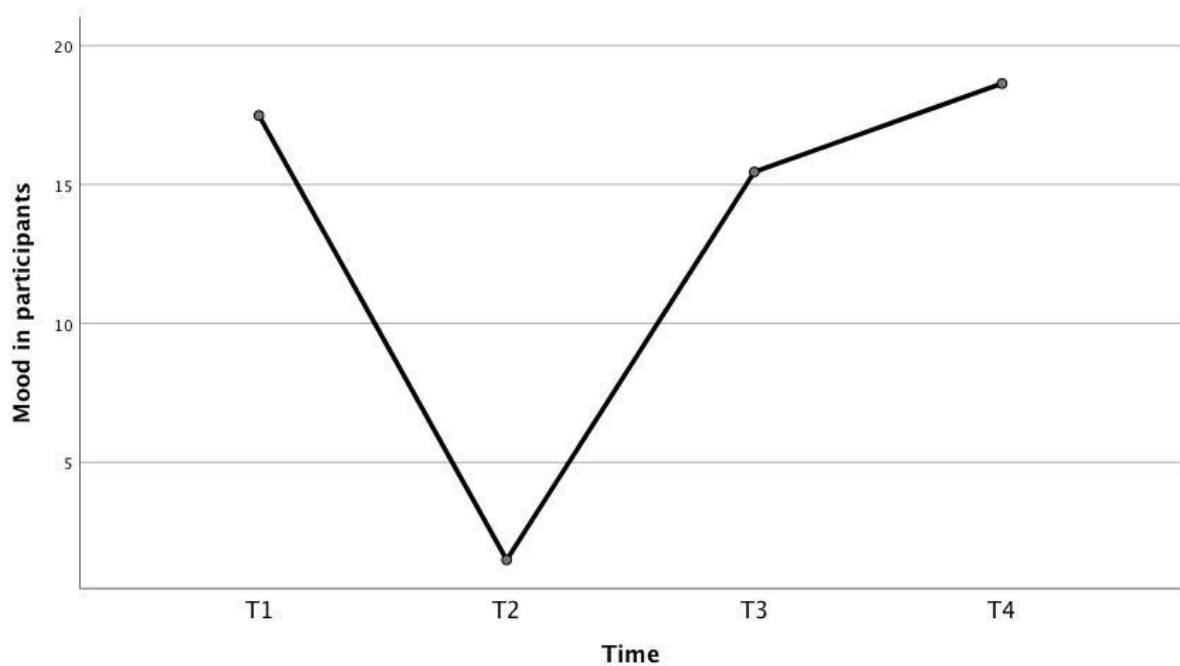


Figure 1: POMS total score at each time point.

Separate two-way ANOVAs were run to investigate whether factors such as gender, previous experience, location, registered tremor, Parkinson's stage and DBS surgery had a relevant impact on mood scores. Interaction results were all not significantly relevant (see Table 4), suggesting that changes in values in both general mood scores and subscales mood scores occurred regardless of participants' gender, previous experience, location, registered tremor, Parkinson's stage and DBS surgery.

**Table 4***Interaction of each factor with time on POMS results - T1 - T2 - T3 - T4 Data Set*

---

	F value	p value
Gender	0.581	0.58
Age	0.54	0.60
Previous experience	1.69	0.13
Location	0.94	0.48
Presence of tremor	0.33	0.74
Parkinson's stage	0.68	0.76
Deep Brain Stimulation	0.33	0.74

---

### 3.3.3 PDQ-39

The results of the repeated-measures ANOVA with a Greenhouse-Geisser correction showed that there was no significant difference in total quality of life scores between all four time points (see Table 5). Regarding subscales, there was no significant difference in quality of life subscale scores between all four time points (see Figure 2).

**Table 5***PDQ-39 results - T1 - T2 - T3 - T4 Data Set*

	Mean Value T1 (SD)	Mean Value T2 (SD)	Mean Value T3 (SD)	Mean Value T4 (SD)	Fvalue	p value	Effect size
PDQ-39: Mobility	30.00 (19.25)	25.38 (20.45)	27.42 (21.83)	26.82 (21.94)	2.31	0.10	.067
PDQ-39: Activity	21.59 (15.18)	18.69 (15.17)	29.83 (16.03)	21.21 (17.99)	1.02	0.37	.031
PDQ-39: Emotional	29.80 (17.92)	24.12 (18.46)	26.90 (19.71)	28.54 (22.05)	2.46	0.08	.071
PDQ-39: Stigma	14.42 (16.94)	14.41 (17.99)	11.76 (17.18)	14.98 (20.68)	0.66	0.56	.019
PDQ-39: Social	14.89 (17.89)	15.41 (20.11)	13.63 (18.14)	14.65 (20.20)	0.25	0.83	.008
PDQ-39: Cognitions	28.82 (22.70)	23.88 (20.10)	22.75 (17.80)	24.07 (17.83)	2.61	0.09	.075
PDQ-39: Communication	21.46 (19.44)	18.93 (15.20)	17.92 (16.16)	17.42 (16.71)	1.33	0.27	.040
PDQ-39:Bodily	35.10 (22.89)	31.06 (23.60)	31.31 (22.05)	31.82 (21.60)	0.99	0.40	.030
PDQ-39: Total score	24.51 (12.29)	21.48 (12.28)	21.57 (12.56)	22.44 (12.49)	2.38	0.09	.069



## Figure 2

PDQ-39 results - T1 - T2 - T3 - T4 Data Set

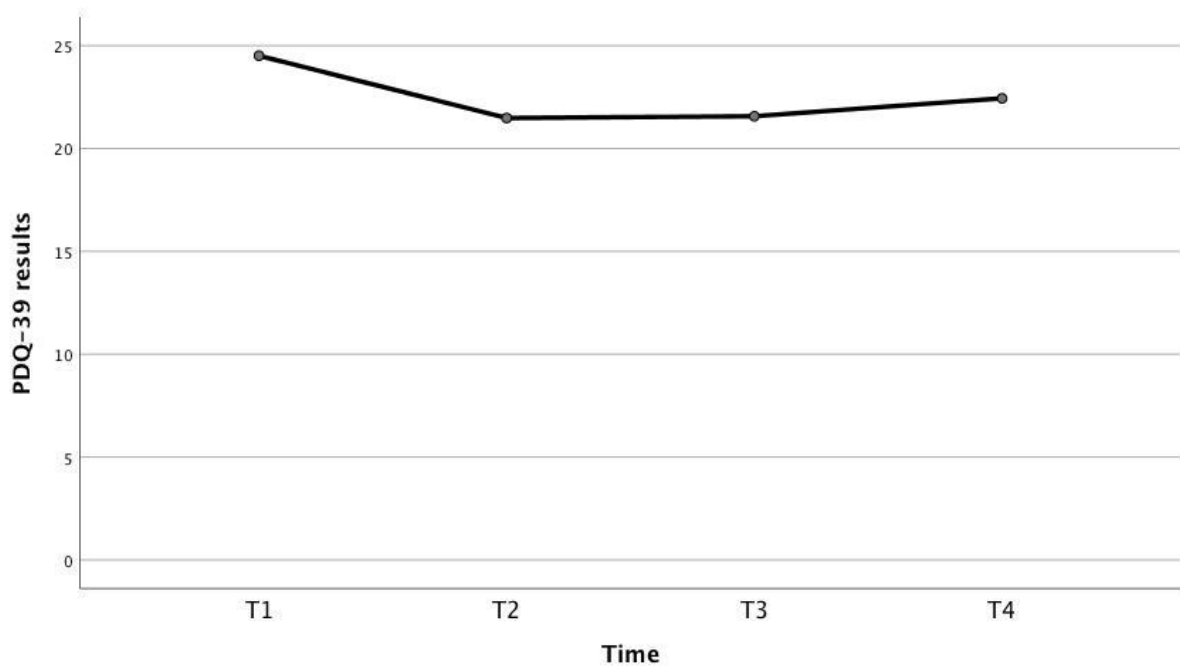


Figure 2: PDQ-39 total score at each time point.

Given that a significant change in total quality of life scores was registered in the T1 - T2 Data Set, and to further explore the data, paired sample *t*-tests with a Bonferroni correction were run. Results showed a significant difference in total quality of life scores between immediately before (T1) the dance class and immediately after (T2) the dance class occurred (see Table 6). No significant differences in total quality of life scores were found between immediately before (T1) and one week after (T4) the dance class, between immediately after (T2) and 24 hours after (T3) the dance class, between immediately after (T2) and one week after (T4) the dance class, and between 24 hours after (T3) and one week after (T4) the dance class occurred (see Table 6).

**Table 6***PDQ-39 t-tests - T1 - T2 - T3 - T4 Data Set*

---

	<i>t</i> value	<i>p</i> value
T1-T2	3.29	0.003
T1-T3	1.91	0.06
T1-T4	1.59	0.12
T2-T3	0.06	0.95
T2-T4	0.68	0.49
T3-T4	0.74	0.47

---

Separate two-way ANOVAs were run to investigate whether factors such as gender, previous experience, location, registered tremor, Parkinson's stage and DBS surgery had a relevant impact on total quality of life scores. Interaction results were all not significantly relevant (see Table 7), suggesting that none of these factors impacted total quality of life scores.

**Table 7**

*Interaction of each factor with time on PDQ-39 results - T1 - T2 - T3 - T4 Data Set*

---

	F value	p value
Gender	0.62	0.56
Age	0.13	0.90
Previous experience	0.91	0.51
Location	1.11	0.37
Presence of tremor	0.79	0.47
Parkinson's stage	1.24	0.27
Deep Brain Stimulation	0.55	0.61

---

Participating in a *Popping For Parkinson's*® dance class immediately tends to improve perceived quality of life, regardless of gender, previous experience, location, registered tremor, Parkinson's stage and DBS surgery, and the effect of the intervention lasts less than 24 hours.

### 3.3.4 Qualitative Feedback

Responses by 11 out of 33 participants were recorded. Feedback was given by participants at the end of the research (one week after the dance class occurred) yet it was not compulsory (see Table 8).

**Table 8**

*Participants' qualitative feedback*

---

Positive - Enjoyed the class	9 of 11
Positive - Found the class fast-paced and challenging	4 of 11
Positive - Enjoyed the music	3 of 11
Negative - Found the class tiring	3 of 11

---

Words such as energized, satisfying, invigorating, optimistic, positive, superb were used to describe the dance class, regarding the material, the atmosphere, and/or the teacher.

One participant that had no previous dance experience reported: *"The class was great fun and I liked the music. I enjoyed the class but sometimes the movements were difficult. Towards the end of the week I was feeling better than before the class, both physically and mentally, I also felt a little calmer"*.

One participant that had previous dance experience but no specific *Popping For Parkinson's*® experience reported: *"Most enjoyable class - have always enjoyed dance. It makes me feel able and at times as if I don't have the condition"*.

One participant that had previous *Popping For Parkinson's*® experience reported: *"Excellent! I always feel optimistic and hopeful after class. It is the highlight of my week. The collective spirit led by the teacher is superb. Everytime is supportive and encouraging"*.

One participant reported: *"I found it fun and challenging. The Popping moves seem to help me release some of the stiffness. Not to mention the Wow's I get from my grandchildren!"*.

Overall, the participants that provided comments enjoyed participating in the *Popping For Parkinson's*® dance class. This result is in line with the quantitative findings. No further analysis was run on qualitative data because of the very small amount of data collected.

## 4. DISCUSSION

The aim of this study was to investigate whether participating in one *Popping For Parkinson's*® dance class could improve the mood and quality of life of participants with Parkinson's in the short-term.

Data analysis showed that participants' mood and perceived quality of life did significantly improve immediately after partaking in a *Popping For Parkinson's*® dance class, and that effects lasted less than 24 hours.

### 4.1 Mood

The results showed that mood largely improved immediately after the dance class, as originally predicted, suggesting that the dance intervention boosted the mood of participants. Feelings of tension, depression, confusion were significantly reduced and vigour significantly increased. These results are in line with previous studies investigating mood improvements after a dance intervention (Heiberger et al., 2011; Lewis, Annett, Davenport, Hall & Lovatt, 2014; Sharp, Hewitt, 2014; Westheimer et al., 2015).

Results showed that all factors (gender, previous experience, location, Parkinson's stage, reported tremor or DBS intervention) had no significant impact on the registered changes in total mood scores. This is relevant, as it supports the prediction that participants can experience changes in their mood regardless of their personal, social and cultural background. Given the small sample of these subgroups, and subsequent lack of power, these results need to be interpreted cautiously.

Results also showed that the effects of the dance class on mood lasted less than 24 hours. This is a key novel finding of this current study, as previous research in the field measured mood in participants only at two time points (at the beginning of the longitudinal studies to collect baselines and at the end of the study to investigate any changes), and no data was collected to understand and evaluate the duration of the registered changes (Hansen, Stevens & Coast, 2001; Kennedy & Newton, 1997; Steinberg et al., 1998). These results also confirm the prediction that the effects of dance interventions are of shorter term than may have been previously assumed or predicted in previous longitudinal studies. Research in other fields shows that mood of populations without neurological conditions does improve thanks to physical activity in the short term (Berger & Motl, 2000), and that mood consistently improves thanks to a consistent training programme and repeated sessions (DiLorenzo, Bargman, Stucky-Ropp, Brassington, French & LaFontaine, 1999), yet the medium and long term effects of physical activity on mood are either not present (Walter et al., 2013) or still unclear and unknown (Berger & Motl, 2000).

Therefore, this current study suggests that dance can be a valuable mood-boosting activity for people with Parkinson's. Since effects only last less than 24 hours it is possible to compare a dance class to a pharmacological pill that requires to be administered once a day in order for mood to improve and limit disturbance. Furthermore, given that previous experience did not interfere with results, it is plausible to postulate that mood does improve without suffering from repetition bias: when people dance, their mood improves, and the more frequently they dance, the more frequently they can experience improved mood. It is therefore suggested here that dance programmes should receive the necessary support to offer daily dance classes to participants with Parkinson's in order to consistently improve participants'

mood, and that the medical field should promote more actively dance activities to their patients.

On another note, a point that the qualitative feedback highlighted was that three participants reported that they felt more fatigued after the dance class occurred, yet the Fatigue subscale within the POMS questionnaire shows a significant decrease (i.e. less fatigue) after the dance class. When looking at the three participants' individual responses within the Fatigue subscale between T1 and T2, one participant scored a lower point, one participant scored the same point and one participant scored a higher point. This could support the idea that fatigue and tiredness are different yet they are commonly confused semantically and conceptually, and that participants might experience fatigue rather than tiredness or vice versa. This is relevant, as fatigue is a common non-motor symptom of Parkinson's (Parkinson's UK, 2017), and more clarity is needed to fully appreciate the relation between being tired after physical activity of any kind and fatigue caused by a disease.

## 4.2 Quality of life

Regarding quality of life, results showed that perceived quality of life improved immediately after the dance class. This is contradicting the original predictions: it was expected that no change in quality of life could be registered due to participants not having the opportunity to experience daily living between immediately before and immediately after the dance class.

Results also showed no difference in quality of life 24 hours and 1 week after the dance class occurred, in line with what was predicted. This suggests that one single dance class is plausibly not enough to significantly improve participants' quality of life



overall, yet it could be enough for participants to change their perception of their quality of life immediately after the dance class. This finding is in contrast with previous studies (McKee & Hackney, 2013; Volpe, Signorini, Marchetto, Lynch & Morris, 2013).

It is known that participants may have a better state of mind at completion of any dance class due to a boost in self-efficacy, self-esteem, and pleasure (Lotzke, Ostermann & Büssing, 2015), which might contribute to participants' quality of life showing improvement on the quality of life measure. It is also possible that the registered change in mood between the same time points might impact participants' perception of their quality of life rather than quality of life itself; a study conducted with people with epilepsy showed that mood has a dominant role over quality of life (Tracy, Dechant, Sperling, Cho & Glosser, 2007). It is also arguable that, if the study was to include several dance classes over a longer period of time, participants' quality of life might or might not show a significant change overall, as increasing the dosage of the intervention might impact quality of life of participants. Another factor that needs to be taken into consideration is that participants' self-perception of improvement might influence the effectiveness of the intervention itself (Hackney & Earhart, 2010). This aspect could be particularly relevant for participants that regularly attend *Popping For Parkinson's*® dance classes, as they might perceive a greater level of benefits than the one registered in this particular study, even if no significant difference was highlighted by the analysis.

Results showed that all factors (gender, previous experience, location, Parkinson's stage, reported tremor or DBS intervention) had no impact on total quality of life scores. This is relevant, as it supports the prediction that participants can experience changes in their perceived quality of life regardless of their personal and cultural

background. Given the small sample of these subgroups, and subsequent lack of power, these results need to be interpreted cautiously.

### 4.3 Limitations

One of the limitations of this study, as well as previous studies in the field, is sample size. It is fundamental to recognize this particular limit in order not to overstate results. This current study has a higher total number of participants when compared to previous studies included in a meta-analysis (Aguilar, da Rocha & Morris, 2016), yet it is essential to recognize that the results registered might not be equal when replicating this study with a wider population.

Participants dropping out of the study worsened the limitation. The drop in response numbers could be explained by different factors, such as no or little access to the internet, technical difficulties in answering the questionnaire online, or participants actively deciding to withdraw from the research. One aspect that is worth mentioning is that participants could not leave unanswered questions in the online format, which meant that on one hand the collected data had no missing values, on the other hand it might have caused participants to struggle submitting the questionnaires and therefore dropping out of the study. As mentioned earlier, participants in New York City could only answer questionnaires at times 3 and 4 online, and even though they were given detailed leaflets with instructions on how to complete questionnaires online, and even though an email was sent to them at the appropriate time as a reminder, the rate of dropping out of the study is the most substantial. Even though it is plausible that the dropout rate in this study could be explained by merely technical difficulties in answering questionnaires in the online format, the real motivations behind dropping out of the study are unknown, as exit questionnaires were not included.

The sample size limitation plays an important role especially when analysing the co-variates, as the very small numbers in subgroups do not allow a real understanding of the factors.

Control groups were not implemented. Even though the study was not designed to measure differences between distinctive groups, having a control group would have provided more insight as to the power of dance. For instance, two groups of participants with Parkinson's of comparable age, location and level of activity readiness could have been set up. One could have participated in a social movement-based activity, while the other could have been a social control group. By recording mood levels of all three groups, it would be possible to compare one movement-based intervention over the other while still controlling for the social aspect of the activities. This limitation was mainly caused by lack of resources.

Participants in this study were self-selected, which could have caused an impact on results, considering the possibility that they might have had a precedent desire and interest in joining a Popping For Parkinson's ® dance class.

It has to be acknowledged that even if self-assessed Parkinson's stage has been used in previous studies as a reliable measurement (Westheimer, 2008), it might not match the actual Parkinson's stage a participant is in, therefore skewing results or interpretation of them. It also has to be acknowledged that there is considerable variability in Parkinson's symptoms, so classifying participants by "stage" only may be a simplification of more complex and personal scenarios.

Regarding the quality of life measurements, it has to be acknowledged that the questionnaire in use (PDQ-39) specifically asks participants to reflect on the

challenges they encountered as part of their daily living within the time frame of a previous month up to completion of the questionnaire. Given that this study was focusing on one single dance class and the effects of it within one week, the questionnaire might not have been chosen correctly to register adequate changes in time. Alternative tools, such as the UPDRS for instance, could potentially have better answered the original questions of the study.

It is possible that registered benefits of any study in the field, including this one, could be caused by the placebo effect: participants' belief in the dance interventions could bring beneficial effects that could possibly not be attributed to the dance interventions themselves. This could be particularly relevant when considering that people with Parkinson's clearly respond to the placebo effect in pharmacological treatments (Shetty, Friedman, Kieburtz, Marshall & Oakes, 1999), and that there is evidence that placebo effects involve the neurotransmitter dopamine that is affected in Parkinson's (de la Fuente-Fernandez, 2009). In addition to this, it is not possible to design dance studies so that the participant is blind to the intervention (as it would be done for a study with a pharmacological intervention), therefore the only way to limit placebo effect in this instance would be to compare a dance intervention with another non-dance intervention that is equally plausible to the participant as potentially useful.

Regarding perception of interventions, it would be useful to consider how the dance class was delivered in the first instance and therefore perceived by participants. Given that dance is a multifaceted activity (Houston, 2015), it could be interpreted and perceived in various ways by participants, including but not limited to pure entertainment, learning platform, motor rehabilitation, social activity or shared spiritual experience. It is therefore relevant to be aware that by shifting the focus of

the dance class on aspects such as therapeutic gains rather than entertainment, education or edutainment or vice versa there could potentially be a difference in the outcome of any dance intervention. Shifting the focus of a dance class can occur in many ways, such as via marketing and promotion of the dance class, the venue in which the dance class is held, the teacher setting a specific theme or outcome for the dance class and more. It is plausible that holding a dance class in a hospital setting with the teacher stressing the outcome of physical benefits of activity could have different results to the same dance class held in a recreational centre with the teacher inciting students to enjoy themselves as the key outcome of the activity.

Music selection could have also had an influence in the outcome of this research as well as previous studies. The songs chosen for this study's dance class could all be considered high-groove music, which has been shown to be the most beneficial kind of music on symptoms for people with Parkinson's (Leow, Parrott & Grahn, 2014). Familiarity with certain songs could also have had an impact on participants' experience of the dance intervention (Morris et al., 2019) and consequently on this study's results, as it has to be considered that the familiarity of personally meaningful music may assist in the internal generation of cues to motivate, initiate and regulate movement (FBASES, 2020; Leow, Rinchon & Grahn, 2015). Moreover, to date, there has been no comprehensive analysis of the music used in dance classes for people with Parkinson's that examine elements such as the melodic phrase length, tonality, instrumentation, tempi and rhythms (Beevers, Morris & McConville, 2015), causing a considerable limitation in comparing interventions.

Possibly, the intensity of the dance class offered as part of the study could have had an impact on results. Unfortunately, the intrinsic intensity of Popping dance has not been explored yet, which leads to a limitation in comparing intensity, energy

expenditure and strenuousness of dance related activities. To expand on this, previous research (Jette, Sidney & Blümchen, 1990) has explored the different levels of metabolic equivalent (METs) expended during various exercise activities, including different styles of dancing, showing that certain dance techniques (such as Irish Dance and Country Dance) require more energy expenditure and are therefore more vigorous and strenuous than others (such as Tango and Ballroom). In addition to this, intensity of exercise can be substantially variable between participants depending on their individual abilities. It is to be acknowledged that progress is currently being made to avoid this limitation in the field both by updating the original paper mentioned earlier and by using accelerometers to measure activity levels of people with Parkinson's while dancing, yet future studies should consider investigating this aspect further. One example could be to monitor individual participants with accelerometers, heart-rate monitors and other wearable technology before, during and after a dance class to register whether there is a significant change of energy expenditure and activity levels during the activity.

Potentially, the intervention might have brought functional benefits to participants in a way that the methods in use did not register and that were not expected in the design of the study. For example, one participant in the study reported: *"I found it fun and challenging. The Popping moves seem to help me release some of the stiffness. Not to mention the Wow's I get from my grandchildren!"*. This participant's experience with his grandchildren might have potentially had an impact on his life as a whole in a way that was not thought of or predicted at the beginning of this study, yet the benefits that the participant reported might not have been detected by the materials in use. As Sara Houston summarized: *"The power of dance is affect, not effect"* (Houston, 2019); it is evident that the participant was positively affected by the dance class regardless of the effects of the intervention itself. Statistical significance is not

necessarily linked with perceived meaningfulness of the intervention itself (Houston & McGill, 2019).

Another limitation that needs to be considered is that most of the participants that joined this research as well as past studies had a level of experience in dance and/or already participated in at least one dance class. It is plausible to think that participants that have previous dance experience enjoy dancing as an activity in the first place, which might bring them significant benefits on many levels such as mood, quality of life and more. It is possible that the benefits registered in any study in the field might be a result of participants partaking in an activity that they enjoy rather than because of dance per se.

A relevant aspect that needs to be taken into consideration is the impact that language has on movement and vice versa. It is known that action-verb processing is particularly affected in people with Parkinson's (Cardona et al., 2013), verb representations are grounded in the same neural networks that control motor skills (Rodriguez-Ferreiro et al., 2009) and that there is a direct correlation between language and motor impairment (Cardona et al., 2013; Garcia et al., 2016). It is therefore consequent that the language used during the dance intervention could potentially have a substantial impact on the outcome of the intervention itself, as research shows that movement, language, learning processes and cognition are all extremely intertwined in human beings (Kraus & Chandrasekaran, 2010). It is also possible that physical changes caused by dance interventions might subsequently impact participants' language. Unfortunately, because of substantial gaps in the literature previously mentioned in regards to composition of dance interventions, it is not possible to appreciate this aspect in depth at this stage. It is also worth mentioning that the classes delivered as part of this particular research were taught

in English (in London, Hatfield and New York City) and in Italian (in Torino). Even though the class was the same for all locations, the translation could have caused information to be received by participants in different ways and could have had an impact on results. Previous research shows that different languages instill certain rhythmic preferences in their respective speakers, and that these preferences affect the way that the speakers hear rhythm (Iversen, Patel & Ohgushi, 2008), and given that rhythm is a basic fundamental element of dance, music and language, it is possible that language could interfere with results of studies as well as create a barrier in both access and impact of dance interventions. Furthermore, it is debatable that the difference in rhythmic cadence in the delivery of the dance classes could potentially have an effect on cognitive processing; this particular aspect would require more thorough investigation.

Lastly, this particular study was conducted in four different locations, spread across two continents and three countries in order to limit bias in cultural relevance of a certain dance technique, and it showed that benefits are present regardless of location. However, the selected locations can all be considered Western first world countries. It is therefore arguable that, even though all dance for Parkinson's programmes believe in the universal power of dance, if the study was to be replicated in a non-Western non-first world country, location could have an impact on results.



## 5. FUTURE STUDIES

This current study has been designed to best answer the questions of the research within the possibilities and resources that are available to both the researcher and his collaborators to date. Given the appropriate resources, many other questions and issues are to be addressed in future studies.

As dance is a multifaceted activity (Houston, 2015), there is a necessity of developing validated scientific tools designed specifically to measure dance interventions and its multifacetedness. This is relevant for the dance for Parkinson's field, as there is a clear need to acquire a better understanding through future studies of what dance interventions could offer to participants. Aspects including empowerment, confidence, feeling of control, feeling of social inclusion, changes in personal and social relationships should be considered in the creation of innovative dance-specific tools, as they appear to be key determinant factors of quality of life in people with Parkinson's (Burgener & Berger, 2008; Ma, Saint-Hilaire, Thomas & Tickle-Degnen, 2016). Other factors that could be considered in more longitudinal studies in the field could also include sense of general belonging, specific belonging, self-esteem, feeling of capability and expressivity; previous research (Koch et al., 2016) even supposes that aesthetic experience in dance may be an important therapeutic factor. All of these elements were highlighted and suggested by participants in qualitative research in the field (Houston & McGill, 2011), hence the need to expand and deepen the understanding of those aspects. Existing scales that measure aspects such as empowerment (Kraimer, Seibert & Liden, 1999; Menon, 1999) or self-esteem (Rosenberg, 1965) have not been utilized within the research in the dance for Parkinson's field but they could potentially be considered as a starting point and being implemented in an innovative dance-specific tool.

Regarding the progression of this particular study, it could also be worth replicating the study yet overcoming current limitations, for example by recruiting non self-selected participants, increasing sample size, adding a control group and recruiting participants that strictly have no specific desire to engage in dance activities and/or knowledge in any dance style or technique. Regarding control groups, future studies could include several control groups, such as groups that participate in dance interventions of different styles and techniques, groups that participate in movement-based social activities that are not dance-based, groups that participate in social activities that are not movement-based and more.

It could be worth investigating in more depth the physical benefits that *Popping For Parkinson's*® might bring to participants, considering aspects including balance, gait, tremor and freezing as outcomes. It is possible and plausible that the combination of high-groove music (that functions as the best auditory cue for people with Parkinson's) and the Popping technique per se (that requires a physicalization of auditory cues) might have a substantial effect on motor skills as well as physical symptoms if offered at the correct dosage and for the correct length of time. This idea is supported by personal informal feedback provided by regular *Popping For Parkinson's*® students.

Future studies in the field could also focus on the effect of dance interventions compared to other non-dance activities. A plausible alternative intervention is needed as a control, especially to limit placebo effect as mentioned earlier. It is important to understand if participants that enjoy dancing have the same benefits, if any, when partaking in a non-dance activity that they equally enjoy. An alternative option to test this idea would be to set up a study based on dance interventions that recruits participants that do not find dance enjoyable; if any beneficial change is registered,

the results could suggest that dance is a beneficial effective therapeutic intervention as it stands and that it does not rely on participants enjoying it.

Another possibility that should be explored is to replicate this study or similar ones with participants who do not have Parkinson's and compare the results. It is plausible that, even though baseline scores on both scales might be different between groups, the effects of the dance intervention on participants' mood and quality of life might be of same size or of proportioned one. By doing so, the field might gain a better understanding of the power of dance as a whole and could potentially lead to extending interventions for other populations and communities, whether they are suffering from a specific condition or not. In other words, the effects of dance that are of value for people with Parkinson's might be of value for people with no or other conditions; that is already the case for several conditions, including dementia (Abreu & Hartley, 2013; Ho et al, 2020), depression (Koch, Morlinghaus & Fuchs, 2007; Meekums, Karkou & Nelson, 2015), trauma (Monteiro & Wall, 2011; Pierce, 2014), stroke (Gregor, Vaughan-Graham, Wallace, Walsh & Patterson, 2020; Patterson, Wong, Nguyen & Brooks, 2018) and Huntington's disease (Schwartz, van Walsem, Brean & Frich, 2019).

It would also be worth investigating the influence and impact of familiarity of music choice within a dance intervention in more depth, for future replications of either this study or other studies (Karageorghis et al., 2020; Leow, Rinchon & Grahn, 2015; Morris et al., 2019). A proposed way to explore to which degree results within dance interventions are affected by familiarity of music could be to compare two identical dance interventions with either popular and familiar songs or musical compositions created exclusively and specifically for the dance class.

Future studies could consider the relationship between movement and language, and evaluate both dance interventions on language processing and language interventions on motor skills and movement qualities. One possible way to achieve this would be to investigate the comparison of two identical dance interventions that utilize different language instructions and verbal cues.

Technology such as wearable devices could be implemented to understand the impact of dance interventions on people with Parkinson's for future research, specifically to better understand whether the vigour and/or intensity of dancing is a relevant factor in any benefits. Initial studies that relied on wearable devices to measure and predict gait and falls on people with Parkinson's (Del Din et al., 2019; Mazilu, Calatroni, Gazit, Mirelman, Hausdorff & Tröster, 2015; Pasluosta, Gassner, Winkler, Klucken & Eskofier, 2015) are promising, and similar studies applied to dance activities could offer a deeper understanding of strictly motor changes and outcomes before, during and after a dance intervention. It has to be acknowledged that the application of wearable devices to monitor general motor skills is at a very early stage and only applied to generic physical exercise (Coe et al, 2018).

It would be worth investigating if benefits of any dance style or technique (if any) on people with Parkinson's are similar or comparable when dance interventions are offered online rather than in face-to-face setup. Previous research found that home-based physical activity programmes for people with Parkinson's tend to attenuate off-state motor signs (van der Kolk et al., 2019), yet home-based dance specific activities still have to be considered. This aspect is relevant especially since there has recently been a substantial increase in online delivery of dance classes due to the global pandemic caused by COVID-19 (Helmich & Bloem, 2020).

A crucial point that needs to be considered is that, even though it is necessary to fully understand how dance interventions work and which ones might be more beneficial than others for certain populations and specific conditions, it is of fundamental importance and relevance that dance programmes are available and accessible. Even if resources might be limited, it is essential that the offer of dance interventions is as varied as possible, in order for participants to choose their preferred one. The World Health Organization confirmed that benefits of different arts on mental and physical health for all kinds of populations, and particularly dance for the Parkinson's community, are clear and evident (Fancourt, Finn, 2019). Past research supports the statement that it is useful for people with Parkinson's to choose the physical training they like the most (Dahmen-Zimmer & Jansen, 2017). As suggested by Houston and McGill (2019), it is fundamental to consider what participants value in the activity of dancing, as dance may have the power to allow people to thrive rather than merely survive. In the same way there is a multitude of medical interventions and a varied offer of pharmaceutical treatments, it is necessary to sustain and support the variety in alternative therapeutic interventions such as dance programmes, especially considering that Parkinson's still has no effective cure to this day.

## 6. CONCLUSION

Participating in one *Popping For Parkinson's*® dance class boosts the mood and improves the perceived quality of life of people with Parkinson's. The effects of the intervention are immediate and last less than 24 hours. These findings are promising, as they offer a new insight on the power that dance can have on people with Parkinson's. Further research is needed to fully appreciate the physical, psychological and social benefits that *Popping For Parkinson's*® could offer to participants with Parkinson's.

## 7. REFERENCES

- Aarsland, D., Larsen, J. P., Karlsen, K., Lim, N. G., & Tandberg, E. (1999). Mental symptoms in Parkinson's disease are important contributors to caregiver distress. *International journal of geriatric psychiatry*, *14*(10), 866-874.
- Abreu, M., & Hartley, G. (2013). The effects of salsa dance on balance, gait, and fall risk in a sedentary patient with Alzheimer's dementia, multiple comorbidities, and recurrent falls. *Journal of geriatric physical therapy*, *36*(2), 100-108.
- Aguiar, L. P. C., da Rocha, P. A., & Morris, M. (2016). Therapeutic dancing for Parkinson's disease. *International Journal of Gerontology*, *10*(2), 64-70.
- Allen, N. E., Sherrington, C., Suriyarachchi, G. D., Paul, S. S., Song, J., & Canning, C. G. (2012). Exercise and motor training in people with Parkinson's disease: a systematic review of participant characteristics, intervention delivery, retention rates, adherence, and adverse events in clinical trials. *Parkinson's Disease*, *2012*.
- Almeida, Q. J., Wishart, L. R., & Lee, T. D. (2002). Bimanual coordination deficits with Parkinson's disease: the influence of movement speed and external cueing. *Movement Disorders*, *17*(1), 30-37.
- American Academy of Neurology. (2020, February 25). Picking up a pingpong paddle may benefit people with Parkinson's. *ScienceDaily*. Retrieved April 24, 2020 from [www.sciencedaily.com/releases/2020/02/200225171757.htm](http://www.sciencedaily.com/releases/2020/02/200225171757.htm)
- Anderson, R. M., Funnell, M. M., Fitzgerald, J. T., & Marrero, D. G. (2000). The Diabetes Empowerment Scale: a measure of psychosocial self-efficacy. *Diabetes care*, *23*(6), 739-743.

- Ashoori, A., Eagleman, D. M., & Jankovic, J. (2015). Effects of auditory rhythm and music on gait disturbances in Parkinson's disease. *Frontiers in neurology*, 6, 234.
- Bakker, F. C. (1988). Personality differences between young dancers and non-dancers. *Personality and individual differences*, 9(1), 121-131.
- Bangert, M., Wiedemann, A., & Jabusch, H. C. (2013). When less of the same is more: Benefits of variability of practice in pianists. In *Proceedings of the International Symposium on Performance Science 2013* (pp. 117-122). Utrecht: European Association of Conservatoires (AEC).
- Batson, G. (2010). Feasibility of an intensive trial of modern dance for adults with Parkinson disease. *Complementary Health Practice Review*, 15(2), 65-83.
- Batson, G., Hugenschmidt, C. E., & Soriano, C. T. (2016). Verbal auditory cueing of improvisational dance: a proposed method for training agency in Parkinson's disease. *Frontiers in neurology*, 7, 15.
- Beevers, W. A., Morris, M. E., & McConville, J. (2015). Music used for Parkinson's dancing classes: Rationale and validity of instruments and methods. *Voices: A World Forum for Music Therapy*, 15(1).
- Berger, B. G., & Motl, R. W. (2000). Exercise and mood: A selective review and synthesis of research employing the profile of mood states. *Journal of applied sport psychology*, 12(1), 69-92.
- Bernstein, B. (2019). Empowerment-focused dance/movement therapy for trauma recovery. *American Journal of Dance Therapy*, 41(2), 193-213.



- Bettle, N., Bettle, O., Neumärker, U., & Neumärker, K. J. (2001). Body image and self-esteem in adolescent ballet dancers. *Perceptual and Motor Skills*, 93(1), 297-309.
- Blandy, L. M., Beevers, W. A., Fitzmaurice, K., & Morris, M. E. (2015). Therapeutic argentine tango dancing for people with mild Parkinson's disease: a feasibility study. *Frontiers in neurology*, 6, 122.
- Bognar, S., DeFaria, A. M., O'Dwyer, C., Pankiw, E., Simic Bogler, J., Teixeira, S., ... & Evans, C. (2017). More than just dancing: experiences of people with Parkinson's disease in a therapeutic dance program. *Disability and rehabilitation*, 39(11), 1073-1078.
- Brown, R. G., Landau, S., Hindle, J. V., Playfer, J., Samuel, M., Wilson, K. C., ... & Gibson, G. (2011). Depression and anxiety related subtypes in Parkinson's disease. *Journal of Neurology, Neurosurgery & Psychiatry*, 82(7), 803-809.
- Burgener, S. C., & Berger, B. (2008). Measuring perceived stigma in persons with progressive neurological disease: Alzheimer's dementia and Parkinson's disease. *Dementia*, 7(1), 31-53.
- Bushnell, D. M., & Martin, M. L. (1999). Quality of life and Parkinson's disease: translation and validation of the US Parkinson's Disease Questionnaire (PDQ-39). *Quality of Life Research*, 8(4), 345-350.
- Cardona, J. F., Gershanik, O., Gelormini-Lezama, C., Houck, A. L., Cardona, S., Kargieman, L., ... & Ibáñez, A. (2013). Action-verb processing in Parkinson's disease: new pathways for motor–language coupling. *Brain Structure and Function*, 218(6), 1355-1373.
- Cepeda, N. J., Vul, E., Rohrer, D., Wixted, J. T., & Pashler, H. (2008). Spacing effects in learning: A temporal ridgeline of optimal retention. *Psychological science*, 19(11), 1095-1102.

- Chaudhuri, K. R., Healy, D. G., & Schapira, A. H. (2006). Non-motor symptoms of Parkinson's disease: diagnosis and management. *The Lancet Neurology*, 5(3), 235-245.
- Chaudhuri, K. R., & Schapira, A. H. (2009). Non-motor symptoms of Parkinson's disease: dopaminergic pathophysiology and treatment. *The Lancet Neurology*, 8(5), 464-474.
- Coe, S., Franssen, M., Collett, J., Boyle, D., Meaney, A., Chantry, R., ... & Dawes, H. (2018). Physical activity, fatigue, and sleep in people with Parkinson's disease: A secondary per protocol analysis from an intervention trial. *Parkinson's Disease*, 2018.
- Colgrove, Y. S., Sharma, N., Kluding, P., Potter, D., Imming, K., & VandeHoef, J. (2012). Effect of yoga on motor function in people with Parkinson's disease: a randomized, controlled pilot study. *J Yoga Phys Ther*, 2(2), 112.
- Crizzle, A. M., & Newhouse, I. J. (2006). Is physical exercise beneficial for persons with Parkinson's disease?. *Clinical Journal of Sport Medicine*, 16(5), 422-425.
- Crooke, A. H. D., Comte, R., & Almeida, C. M. (2020). Hip Hop as an Agent for Health and Wellbeing in Schools. In *Voices: A World Forum for Music Therapy* (Vol. 20, No. 1).
- Cummings, J. L. (1992). Depression and Parkinson's disease: a review. *The American journal of psychiatry*.
- Dahmen-Zimmer, K., & Jansen, P. (2017). Karate and Dance Training to improve Balance and stabilize Mood in Patients with Parkinson's Disease: a Feasibility study. *Frontiers in medicine*, 4, 237.

- Dail, T. K., & Christina, R. W. (2004). Distribution of practice and metacognition in learning and long-term retention of a discrete motor task. *Research quarterly for exercise and sport*, 75(2), 148-155.
- Degeneffe, C. E., Chan, F., Dunlap, L., Man, D., & Sung, C. (2011). Development and validation of the Caregiver Empowerment Scale: A resource for working with family caregivers of persons with traumatic brain injury. *Rehabilitation Psychology*, 56(3), 243.
- Del Din, S., Elshehabi, M., Galna, B., Hobert, M. A., Warmerdam, E., Suenkel, U., ... & Rochester, L. (2019). Gait analysis with wearables predicts conversion to parkinson disease. *Annals of neurology*, 86(3), 357-367.
- DiLorenzo, T. M., Bargman, E. P., Stucky-Ropp, R., Brassington, G. S., Frensch, P. A., & LaFontaine, T. (1999). Long-term effects of aerobic exercise on psychological outcomes. *Preventive medicine*, 28(1), 75-85.
- Di Stefano, A., Sozio, P., Serafina Cerasa, L., & Iannitelli, A. (2011). L-Dopa prodrugs: an overview of trends for improving parkinson's disease treatment. *Current pharmaceutical design*, 17(32), 3482-3493.
- Downs, D. M., James, S., & Cowan, G. (2006). Body objectification, self-esteem, and relationship satisfaction: A comparison of exotic dancers and college women. *Sex Roles*, 54(11-12), 745-752.
- Earhart, G. M. (2009). Dance as therapy for individuals with Parkinson disease. *European journal of physical and rehabilitation medicine*, 45(2), 231.
- Easterbrook, P. J., Gopalan, R., Berlin, J. A., & Matthews, D. R. (1991). Publication bias in clinical research. *The Lancet*, 337(8746), 867-872.

- Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities. *Sports medicine*, 41(8), 641-671.
- Fancourt D, & Finn S. (2019). What is the evidence on the role of the arts in improving health and well-being? A scoping review. *WHO Regional Office for Europe(Health Evidence Network (HEN) synthesis report 67)*.
- de la Fuente-Fernández, R. (2009). The placebo-reward hypothesis: dopamine and the placebo effect. *Parkinsonism & Related Disorders*, 15, S72-S74.
- García, A. M., Carrillo, F., Orozco-Aroyave, J. R., Trujillo, N., Bonilla, J. F. V., Fittipaldi, S., ... & Ibáñez, A. (2016). How language flows when movements don't: an automated analysis of spontaneous discourse in Parkinson's disease. *Brain and language*, 162, 19-28.
- Georgiou, N., Bradshaw, J. L., Iansek, R., Phillips, J. G., Mattingley, J. B., & Bradshaw, J. A. (1994). Reduction in external cues and movement sequencing in Parkinson's disease. *Journal of Neurology, Neurosurgery & Psychiatry*, 57(3), 368-370.
- Gibb, W. R., & Lees, A. (1988). The relevance of the Lewy body to the pathogenesis of idiopathic Parkinson's disease. *Journal of Neurology, Neurosurgery & Psychiatry*, 51(6), 745-752.
- Gibson, S. J. (1997). The measurement of mood states in older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 52(4), P167-P174.
- Goodwin, V. A., Richards, S. H., Taylor, R. S., Taylor, A. H., & Campbell, J. L. (2008). The effectiveness of exercise interventions for people with Parkinson's disease: A systematic review and meta-analysis. *Movement disorders*, 23(5), 631-640.

- Goossens, N. A., Camp, G., Verkoeijen, P. P., Tabbers, H. K., & Zwaan, R. A. (2012). Spreading the words: A spacing effect in vocabulary learning. *Journal of Cognitive Psychology, 24*(8), 965-971.
- Gregor, S., Vaughan-Graham, J., Wallace, A., Walsh, H., & Patterson, K. K. (2020). Structuring community-based adapted dance programs for persons post-stroke: a qualitative study. *Disability and Rehabilitation, 1-11*.
- Grove, J. R., & Prapavessis, H. (1992). Preliminary evidence for the reliability and validity of an abbreviated Profile of Mood States. *International Journal of Sport Psychology.*
- Grover, S., Somaiya, M., Kumar, S., & Avasthi, A. (2015). Psychiatric aspects of Parkinson's disease. *Journal of neurosciences in rural practice, 6*(1), 65.
- Haas, C. T., Turbanski, S., Kessler, K., & Schmidtbleicher, D. (2006). The effects of random whole-body-vibration on motor symptoms in Parkinson's disease. *NeuroRehabilitation, 21*(1), 29-36.
- Hackney M. E., & Bennett, C. G. (2014). Dance therapy for individuals with Parkinson's disease: improving quality of life. *Journal of Parkinsonism and Restless Legs Syndrome, Vol 2014, Iss Default, Pp 17-25 (2014)*, (default), 17.
- Hackney, M. E., & Earhart, G. M. (2008). Tai Chi improves balance and mobility in people with Parkinson disease. *Gait & posture, 28*(3), 456-460.
- Hackney, M. E., & Earhart, G. M. (2009a). Effects of dance on movement control in Parkinson's disease: a comparison of Argentine tango and American ballroom. *Journal of rehabilitation medicine, 41*(6), 475-481.

- Hackney, M. E., & Earhart, G. M. (2009b). Health-related quality of life and alternative forms of exercise in Parkinson disease. *Parkinsonism & related disorders*, 15(9), 644-648.
- Hackney, M. E., & Earhart, G. M. (2009c). Short duration, intensive tango dancing for Parkinson disease: an uncontrolled pilot study. *Complementary therapies in medicine*, 17(4), 203-207.
- Hackney, M. E., & Earhart, G. M. (2010a). Recommendations for Implementing Tango Classes for Persons with Parkinson Disease. *American Journal of Dance Therapy*, 32(1), 41.
- Hackney, M. E., & Earhart, G. M. (2010b). Effects of dance on gait and balance in Parkinson's disease: a comparison of partnered and nonpartnered dance movement. *Neurorehabilitation and neural repair*, 24(4), 384-392.
- Hackney, M. E., & Earhart, G. M. (2010c). Effects of dance on balance and gait in severe Parkinson disease: a case study. *Disability and rehabilitation*, 32(8), 679-684.
- Hackney, M., Kantorovich, S., & Earhart, G. (2007). A Study on the Effects of Argentine Tango as a Form of Partnered Dance for those with Parkinson Disease and the Healthy Elderly. *American Journal of Dance Therapy*, 29(2), 109.
- Hansen, C. J., Stevens, L. C., & Coast, J. R. (2001). Exercise duration and mood state: How much is enough to feel better?. *Health Psychology*, 20(4), 267.
- Hansson, L., & Björkman, T. (2005). Empowerment in people with a mental illness: reliability and validity of the Swedish version of an empowerment scale. *Scandinavian Journal of Caring Sciences*, 19(1), 32-38.
- Haseler, C., Crooke, R., & Haseler, T. (2019). Promoting physical activity to patients. *BMJ*, 366, l5230.

- Hashimoto, H., Takabatake, S., Miyaguchi, H., Nakanishi, H., & Naitou, Y. (2015). Effects of dance on motor functions, cognitive functions, and mental symptoms of Parkinson's disease: a quasi-randomized pilot trial. *Complementary therapies in medicine*, 23(2), 210-219.
- Heiberger, L., Maurer, C., Amtage, F., Mendez-Balbuena, I., Schulte-Mönting, J., Hepp-Reymond, M. C., & Kristeva, R. (2011). Impact of a weekly dance class on the functional mobility and on the quality of life of individuals with Parkinson's disease. *Frontiers in aging neuroscience*, 3, 14.
- Helmich, R. C., & Bloem, B. R. (2020). The Impact of the COVID-19 Pandemic on Parkinson's Disease: Hidden Sorrows and Emerging Opportunities. *Journal of Parkinson's disease*, 10(2), 351-354.
- Ho, R. T., Fong, T. C., Chan, W. C., Kwan, J. S., Chiu, P. K., Yau, J. C., & Lam, L. C. (2020). Psychophysiological effects of dance movement therapy and physical exercise on older adults with mild dementia: a randomized controlled trial. *The Journals of Gerontology: Series B*, 75(3), 560-570.
- Hoehn, M. M., & Yahr, M. D. (1967). Parkinsonism: onset, progression, and mortality. *Neurology*, 17(5), 427-427.
- Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., ... & Lamb, S. E. (2014). Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *Bmj*, 348.
- Hornykiewicz, O. (1981). Brain neurotransmitter changes in Parkinson's disease. In *Movement disorders*(pp. 41-58). Butterworth-Heinemann.
- Houston, S. (2011). The methodological challenges of research into dance for people with Parkinson's. *Dance Research*, 29(supplement), 329-351.
- Houston, S. (2015). Feeling Lovely: An Examination of the Value of Beauty for

- People Dancing with Parkinson's. *Dance Research Journal*, 47(1), 27–43.
- Houston, S. (2019). *Dancing with Parkinson's*. Intellect Books.
- Houston, S., & McGill, A. (2013). A mixed-methods study into ballet for people living with Parkinson's. *Arts & health*, 5(2), 103-119.
- Houston, S., & McGill, A. (2019). Understanding Quality of Life Through the Experiences of Dancers with Parkinson's. In *Dance and the Quality of Life* (pp. 281-291). Springer, Cham.
- Howe, T. E., Lövgreen, B., Cody, F. W., Ashton, V. J., & Oldham, J. A. (2003). Auditory cues can modify the gait of persons with early-stage Parkinson's disease: a method for enhancing parkinsonian walking performance?. *Clinical rehabilitation*, 17(4), 363-367.
- Iversen, J. R., Patel, A. D., & Ohgushi, K. (2008). Perception of rhythmic grouping depends on auditory experience. *The Journal of the Acoustical Society of America*, 124(4), 2263-2271.
- Janata, P., Tomic, S. T., & Haberman, J. M. (2012). Sensorimotor coupling in music and the psychology of the groove. *Journal of Experimental Psychology: General*, 141(1), 54.
- Jankovic, J., & Stacy, M. (2007). Medical management of levodopa-associated motor complications in patients with Parkinson's disease. *CNS drugs*, 21(8), 677-692.
- Jenkinson, C., Fitzpatrick, R., Peto, V., Dummatt, S., Morley, D., & Saunders, P. (1998). The Parkinson's disease questionnaire. *Health Services Research Unit. Oxford: Joshua Horgan Print Partnership*.
- Jenkinson, C., Fitzpatrick, R. A. Y., Peto, V. I. V., Greenhall, R., & Hyman, N. (1997). The Parkinson's Disease Questionnaire (PDQ-39): development and validation of a Parkinson's disease summary index score. *Age and ageing*, 26(5), 353-357.



- Jette, M., Sidney, K., & Blümchen, G. (1990). Metabolic equivalents (METS) in exercise testing, exercise prescription, and evaluation of functional capacity. *Clinical cardiology, 13*(8), 555-565.
- Kalliopuska, M. (1991). Empathy, self-esteem and other personality factors among junior ballet dancers. *British journal of projective psychology*.
- Karageorghis, C. I. (2020). Music-related interventions in sport and exercise. *Handbook of sport psychology (4th ed., pp. 929-949)*. Hoboken, NJ: Wiley.
- Karageorghis, C., Rose, D. C., Annett, L., Bek, J., Bottoms, L., Lovatt, P., ... & Delevoeye-Turrell, Y. (2020). Bases expert statement on the use of music for movement among people with Parkinson's. *The Sport and Exercise Scientist*.
- Kattenstroth, J. C., Kolankowska, I., Kalisch, T., & Dinse, H. R. (2010). Superior sensory, motor, and cognitive performance in elderly individuals with multi-year dancing activities. *Frontiers in Aging Neuroscience, 2*, 31.
- Kaye, J. M., Lawton, M. P., Gitlin, L. N., Kleban, M. H., Windsor, L. A., & Kaye, D. (1988). Older people's performance on the Profile of Mood States (POMS). *Clinical Gerontologist, 7*(3-4), 35-56.
- Kealiinohomoku, J. (1970). An anthropologist looks at ballet as a form of ethnic dance. *Impulse, 20*, 24-33.
- Kennedy, M. M., & Newton, M. (1997). Effect of exercise intensity on mood in step aerobics. *The Journal of sports medicine and physical fitness, 37*(3), 200-204.
- Kieft, E. (2013). *Dance, empowerment and spirituality: An ethnography of Movement Medicine*(Doctoral dissertation, Roehampton University).
- Koch, S. C., Mergheim, K., Raeke, J., Machado, C. B., Riegner, E., Nolden, J., ... & Hillecke, T. K. (2016). The embodied self in Parkinson's Disease: Feasibility of a single tango intervention for assessing changes in

- psychological health outcomes and aesthetic experience. *Frontiers in neuroscience*, 10, 287.
- Koch, S. C., Morlinghaus, K., & Fuchs, T. (2007). The joy dance: Specific effects of a single dance intervention on psychiatric patients with depression. *The Arts in Psychotherapy*, 34(4), 340-349.
- van der Kolk, N. M., de Vries, N. M., Kessels, R. P., Joosten, H., Zwinderman, A. H., Post, B., & Bloem, B. R. (2019). Effectiveness of home-based and remotely supervised aerobic exercise in Parkinson's disease: a double-blind, randomised controlled trial. *The Lancet Neurology*, 18(11), 998-1008.
- Kornell, N., & Bjork, R. A. (2008). Learning concepts and categories: Is spacing the “enemy of induction”? *Psychological science*, 19(6), 585-592.
- Kraimer, M. L., Seibert, S. E., & Liden, R. C. (1999). Psychological empowerment as a multidimensional construct: A test of construct validity. *Educational and psychological measurement*, 59(1), 127-142.
- Kraus, N., & Chandrasekaran, B. (2010). Music training for the development of auditory skills. *Nature reviews neuroscience*, 11(8), 599-605.
- Kudlacek, S., Pietschmann, F., Bernecker, P., Resch, H., & Willvonseder, R. (1997). The impact of a senior dancing program on spinal and peripheral bone mass<sup>1</sup>. *American journal of physical medicine & rehabilitation*, 76(6), 477-481.
- Lane, A., Hewston, R., Redding, E., & Whyte, G. P. (2003). Mood changes following modern-dance classes. *Social Behavior and Personality: an international journal*, 31(5), 453-460.

- Lees, A. J., Hardy, J., & Revesz, T. Parkinson's disease Lancet. 2009; 373: 2055–66 doi: 10.1016. S0140-6736 (09).
- Leow, L. A., Rinchon, C., & Grahn, J. (2015). Familiarity with music increases walking speed in rhythmic auditory cueing. *Annals of the New York Academy of Sciences*, 1337(1), 53-61.
- Leow, L. A., Parrott, T., & Grahn, J. A. (2014). Individual differences in beat perception affect gait responses to low-and high-groove music. *Frontiers in human neuroscience*, 8, 811.
- Lew, M. (2007). Overview of Parkinson's disease. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, 27(12P2), 155S-160S.
- Lewis, C., Annett, L. E., Davenport, S., Hall, A. A., & Lovatt, P. (2014). Mood changes following social dance sessions in people with Parkinson's disease. *Journal of Health Psychology*, 1, 10.
- Li, F., Harmer, P., Fitzgerald, K., Eckstrom, E., Stock, R., Galver, J., ... & Batya, S. S. (2012). Tai chi and postural stability in patients with Parkinson's disease. *New England Journal of Medicine*, 366(6), 511-519.
- Lopopolo, R. B., Greco, M., Sullivan, D., Craik, R. L., & Mangione, K. K. (2006). Effect of therapeutic exercise on gait speed in community-dwelling elderly people: a meta-analysis. *Physical therapy*, 86(4), 520-540.
- Lötzke, D., Ostermann, T., & Büssing, A. (2015). Argentine tango in Parkinson disease-a systematic review and meta-analysis.
- Ma, H. I., Saint-Hilaire, M., Thomas, C. A., & Tickle-Degnen, L. (2016). Stigma as a key determinant of health-related quality of life in Parkinson's disease. *Quality of Life Research*, 25(12), 3037-3045.
- Marchant, D., Sylvester, J. L., & Earhart, G. M. (2010). Effects of a short duration, high dose contact improvisation dance workshop on Parkinson disease: a pilot study. *Complementary therapies in medicine*, 18(5), 184-190.

- Mazilu, S., Calatroni, A., Gazit, E., Mirelman, A., Hausdorff, J. M., & Tröster, G. (2015). Prediction of freezing of gait in Parkinson's from physiological wearables: an exploratory study. *IEEE journal of biomedical and health informatics*, *19*(6), 1843-1854.
- McIntosh, G. C., Brown, S. H., Rice, R. R., & Thaut, M. H. (1997). Rhythmic auditory-motor facilitation of gait patterns in patients with Parkinson's disease. *Journal of Neurology, Neurosurgery & Psychiatry*, *62*(1), 22-26.
- McKee, K. E., & Hackney, M. E. (2013). The effects of adapted tango on spatial cognition and disease severity in Parkinson's disease. *Journal of motor behavior*, *45*(6), 519-529.
- McNeely, M. E., Duncan, R. P., & Earhart, G. M. (2015a). A comparison of dance interventions in people with Parkinson disease and older adults. *Maturitas*, *81* (1), 10-16.
- McNeely, M. E., Duncan, R. P., & Earhart, G. M. (2015b). Impacts of dance on non-motor symptoms, participation, and quality of life in Parkinson's disease and healthy older adults. *Maturitas*, *82*(4), 336-341.
- McNeely, M. E., Mai, M. M., Duncan, R. P., & Earhart, G. M. (2015). Differential effects of Tango versus dance for PD in Parkinson disease. *Frontiers in aging neuroscience*, *7*, 239.
- McRae, C., Leventhal, D., Westheimer, O., Mastin, T., Utley, J., & Russell, D. (2018). Long-term effects of Dance for PD® on self-efficacy among persons with Parkinson's disease. *Arts & Health*, *10*(1), 85-96.
- Menon, S. T. (1999). Psychological empowerment: Definition, measurement, and validation. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, *31*(3), 161.

Monteiro, N. M., & Wall, D. J. (2011). African dance as healing modality throughout the diaspora: The use of ritual and movement to work through trauma. *Journal of Pan African Studies*, 4(6), 234-252.

Morris, M. E., Iansek, R., Matyas, T. A., & Summers, J. J. (1994). The pathogenesis of gait hypokinesia in Parkinson's disease. *Brain*, 117(5), 1169-1181.

Morris, I. B., Vasudevan, E., Schedel, M., Weymouth, D., Loomis, J., Pinkhasov, T., & Muratori, L. M. (2019). Music to one's ears: Familiarity and music engagement in people with Parkinson's disease. *Frontiers in neuroscience*, 13.

Müller, P., Rehfeld, K., Schmicker, M., Hökelmann, A., Dordevic, M., Lessmann, V., ... & Müller, N. G. (2017). Evolution of neuroplasticity in response to physical activity in old age: the case for dancing. *Frontiers in aging neuroscience*, 9, 56.

Nadeau, A., Lungu, O., Duchesne, C., Robillard, M. È., Bore, A., Bobeuf, F., ... & Doyon, J. (2017). A 12-week cycling training regimen improves gait and executive functions concomitantly in people with Parkinson's disease. *Frontiers in human neuroscience*, 10, 690.

de Natale, E. R., Paulus, K. S., Aiello, E., Sanna, B., Manca, A., Sotgiu, G., ... & Deriu, F. (2017). Dance therapy improves motor and cognitive functions in patients with Parkinson's disease. *NeuroRehabilitation*, 40(1), 141-144.

NHS (2019). Parkinson's disease.

Ni, M., Mooney, K., & Signorile, J. F. (2016). Controlled pilot study of the effects of power yoga in Parkinson's disease. *Complementary therapies in medicine, 25*, 126-131.

Nordin-Bates, S. M., Walker, I. J., Baker, J., Garner, J., Hardy, C., Irvine, S., ... & Blevins, P. (2011). Injury, imagery, and self-esteem in dance healthy minds in injured bodies?. *Journal of Dance Medicine & Science, 15*(2), 76-85.

Okun, M. S., & Foote, K. D. (2010). Parkinson's disease DBS: what, when, who and why? The time has come to tailor DBS targets. *Expert review of neurotherapeutics, 10*(12), 1847-1857.

Park, A., & Stacy, M. (2009). Non-motor symptoms in Parkinson's disease. *Journal of neurology, 256*(3), 293-298.

Parkinson's, U. K. (2017). Fatigue and Parkinson's.

Parkinson's, U. K. (2018). The Incidence and Prevalence of Parkinson's in the UK: Results from the Clinical Practice Research Datalink Summary Report.

Pasluosta, C. F., Gassner, H., Winkler, J., Klucken, J., & Eskofier, B. M. (2015). An emerging era in the management of Parkinson's disease: wearable technologies and the internet of things. *IEEE journal of biomedical and health informatics, 19*(6), 1873-1881.

Patterson, K. K., Wong, J. S., Nguyen, T. U., & Brooks, D. (2018). A dance program to improve gait and balance in individuals with chronic stroke: a feasibility study. *Topics in stroke rehabilitation, 25*(6), 410-416.

Pedersen, S. W., Oberg, B., Larsson, L. E., & Lindval, B. (1997). Gait analysis, isokinetic muscle strength measurement in patients with Parkinson's disease. *Scandinavian journal of rehabilitation medicine, 29*(2), 67-74.

- Peto, V., Jenkinson, C., & Fitzpatrick, R. (1998). PDQ-39: a review of the development, validation and application of a Parkinson's disease quality of life questionnaire and its associated measures. *Journal of neurology*, 245(1), S10-S14.
- Pierce, L. (2014). The integrative power of dance/movement therapy: Implications for the treatment of dissociation and developmental trauma. *The Arts in Psychotherapy*, 41(1), 7-15.
- Pillay, S. S. (2010). *Life unlocked: 7 revolutionary lessons to overcome fear*. Rodale Books.
- Poewe, W. (2008). Non-motor symptoms in Parkinson's disease. *European journal of neurology*, 15, 14-20.
- Praamstra, P., Stegeman, D. F., Cools, A. R., & Horstink, M. W. (1998). Reliance on external cues for movement initiation in Parkinson's disease. Evidence from movement-related potentials. *Brain: a journal of neurology*, 121(1), 167-177.
- Riddoch, C., Puig-Ribera, A., & Cooper, A. (1998). *Effectiveness of physical activity promotion schemes in primary care: a review*. London: Health Education Authority.
- Ridgel, A. L., Peacock, C. A., Fickes, E. J., & Kim, C. H. (2012). Active-assisted cycling improves tremor and bradykinesia in Parkinson's disease. *Archives of physical medicine and rehabilitation*, 93(11), 2049-2054.
- Rocha, P. A., Porfírio, G. M., Ferraz, H. B., & Trevisani, V. F. (2014). Effects of external cues on gait parameters of Parkinson's disease patients: a systematic review. *Clinical neurology and neurosurgery*, 124, 127-134.
- Rodríguez-Ferreiro, J., Menéndez, M., Ribacoba, R., & Cuetos, F. (2009). Action naming is impaired in Parkinson disease patients. *Neuropsychologia*, 47(14), 3271-3274.

- Rose, D., Delevoeye-Turrell, Y., Ott, L., Annett, L. E., & Lovatt, P. J. (2019). Music and Metronomes Differentially Impact Motor Timing in People with and without Parkinson's Disease: Effects of Slow, Medium, and Fast Tempi on Entrainment and Synchronization Performances in Finger Tapping, Toe Tapping, and Stepping on the Spot Tasks. *Parkinson's Disease*, 2019.
- Rosenberg, M. (1965). Rosenberg self-esteem scale (RSE). *Acceptance and commitment therapy. Measures package*, 61(52), 18.
- Rothstein, H. R., Sutton, A. J., & Borenstein, M. (2005). Publication bias in meta-analysis. *Publication bias in meta-analysis: Prevention, assessment and adjustments*, 1-7.
- Sacco, K., Cauda, F., Cerliani, L., Mate, D., Duca, S., & Geminiani, G. C. (2006). Motor imagery of walking following training in locomotor attention. The effect of 'the tango lesson'. *Neuroimage*, 32(3), 1441-1449.
- Schwartz, A. E., van Walsem, M. R., Brean, A., & Frich, J. C. (2019). Therapeutic Use of Music, Dance, and Rhythmic Auditory Cueing for Patients with Huntington's Disease: A Systematic Review. *Journal of Huntington's disease*, 8(4), 393-420.
- Sharp, K., & Hewitt, J. (2014). Dance as an intervention for people with Parkinson's disease: a systematic review and meta-analysis. *Neuroscience & Biobehavioral Reviews*, 47, 445-456.
- Shanahan, J., Morris, M. E., Bhriain, O. N., Saunders, J., & Clifford, A. M. (2015). Dance for people with Parkinson disease: what is the evidence telling us?. *Archives of physical medicine and rehabilitation*, 96(1), 141-153.



Shanahan, J., Morris, M. E., Bhriain, O. N., Volpe, D., Lynch, T., & Clifford, A. M. (2017). Dancing for Parkinson disease: a randomized trial of Irish set dancing compared with usual care. *Archives of physical medicine and rehabilitation, 98*(9), 1744-1751.

Shanahan, J., Morris, M. E., Ni Bhriain, O., Volpe, D., Richardson, M., & Clifford, A. M. (2015). Is Irish set dancing feasible for people with Parkinson's disease in Ireland.

Sharma, N. K., Robbins, K., Wagner, K., & Colgrove, Y. M. (2015). A randomized controlled pilot study of the therapeutic effects of yoga in people with Parkinson's disease. *International journal of yoga, 8*(1), 74.

Shetty, N., Friedman, J. H., Kieburtz, K., Marshall, F. J., & Oakes, D. (1999). The placebo response in Parkinson's disease. Parkinson Study Group. *Clinical neuropharmacology, 22*(4), 207-212.

Sistarelli, S. [Simone Sistarelli] (2020, January 19). *Popping For Parkinson's Full Class*[Video file]. Retrieved from <https://youtu.be/i59IMMa8i1c>

Sean Slusser (2018, December 20). *Straight Outta Fresno News Story on Fresno Popping History* [Video file]. Retrieved from <https://www.youtube.com/watch?v=dmxZMIkHr8c>

Solla, P., Cugusi, L., Bertoli, M., Cereatti, A., Della Croce, U., Pani, D., ... & Mercurio, G. (2019). Sardinian Folk Dance for Individuals with Parkinson's Disease: A Randomized Controlled Pilot Trial. *The Journal of Alternative and Complementary Medicine, 25*(3), 305-316.

Steinberg, H., Nicholls, B. R., Sykes, E. A., LeBoutillier, N., Ramlakhan, N., Moss, T. P., & Dewey, A. (1998). Weekly exercise consistently reinstates positive mood. *European Psychologist, 3*(4), 271-280.

Stupacher, J., Hove, M. J., Novembre, G., Schütz-Bosbach, S., & Keller, P. E. (2013). Musical groove modulates motor cortex excitability: a TMS investigation. *Brain and cognition*, *82*(2), 127-136.

Sumner, R. C., Crone, D. M., Baker, C., Hughes, S., Loughren, E. A., & James, D. V. (2020). Factors associated with attendance, engagement and wellbeing change in an arts on prescription intervention. *Journal of Public Health*, *42*(1), e88-e95.

Suteerawattananon, M., Morris, G. S., Etnyre, B. R., Jankovic, J., & Protas, E. J. (2004). Effects of visual and auditory cues on gait in individuals with Parkinson's disease. *Journal of the neurological sciences*, *219*(1-2), 63-69.

Suzukamo, Y., Ohbu, S., Kondo, T., Kohmoto, J., & Fukuhara, S. (2006). Psychological adjustment has a greater effect on health-related quality of life than on severity of disease in Parkinson's disease. *Movement Disorders*, *21*(6), 761-766.

Teixeira-Machado, L., Arida, R. M., & de Jesus Mari, J. (2019). Dance for neuroplasticity: A descriptive systematic review. *Neuroscience & Biobehavioral Reviews*, *96*, 232-240.

Tracy, J. I., Dechant, V., Sperling, M. R., Cho, R., & Glosser, D. (2007). The association of mood with quality of life ratings in epilepsy. *Neurology*, *68*(14), 1101-1107.

Travis Jr, R., Gann, E., Crooke, A. H., & Jenkins, S. M. (2020). Using Therapeutic Beat Making and lyrics for empowerment. *Journal of Social Work*, 1468017320911346.

- Uygun, M., Bellumori, M., LeNoir, K., Poole, K., Pretzer-Aboff, I., & Knight, C. A. (2015). Immediate effects of high-speed cycling intervals on bradykinesia in Parkinson's disease. *Physiotherapy theory and practice*, 31(2), 77-82.
- Volpe, D., Signorini, M., Marchetto, A., Lynch, T., & Morris, M. E. (2013). A comparison of Irish set dancing and exercises for people with Parkinson's disease: a phase II feasibility study. *BMC geriatrics*, 13(1), 54.
- Walter, K., von Haaren, B., Löffler, S., Hey, S., Haertel, S., Jansen, C. P., ... & Boes, K. (2013). Acute and medium term effects of a 10-week running intervention on mood state in apprentices. *Frontiers in psychology*, 4, 411.
- Westbrook, B. K., & McKibben, H. (1989). Dance/movement therapy with groups of outpatients with Parkinson's disease. *American Journal of Dance Therapy*, 11(1), 27-38.
- Westheimer, O. (2008). Why dance for Parkinson's disease. *Topics in Geriatric Rehabilitation*, 24(2), 127-140.
- Westheimer, O., McRae, C., Henchcliffe, C., Fesharaki, A., Glazman, S., Ene, H., & Bodis-Wollner, I. (2015). Dance for PD: a preliminary investigation of effects on motor function and quality of life among persons with Parkinson's disease (PD). *J Neural Transm*, 122, 1263-1270.
- Witek, M. A., Clarke, E. F., Wallentin, M., Kringelbach, M. L., & Vuust, P. (2014). Syncopation, body-movement and pleasure in groove music. *PloS one*, 9(4), e94446.
- Yahr, M. D. (1978). Overview of present day treatment of Parkinson's disease. *Journal of neural transmission*, 43(3-4), 227-238.
- Yamada, S., & Suzuki, K. (2007). Application of Empowerment Scale to patients with schizophrenia: Japanese experience. *Psychiatry and clinical neurosciences*, 61(6), 594-601.

Zafar, M., Bozzorg, A., & Hackney, M. E. (2017). Adapted Tango improves aspects of participation in older adults versus individuals with Parkinson's disease. *Disability and rehabilitation*, 39(22), 2294-2301.

## 8. APPENDIXES

### 8.1 Appendix I

List of songs used for the *Popping For Parkinson's*® dance class (in BPM order):

Eklips - "Jazzy" 91 BPM

Eklips - "No Shame" 99 BPM

Prince - "Kiss" 110 BPM

Beatslaya - "Power" 112 BPM

Tom Misch - "South Of The River" 114 BPM

Lalah Hathaway - "Sentimental" 114 BPM

Funkadelic - "(Not just) Knee deep" 115 BPM

The APX - "Right On Time" 117 BPM

Earth Wind and Fire - "September" 119 BPM

Tom Misch - "Disco Yes" 123 BPM

Cybotron - "Clear" 125 BPM

Janet Jackson - "Young Love" 126 BPM

## 8.2 Appendix II

### Profile Of Mood Questionnaire (POMS)

*Directions: Describe HOW YOU FEEL RIGHT NOW  
by circling the most appropriate number after each of the words listed below:*

FEELING	Quite a				
	Not at all	A little	Moderate	bit	Extremely
1. Friendly	1	2	3	4	5
2. Tense	1	2	3	4	5
3. Angry	1	2	3	4	5
4. Worn Out	1	2	3	4	5
5. Unhappy	1	2	3	4	5
6. Clear-headed	1	2	3	4	5
7. Lively	1	2	3	4	5
8. Confused	1	2	3	4	5
9. Sorry for things done	1	2	3	4	5
10. Shaky	1	2	3	4	5
11. Listless	1	2	3	4	5
12. Peeved	1	2	3	4	5
13. Considerate	1	2	3	4	5
14. Sad	1	2	3	4	5
15. Active	1	2	3	4	5
16. On edge	1	2	3	4	5
17. Grouchy	1	2	3	4	5
18. Blue	1	2	3	4	5
19. Energetic	1	2	3	4	5
20. Panicky	1	2	3	4	5
21. Hopeless	1	2	3	4	5
22. Relaxed	1	2	3	4	5
23. Unworthy	1	2	3	4	5
24. Spiteful	1	2	3	4	5
25. Sympathetic	1	2	3	4	5
26. Uneasy	1	2	3	4	5
27. Restless	1	2	3	4	5
28. Unable to	1	2	3	4	5
29. Fatigued	1	2	3	4	5

30. Helpful	1	2	3	4	5
31. Annoyed	1	2	3	4	5
32. Discouraged	1	2	3	4	5
33. Resentful	1	2	3	4	5
34. Nervous	1	2	3	4	5
35. Lonely	1	2	3	4	5
36. Miserable	1	2	3	4	5
37. Muddled	1	2	3	4	5
38. Cheerful	1	2	3	4	5
39. Bitter	1	2	3	4	5
40. Exhausted	1	2	3	4	5
41. Anxious	1	2	3	4	5
42. Ready to fight	1	2	3	4	5
43. Good-natured	1	2	3	4	5
44. Gloomy	1	2	3	4	5
45. Desperate	1	2	3	4	5
46. Sluggish	1	2	3	4	5
47. Rebellious	1	2	3	4	5
48. Helpless	1	2	3	4	5
49. Weary	1	2	3	4	5
50. Bewildered	1	2	3	4	5
51. Alert	1	2	3	4	5
52. Deceived	1	2	3	4	5
53. Furious	1	2	3	4	5
54. Effacious	1	2	3	4	5
55. Trusting	1	2	3	4	5
56. Full of pep	1	2	3	4	5
57. Bad-tempered	1	2	3	4	5
58. Worthless	1	2	3	4	5
59. Forgetful	1	2	3	4	5
60. Carefree	1	2	3	4	5
61. Terrified	1	2	3	4	5
62. Guilty	1	2	3	4	5
63. Vigorous	1	2	3	4	5
64. Uncertain about things	1	2	3	4	5
65. Bushed	1	2	3	4	5

## 8.3 Appendix III

### Parkinson's Disease Questionnaire (PDQ-39)

Due to having Parkinson's, how often during <b>the last month have you?</b>	Please tick <b>one</b> box for each question				
	Never	Occasionally	Sometimes	Often	Always or cannot do it at all
1. Have difficulty doing the leisure activities which you would like to do?					
2. Had difficulty looking after your home, e.g. DIY, housework, cooking?					
3. Had difficulty carrying bags of shopping?					
4. Had problems walking half a mile?					
5. Had problems walking 100 yards?					
6. Had problems getting around the house as easily as you would like?					
7. Had difficulty getting around in public?					
8. Needed someone else to accompany you when you went out?					
9. Felt frightened or worried about falling over in public?					
10. Been confined to the house more than you would like?					
11. Had difficulty washing yourself?					
12. Had difficulty dressing yourself?					
13. Had problems doing up buttons or shoe laces?					
14. Had problems writing clearly?					
15. Had difficulty cutting up your food?					
16. Had difficulty holding a drink without spilling it?					



17. Felt depressed?					
18. Felt isolated and lonely?					
19. Felt weepy or tearful?					
20. Felt angry or bitter?					
21. Felt anxious?					
22. Felt worried about your future?					
23. Felt you had to conceal your Parkinson's from people?					
24. Avoided situations which involve eating or drinking in public?					
25. Felt embarrassed in public due to having Parkinson's?					
26. Felt worried by other people's reaction to you?					
27. Had problems with your close personal relationships?					
28. Lacked support in the ways you need from your spouse or partner? <b><i>If you do not have a partner or spouse please circle this question.</i></b>					
29. Lacked support in the ways you need from your family or close friends?					
30. Unexpectedly fallen asleep during the day?					
31. Had problems with your concentration, e.g. when reading or watching TV?					
32. Felt your memory was bad?					
33. Had distressing dreams or hallucinations?					
34. Had difficulty with speech?					
35. Felt unable to communicate with people properly?					
36. Felt ignored by people?					
37. Had painful muscle cramps or spasms?					
38. Had aches and pains in your joints or body?					
39. Felt unpleasantly hot or cold?					

## 8.4 Appendix IV

### Hoehn & Yahr Staging

Please tick the box that you think best describes your symptoms of Parkinson's disease. The symptoms may be mild or severe or happen a lot, or not as much. Also, the time spent at each stage of the disease varies, and the skipping of stages, from Stage 1 to Stage 3, for example, is not uncommon.

- Stage 0: no signs of disease
- Stage 1: The main symptoms but very mild- tremor, muscle stiffness, slowness of movement and problems with posture- are only on one side of the body.
- Stage 1.5: symptoms appear only on one side of the body. Problems with balance may appear.
- Stage 2: symptoms appear on both sides, minor symptoms like problems with swallowing, talking and something called "facial masking" (loss of facial expression) may be noticed.
- Stage 2.5: symptoms appear on both sides and still mild. The same symptoms of Stage 2 are still there but may be worse now
- Stage 3: symptoms are mild to moderate, some postural instability occurs, but patients are physically independent
- Stage 4: symptoms are severe, the patient is severely debilitated and needs some assistance, but can still walk or stand unassisted. The patient will need help with some or all activities of daily living.
- Stage 5: symptoms are very severe, the patient is typically wheelchair-bound or confined to a bed, unless aided

## 8.5 Appendix V

Demographic Information

### General Information

Gender: Male Female

Date of birth (DD/MM/YYYY):

Phone Number:

### Health Information

How much time do you spend exercising during an average week?

Less than 30 minutes Between one to two hours

Between two to three hours Between three to four hours

Over four hours

If you regularly take part in a sport or physical activity/activities, could you please list them below (for example, swimming or going on long walks). Regularly is defined as at least once a week, on average:

Have you attended dance classes in the past?

Yes No

If yes, could you provide more detail below:

Have you been diagnosed with Parkinson's? Yes No

If you answered yes, please answer the questions below.

At what age were you diagnosed with Parkinson's? (please write in years)

Are the Parkinson's symptoms more prominent on one side of the body compared with the other?

Yes No

If yes, please could you provide more detail below about which side of the body and what symptoms you experience.

Do you have a tremor?

Yes No

If yes, could you please provide more information below, such as which limb/s (left, right or both):

If both, which limb is the tremor greatest?

Have you undergone deep brain stimulation?

Yes No

Are you taking any medication for your Parkinson's? Yes No

If you answered yes, please could you provide information about each type of medication on the following page.



## 8.6 Appendix VI

### Physical Activity Readiness Questionnaire.

Title: \_\_\_\_\_ Full name: \_\_\_\_\_ Age: \_\_\_\_\_

DOB: \_\_\_\_\_

Address:

\_\_\_\_\_

—

\_\_\_\_\_

Postcode: \_\_\_\_\_

Contact phone

number/s: \_\_\_\_\_

Email: \_\_\_\_\_

Emergency contact: \_\_\_\_\_ Contact number: \_\_\_\_\_

Relation of emergency contact (friend, spouse, partner etc):

\_\_\_\_\_

Doctors surgery:\_\_\_\_\_ Contact number:

\_\_\_\_\_

Do you object to your information being stored (this will be just for our records)? Yes/No

(information will be collected, stored and disposed of as per the terms of the data protection act 2018)

I have read and understood this questionnaire and any questions I had were answered to my full satisfaction.

**Signature:**\_\_\_\_\_ **Date:**\_\_\_\_\_

Regular physical activity is fun and healthy. Being more active is very safe for most people whatever their age. However, some people should check with their doctors before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the questions below. If you are over 69 years of age and you are not used to being very active, please check with your doctor beforehand. Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly. **Circle YES or NO.**

Questions:

1. Has your doctor ever said that you should only do physical activity recommended by a doctor?

**YES NO**

2. Have you ever had a heart attack? **YES NO**

If so, how long ago?

What **medication** are you on, if any?

3. Do you have angina?

**YES NO**

If so, what **medication** are you on, if any?

4. Have you ever had a stroke?

**YES NO**

If so, how long ago?

What are the side effects from your stroke (if any)?

What **medication** are you on, if any?

5. Do you feel pain in your chest when you do  
physical activity?

**YES NO**

6. In the past  
month, have you  
had chest pain  
when **not** doing  
physical activity?

**YES NO**

7. Do you lose your balance because of dizziness or do you ever lose  
consciousness?

YES NO

8. Do you have osteoarthritis (OA)?

**YES NO**

What medication are you on, if any?

9. Do you have rheumatoid arthritis (RA)?

**YES NO**

What medication are you on, if any?

10. Do you have any other bone or joint problem that could be made worse by a change in your physical activity? If so, please describe the problem.

**YES NO**

11. Do you have high blood pressure (Hypertension)?

**YES NO**

What **medication** are you on, if any?

12. Do you have epilepsy?

**YES NO**

What **medication** are you on, if any?

13. Do you have diabetes?

**YES NO**

Are you dependent on insulin?

**YES NO**

14. Do you have asthma?

**YES NO**



What **medication** are you on, if any?

15. Do you have any other condition that may affect your ability to start physical activity?

**YES NO**

Please describe.

16. Are you on any other medication not already mentioned above?

**YES NO**

If so, please state what it is and what it is for.

17. Do you know of any other reason why you should not do physical activity?

**YES NO**

Please describe.

18. Do you have any **hearing** or **sight** issues – please describe, or any other issue you wish to tell us about that may be relevant?

**YES NO**

**If you answered YES to one or more questions...**

You may be able to do any activity you want as long as you start slowly and build up gradually. Or you may need to restrict your activities to those which are safe for you.

**Talk** with your doctor about the kinds of activities you wish to participate in and follow his/her advice.

**If you answered NO to all questions...**

If you answered honestly to all questions, you can be reasonably sure that you can:

- Start becoming more physically active - begin slowly and build up gradually.

This is the safest and easiest way to go.

**Delay becoming much more active if...**

- If you are not feeling well because of a temporary illness such as a cold or a fever - wait until you feel better.
- If you are or may be pregnant - talk to your doctor before you start becoming more active

**Please Note:** If your health changes so that you answer **YES** to any of the above questions, please notify either the researcher or dance teacher.

**If you have any doubt whatsoever after completing this questionnaire, consult your doctor prior to commencing physical activity.**