A Study on the Effects of Argentine Tango as a Form of Partnered Dance for those with Parkinson Disease and the Healthy Elderly

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Falls are the leading cause of injury deaths in older adults (Murphy 2000), and they can lead to fear of falling, reduced quality of life, withdrawal from activities, and injury. Changes in joint ranges of motion, strength, sensory processing, and sensorimotor integration all contribute to reduced balance stability with increasing age and these changes are paralleled in those with Parkinson Disease (PD). Interventions, such as traditional exercises tailored specifically for seniors and/or individuals with PD, have addressed balance and gait difficulties in an attempt to reduce fall rates with mixed, undocumented results. Argentine tango dancing has recently emerged as a

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promising non-traditional approach to ameliorating balance and gait problems among elderly individuals. The goal of this study was to determine whether the functional mobility benefits noted in elders following a tango dancing program might also extend to older individuals with PD. We compared the effects of tango to those of traditional exercise on functional mobility in individuals with and without PD. We predicted that the functional mobility and quality of life gains noted with Argentine tango would be greater than those noted with traditional strength/flexibility exercise. Thirty-eight subjects (19 control and 19 with PD) were assigned to 20 hour-long exercise or tango classes that were completed within 13 weeks. Although all groups showed gains in certain measures, only the Parkinson Tango group improved on all measures of balance, falls and gait. Moreover, upon terminating the program the Parkinson Tango group was more confident about balance than the Parkinson Exercise group. In psychosocial terms, both groups largely enjoyed their experiences because the classes fostered community involvement and became a source of social support for the members. Our results suggest that Argentine tango is an appropriate, enjoyable, and beneficial activity for the healthy elderly and those with PD and that tango may convey benefits not obtained with a more traditional exercise program.

KEY WORDS: Tango; Parkinson disease; Balance.

Introduction

Falls are the leading cause of injury deaths in older adults (Murphy 2000). Approximately one third of individuals 65 and older living in the community will fall at least once in the span of a year (Hornbrook et al. 1994; Hausdorff et al. 2001; CDC 2004). Falls can lead to fear of falling, reduced quality of life, withdrawal from activities, and injury. In 2003, more than 1.8 million seniors were treated in emergency departments for fall-related injuries and 421,000 were hospitalized. The cost of fall injuries is expected to reach $43.8 billion by the year 2020 (CDC 2004). Declines in gait, balance and cognitive function with aging are major contributors to falling (Rubenstein and Josephson 2002). These difficulties are even more pronounced in individuals with idiopathic Parkinson Disease (PD), a progressive neurodegenerative condition that affects approximately one million older adults in the United States. Many individuals with PD experience a reduction in mobility as a result of gait and balance difficulties. A 6-month prospective study found that roughly 60% of people with PD experienced at least one fall (Bloem et al. 2001a, b). Among those who fall, 10% will experience serious injury such as hip fracture or head trauma (Sterling et al. 2001).

Changes in joint ranges of motion, strength, sensory processing, and sensorimotor integration all contribute to reduced balance stability with increasing age (Rogers and Mille 2003). Gait changes associated with aging include decreased gait speed, decreased stride length, increased double support time, and increased width of the base of support (Woo et al. 1995; Dobbs et al. 1993; Elble et al. 1991). These changes are more pronounced in individuals who are fearful of falling (Chamberlin et al. 2005). Older adults also have difficulty walking in dual task conditions such as walking while doing mental arithmetic (Beauchet et al. 2005). The degree of impairment noted on dual task walking is highly predictive of fall risk among the elderly. Finally, many older adults also have difficulty executing turns in the midst of walking. Unlike younger people and high-functioning elders, lower functioning older adults often do not use a pivot strategy to turn (Judge 2003). Falls during turning are common and are 8 times more likely to result in hip fracture than are falls during straight walking (Cumming and Klineberg 1994).

There are many parallels between the changes associated with aging and those seen with PD. Gait changes commonly noted in PD include a flexed posture, shuffling steps, deficits in stride length regulation, reduced foot clearance during swing phase, and increased cadence (Morris et al. 1994a, b, 1996, 1999, 2001a; Pedersen 1997; Rogers 1996). People with PD often have more difficulty turning while walking than they do when walking in a straight line. Turning can trigger freezing, i.e. a slowing or stoppage of movement, during gait. Freezing of gait is a common problem, affecting 53% of patients who have had PD for over 5 years (Nieuwboer et al. 2001). Freezing also commonly occurs with gait initiation and when walking through doorways or other tight spaces. Individuals with PD have difficulty walking in dual task conditions as well (Galletly and Brauer 2005; Canning 2005; Rochester et al. 2004; O'Shea et al. 2002). Gait speed, stride length and stability decrease when individuals with PD are placed in dual task conditions. Changes with dual task walking are greater in those with PD than those without and dual tasking may trigger freezing in individuals with PD (Giladi and Hausdorff 2006). Gait and balance difficulties clearly limit functional mobility, leading to the potential for falls and the associated sequelae.

Several interventions have attempted to reduce fall rates by addressing balance and gait difficulties. One common approach is traditional exercises tailored specifically for seniors and/or individuals with PD (e.g., Fit 'N Fun (Braford 1996), Parkinson Disease & the Art of Moving (Argue 2000)). Although several commercial exercise programs are available and claim to be beneficial, none have been rigorously investigated to evaluate their effects on functional mobility. One goal of this study was to provide baseline information about the effectiveness of

a traditional strength/flexibility exercise regimen based upon the Fit 'N Fun (Braford 1996) program.

Though traditional exercise programs have been touted by many, emerging evidence suggests that dance may be effective at reducing the mobility deficits associated with aging. Dance therapist, Cynthia Berrol defines dance as "a kinesthetic form that expresses and objectifies human emotion and experience through ordered sequences of moving rhythmic patterns". As a dance/movement therapist, she believes movement can be used to therapeutically improve the physical function of the individual (Berrol 1990). Dance can be used to augment the movement strategies of the individual (Berrol 1990; Westbrook and McKibben 1989) and has been recommended for elderly people to increase or maintain their range of motion (Pratt 2004). Dance therapy has also been used as a successful therapeutic intervention for individuals with PD. People with PD who were encouraged to explore alternative movement strategies through dance demonstrated gains in neurological status and movement initiation (Westbrook and McKibben 1989). Additionally, dance appears to be an appropriate and pleasurable therapeutic activity for the elderly, in terms of its benefits to physical, mental and emotional states (Kudlacek et al. 1997). However, there is little research to date that documents this phenomenon, and it is deserving of attention (Judge 2003; Pratt 2004).

Argentine tango has recently emerged as a promising non-traditional approach to ameliorating balance and gait problems among elderly individuals. Jacobson et al. (2005) reported pilot results of Argentine tango lessons compared to walking on clinical measures of balance and gait in the frail elderly. They noted greater improvements in balance and complex gait tasks in the tango group as compared to the walking group. Brown et al. (2006) used positron emission tomography (PET) to study the regions of the brain involved in the control of tango movements of a single lower limb in healthy subjects lying supine. Their results suggested that the basal ganglia, the area of neurological degeneration in those with PD, are specifically involved in the control of dance movements. Increased activity in the basal ganglia was observed when the tango movements were performed to a metered beat in a predictable rhythm. These two studies, (Jacobson et al. (2005) and Brown et al. (2006)), are the only works to date that scientifically evaluate the effects of dance on functional mobility and neurological activation.

Because of the life-altering deficits in motor ability in those with PD, combined with the effects of aging, it is extremely desirable to enhance their safety and quality of life. In this study we compared the effects of tango to those of traditional exercise on functional mobility in individuals with and without PD. We predicted that the functional mobility and quality of life gains noted with Argentine tango would be greater than

those noted with traditional strength/flexibility exercise. We chose Argentine tango, a form of partnered movement that is less prescribed and structured than most social dances, because it involves movement initiation and termination, rotating (both stationary and while traveling), and moving in close proximity to another individual. We postulated that these movement characteristics would specifically target and improve the motor ability of our participants with PD who have difficulty initiating gait, difficulty turning, and may experience freezing when moving in close quarters.

Methods

Subjects

We recruited 19 subjects with PD and 19 age- and gender-matched controls. All subjects were at least 55 years of age. All control subjects met the following inclusion criteria: (1) normal central and peripheral neurological function, (2) vision corrected to 20/40 or better, (3) able to stand independently for at least 30 min and walk independently for 10 feet, (4) no history of vestibular dysfunction, and (5) MMSE score of >25. Exclusionary criteria included: (1) serious medical problem, (2) use of neuroleptic or other dopamine-blocking drug, (3) use of drug that might affect balance, like a benzodiazepine, (4) evidence of abnormality on brain imaging (previously done for clinical evaluations—not part of this research), (5) history or evidence of other neurological deficit or (6) history or evidence of orthopedic, muscular, or psychological problem that could influence ability to participate in the study.

Subjects with PD were recruited from the Washington University School of Medicine's Movement Disorders Center and from the community. Subjects with PD met all of the inclusion criteria for controls except for their neurological diagnosis and use of medications for PD. PD diagnostic criteria include those used for clinically defined "definite PD", as previously outlined by Racette et al. (1999) based upon established criteria (Calne et al. 1992; Hughes et al. 1992). Each must have had clear benefit from PD medications and meet the above inclusionary and exclusionary criteria.

Research Design

Subjects were randomly assigned to one of two groups: tango or traditional exercise. Nine people with PD and nine controls were assigned to

the Tango group. Ten people with PD and ten controls were assigned to the Exercise group. Those in the Tango group participated in progressive tango lessons. People with PD were partnered only with controls. Those in the exercise group participated in a structured traditional strength/flexibility chair exercise class designed for people with PD and/or the elderly (adapted from Fit 'N Fun, Braford 1996). Both groups participated in two 1-hour sessions per week, completing 20 lessons within a span of 13 weeks. All training sessions, i.e. tango and traditional exercises, were led by a professional dance instructor/certified personal trainer. Subjects were instructed to continue their ordinary exercise routine, and not to begin anything new during the course of the study.

Subjects were assessed the week prior to initiation of training and the week following the 10-week training session. All assessments were videotaped and all data files coded to allow for blinded ratings of all subjects. Subjects completed the following questionnaires: the Activities-specific Balance Confidence (ABC) Scale (Powell and Myers 1995), the Modified Falls Efficacy Scale (Hill et al. 1996), and the 17-item Philadelphia Geriatric Center Morale Scale (Lawton 1975). Balance was evaluated using the Functional Reach (Duncan et al. 1990) and One Leg Stance Test (Vellas et al. 1997). Walking velocity was assessed by tracking a reflective marker placed on the trunk using a motion capture system (Motion Analysis Corporation, Santa Rosa, CA). Measurement sessions were conducted using a standardized script with specific instructions for each task. Measurement sessions were videotaped and a blinded rater who is a physical therapist scored all items by watching the videos. Appropriate parametric statistics ($p = 0.05$) were used to compare pre- to post-training measures. During post-testing, participants were asked to complete an additional questionnaire that asked them to rate several features of the program on a Likert scale. They also completed a music questionnaire to determine how music affected their experience in the program.

Tango Classes

Twenty hour-long progressive tango sessions were completed within 13 weeks. These lessons included postural stretches, balance exercises, tango-style walking, embellishment footwork games, and rhythmical experimentation, both with and without a partner.

During warm-up, the class typically began holding hands in a circle. Imagery was suggested to the participants, such as "clouds beneath their

arms" so they could offer each other support, and become aware of supporting their own weight, which are very important concepts in partner dancing. The instructor suggested the students "allow their weight to fall into the floor," "reach their ears toward the ceiling," "their spine is a "pearl necklace" and thus "imagine your tail bone is like a heavy amulet at the end of the pearl necklace and falling to the floor." In a tai-chi inspired exercise, while standing on two feet, participants would slowly shift weight from one foot to the other. To target and improve balance, students were encouraged to release their weight into the floor by reducing tension in their feet and calves, while concentrating on their core so their body weight was supported. For some participants, it was difficult to balance in single leg stance. During the warm up, careful placement of weight through the feet during weight changes, and attention to posture were most emphasized.

After warm up, students worked on basic Argentine tango principles, such as partnership, timing, footwork, and movement quality. Students learned and practiced compression towards a partner and leveraging away from the partner through body weight, not through the common mistake of pushing or pulling with their arms and hands. Because students found it easier to accomplish the movements, they held hands standing in front of each other in a 'practice' hold, rather than the traditional ballroom frame used in most social dances. 'Steps' were taught by learning the footwork separately, and then trying it with a partner. The instructor provided a theme for the session (i.e., the 'cross', (crossing one foot in front of the other) 'ochos' (a figure eight footwork pattern) or 'pausing'), and allowed dancers to experiment with these themes, while assisting the dancers with individual questions. Sometimes as many as four and never less than two assistant instructors would dance with the students and answer questions. Traditional tango music was played to which dancers were to move rhythmically, i.e., on the beat. However, at times the focus was more on the shape of the movement, transition and partnership skills, and less on dancing to a prescribed (i.e., instructor-dictated) beat.

The sessions were structured such that each dancer could learn from his/her partner and from the rest of the group. During the partnering, participants danced both the leading and following roles, regardless of gender. They rotated partners approximately every 10–15 min, which anecdotally has tended to encourage faster learning. Although many participants were very physically challenged, everyone participated in most of the class period. Students were encouraged to take breaks as necessary and to ask questions or offer comment about their dance experience at the end of the class.

Exercise Classes

Twenty hour-long exercise classes were completed within 13 weeks. During the first 40 min of the class participants exercised in chairs. They began with breathing and stretching exercises, and progressed to resistance and dexterity exercises, sometimes using water bottles or yard sticks to provide resistance or leverage. For particular exercises, class participation was greatly encouraged and necessary, such as for 'bicycling'. The students were asked "Where are we bicycling to, today?" which received responses like 'next door', 'to church' or 'along the Great Wall of China'. Other imagination enhancing exercises were 'rowing down the river' or 'running a marathon'. 'Rotating the wrists' required that each class period students learn new rhythmic patterns of wrist movement upon the thighs. Examples from the Exercise Routine Handout follow:

From "Wand exercises (performed with a yard stick)":

a. Swing: Forward and backward, Then in Big circles to R and L.
b. Paddle: What river, lake or stream would you like to paddle down on your canoe? Imagine your trip. Be sure to take big strokes!
c. Shrug: Arms behind chair with wand.
d. Arm extension: press the wand backwards (arms still behind chair).
e. Finger roll: As fast as you can, then as slow as you can; Rolling out to the sides of the wand, and back to center. Come up with your own plan!

From "Lower Body exercises":

f. Bicycle: Where are you going to pedal to? Imagine the trip there and back.
g. Leg swing: Create your own rhythm.
h. Abs: Try one leg first, then two, then lift higher.
i. Heel toe exercise.
j. Skipping: slow then fast.
k. Scooting: Run a Marathon on your chair. Where would you run that marathon? Close your eyes and imagine the run.

From "Upper Body exercises":

l. Rotate wrist: come up with your own rhythms.
m. Head, shoulder, knees, toes: you can say this along with the exercise, or sing.
n. Wood: You're going to make a new piece of furniture for your home. What type of wood would you use?
o. Big circles: Forward and Backward in time.

Approximately 40 min into the class participants would rise from their chairs to exercise while standing using chair support as a 'barre'. Exercises included the 'hula', 'heel-toe jig', 'flamingo balance', and 'apple picking', during which students were again encouraged to use their imaginations. During the last 10 min of class, students performed core strengthening and stretching exercises. Those that could not recline on the floor completed modified exercises on the chair.

Results

Depression

The Philadelphia Geriatric Center Morale Scale (scores range from 0 to 17, with higher scores indicating greater morale) demonstrated that people with PD had lower morale than controls at the outset of the study (mean values: Controls = 14.94 ± 1.68, PD = 11.37 ± 2.79, independent t-test, $p < 0.001$). Upon completion of the program, there was little overall change between Controls and people with PD (mean values: Controls = 14.42 ± 1.90, PD = 11.11 ± 3.71, independent t-test, $p = 0.001$).

Walking Velocity

All groups showed small increases in average walking velocity (Table 1). These changes were not significant for any of the groups.

Balance/Falls

The Exit Questionnaire was composed of eight items ranked by participants on a scale of 1–5 (1 = strongly agree, 2 = somewhat agree, 3 = nei-

Table 1
Walking velocity (m/s)

Group	*Pre*	*Post*
PD tango	0.86 ± 0.13	0.88 ± 0.11
PD exercise	0.89 ± 0.17	0.91 ± 0.022
Control tango	1.03 ± 0.10	1.17 ± 0.14
Control exercise	0.94 ± 0.17	1.01 ± 0.14

Values are means ± SD

ther agree nor disagree, 4 = somewhat disagree, 5 = strongly disagree.) The balance item stated "My balance has improved since starting this program." The Parkinson tango group believed they had experienced more gains in balance than the Parkinson exercise group (PD tango mean: 1.78 ± 0.67, PD Exercise mean = 2.89 ± 0.78, independent t-test, $p = 0.005$). The control tango and exercise group reversed this trend (Control Exercise mean = 1.22 ± 0.44, Control Tango = 2.22 ± 1.10, independent t-test, $p = 0.022$). See Table 2 for means and standard errors for all items on the Exit Questionnaire.

On the One Leg Stance, the Functional reach test, the Falls Efficacy Scale, and the Activities-specific Balance Confidence Scale, we saw some improvement in all four measures in the Parkinson tango group. Regarding the Parkinson exercise group we saw improvement in only Functional Reach and One Leg Stance while their scores declined on both the Falls Efficacy Scale and Activities Balance Confidence Scale. The control exercise group experienced gains only in the One Leg Stance, and the Activities Balance Confidence Scale, while decreasing in Functional Reach. The control tango group experienced gains in One Leg Stance, and remained the same in Functional Reach, and Activities Balance Confidence (Table 3, Figs. 1 and 2).

Attendance/Participation

All subjects completed the required 20 sessions within 13 weeks. Subjects who had no or few absences and finished promptly were given the option,

Table 2
Exit Questionnaire

	PT	*PE*	*CT*	*CE*
1 (enjoyment)	1.11 ± 0.33	1.00 ± 0.00	1.00 ± 0.00	1.00 ± 0.00
2 (balance)	1.78 ± 0.67	2.89 ± 0.78	1.22 ± 0.44	2.22 ± 1.10
3 (walking)	1.89 ± 0.93	2.33 ± 0.87	1.56 ± 0.88	2.22 ± 1.10
4 (mood)	1.44 ± 0.53	1.89 ± 0.78	1.67 ± 1.12	2.00 ± 1.00
5 (coordination)	2.11 ± 0.60	2.56 ± 0.73	1.33 ± 0.71	2.00 ± 0.87
6 (strength)	2.33 ± 1.11	2.11 ± 0.93	1.33 ± 0.71	2.11 ± 0.93
7 (endurance)	2.11 ± 0.78	2.00 ± 0.87	1.67 ± 0.87	2.11 ± 0.93

Values are means ± standard deviations; Likert Scale ranging from 1 (strongly agree) to 5 (strongly disagree), item 1 asked if participants enjoyed participating, items 2 through 7 ask if participant noted improvement in that particular aspect of physical well-being

Table 3
Balance measures

	Functional Reach (in.)		*One Leg Stance (s)*	
	Pre	*Post*	*Pre*	*Post*
PD tango	9.6 ± 2.3	10.12 ± 3.6	9.9 ± 10.0	10.3 ± 11.0
PD exercise	8.8 ± 2.6	9.2 ± 3.8	6.9 ± 11.3	8.3 ± 4.4
Control tango	12.5 ± 2.0	12.5 ± 2.5	34.4 ± 24.3	38.6 ± 25.4
Control exercise	9.2 ± 1.9	8.7 ± 3.0	7.7 ± 9.6	11.1 ± 7.1

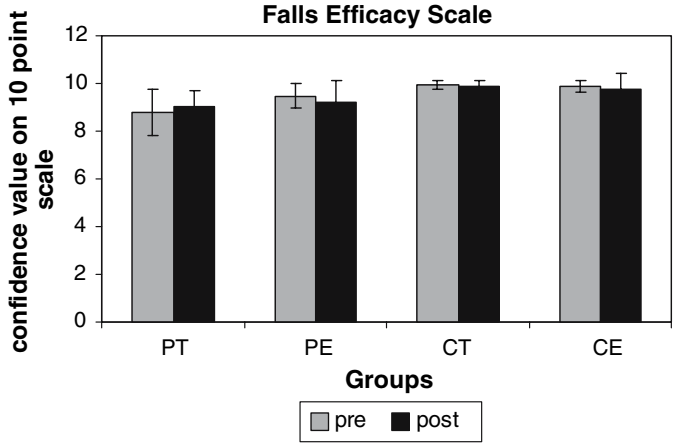

Fig. 1
Falls Efficacy Scale scores for all groups before and after the intervention. Subjects rate on a ten-point scale confidence in their ability not to fall during daily activities. Higher scores indicate more confidence.

after post-testing, to continue attending the classes being offered for those who had missed some sessions. Seven students from the tango group elected to continue attending classes, while no one from the exercise group attended more than the required 20 sessions.

Music

On the music questionnaire completed during post-testing, all (18 of 18) participants in the tango group felt that music helped their experience in the class. Some stated reasons were because music helped them initiate movement, the beat of the music helped keep them moving in time to it, and music made it more enjoyable for them. One participant wrote that with music she, "could forget imbalance, could be relaxed on my feet,

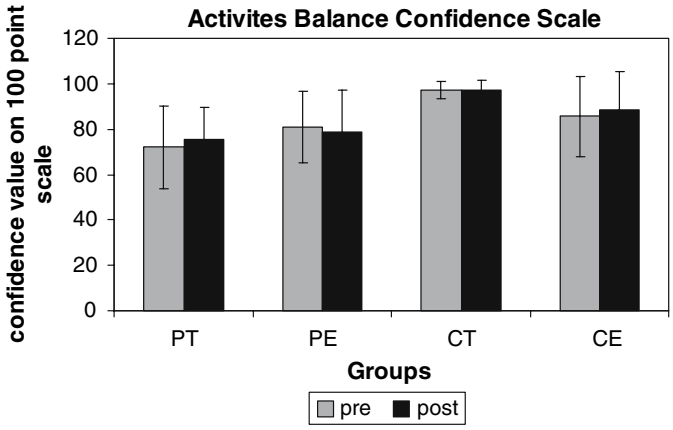

Fig. 2
Activities-specific Balance Confidence (ABC) Scale scores for all groups before and after the intervention. The ABC is a 16-item scale that quantifies percent confidence in balance during activities of daily living. The maximum score is 100%.

because the music directed and initiated movement, it was so pleasant and enjoyable." Another wrote "Without music, why dance?" Many extolled music's virtue of making exercise become dance.

Fewer participants (15 of 20) in the exercise group felt that music helped their experience. There were opinions about the type of music that should be played, whether it should be played, and some people with PD claimed that it distracted them from the exercise at hand. However, many claimed that music provided a lighthearted feeling by lifting the mood, and it tended to make the time pass, and the movements easier to initiate. They would have preferred to have exercised to the beat of the music more.

Exit Survey Open-Ended Responses

The tango group stated on the exit questionnaire what they liked best and least about the program. They greatly appreciated the camaraderie and socialization engendered by the program. Being able to meet others with PD and their caregivers while having a novel experience was important to them. They reported liking the challenge of learning something new. They additionally appreciated the patient instruction and involvement of the instructor and assistants.

The commute to and from classes, which involved driving long distances for some participants, was not liked by most, and the schedule appeared inconvenient (1 pm in the afternoon) for some. Some people felt partner rotations occurred too quickly, and some preferred to dance with

only the person with whom they came. But many appreciated dancing with a new person.

The exercise group stated on the exit questionnaire what they liked best and least about the program. Again, meeting new people and having the regular opportunity to socialize and 'work together' were appreciated. They felt the exercises were not boring, and neither did they 'feel' like exercise. The afternoon scheduled time and the drive home were inconvenient for many, as in the tango group.

The tango group often expressed how important it was that people with PD and their partners (spouses or caregivers) get together with others like them because of the supportive and therapeutic aspects. They requested that they have lunch together at the end of the sessions. During the dance classes, they were very helpful to one another. Although spouses did not always dance together, all the control subjects were very considerate of their partners, the individuals with PD. All non-neurologically challenged individuals who participated as controls in this study were terrific partners for those with PD. Tango dancing demands concentration of which the group was quite capable. Since the neurologically challenged were at different stages of the disease, some participants were more severely disabled than others, but everyone adjusted to his or her partner's capabilities.

The exercise group appeared to enjoy their classes immensely, which was evident and provable if one could measure their laughter and smiles. They were very enthusiastic about participating in the imagination and rhythmic games and seemed quite friendly with one another. It was reported to the instructor that the class members would come early for conversation before walking down to the laboratory for their classes.

Discussion

Although all groups showed gains in various measures, only the Parkinson tango group improved on all measures of balance, falls and gait. Moreover, the people with PD who participated in tango were more confident about balance upon terminating the program. It is possible that these results are an effect of the rhythm, touch, novelty, and interpersonal connection of social dance while music acted as a motivator. In psychosocial terms, both groups largely enjoyed their experience, as the classes appeared to foster community involvement and became a source of social support for the members.

The pace of the Argentine tango lessons was at the level of the average person with PD. The control tango group may have experienced greater gains had their class been tailored to the pace of non-neurologically

challenged individuals. The control exercise group appeared to be slightly worse than the control tango group on most pre-test measures. It is possible that their gains were merely an aspect of regression to the mean or a testing effect. Jacobson et al. (2005) observed tango to be an effective and feasible modality in improving mental function and balance in the frail elderly. Our results reconfirm theirs but we now have contributory information about the ramifications of Argentine tango for those with PD.

To decipher the appeal of Argentine tango classes, one must note that while self-reported enjoyment was ubiquitous for all groups, more members remarked on the novelty of the Argentine tango. Although both classes had a large social and interactive component, the tango involves touch, which is indispensable to the elderly and health-challenged as demonstrated in a Dance/Movement Therapy program for the neurologically impaired (Berrol et al. 1997). Learning new concepts has been revealed to retard mental decline (Cusack and Thompson 1998; Rowe and Kahn 1998). The progressive nature of the lessons was attractive to those in the tango group because they learned throughout the class, perfected motor skills, and used movement in problem solving.

In the traditional exercise class, exercises became repetitious which is illustrated by this point. During the 'bicycling' exercise of the exercise class, members were invited to tell stories about places they were bicycling to, one of the members would consistently say "We're still bicycling, here!" in order to speed up the speaker's tale. This was always amusing, but it accentuates the pervasive concept that exercises are "to be gotten over with", while the progressive nature of tango leads people to wonder what lies ahead. In the tango class we focused on the movement itself, on one's physical connection to one's partner and on what one's partner was doing. In each lesson new steps or concepts were introduced, and all members knew there was plenty more to learn. In the exercise class, to make the movement fun we focused on imagined and fantastic scenarios, rather than on the movement itself.

Argentine tango is a dance done in an embrace or frame, unlike swing or salsa. This aspect is particularly useful to individuals who are challenged in terms of balance, because the partner may provide helpful sensory information and stabilizing support that leads to improved balance and gait. Argentine tango 'steps' are themselves composed of balance exercises: steps in all directions, placing one foot in front of another in tandem, rolling through the foot from heel to toe, or toe to heel, leaning toward or away from a partner, and dynamic balances in single stance. The tango technique develops focus and attention to task while a dancer executes the movements, be it turning, stepping, balancing, or a combination of all three. Among social dances, partnered movement shared within a social, group setting. Argentine tango allows both participants

an enormous amount of flexibility and choice in movement. Unlike waltz or foxtrot, no one step must follow another. The leader can choose to turn in place, to travel in any direction, or to remain stationary while enjoying the music. The interpretation of tempo and rhythm are also up to the whim of the leader, and beautifully matched by the follower because it is acceptable to move energetically or to pause for an extra beat. Free to constantly improvise, and create unique rhythms for every moment of the dance, a couple dances in sync to the meter of the music. One can rarely be "wrong" while dancing Argentine tango.

Argentine tango is a form of artistic expression. Soulful, and full of meaning, tango music creates an atmosphere of contemplation, longing and intellectual stimulation. Since a dancer's attention must be divided between navigation and balance, Argentine tango helps develop cognitive skills like dual tasking. Exercises designed to improve balance engender functional mobility. These tasks may be walking on a straight line, practicing turns of various natures, placing the feet mindfully, and postural awareness during locomotion.

Tango appeared to be a conduit for helpful human interaction for people who are dealing with a difficult malady on an ongoing basis. The touch of others, the rhythm of the music, and the novelty of the experience all contributed to the beneficial effects. The sense of community spirit was evident when the tango group requested that they have lunch together when some of the participants were nearing the end of their 20 lessons. Several of the control members in the tango class commented on how important it was to do an activity together with their spouse. In some ways, the caregivers for the individuals with PD find life even more difficult and they often claim to need social support (Goodill 2005, p. 42). This was definitely commented upon by our members who appreciated spending time with their spouses, and getting together to dance with other couples in a similar situation. Anecdotally, many people reported to the instructor and principal investigators their disbelief that people with PD could dance, but this experience showed them that not only could they dance, they could learn and improve their dancing abilities similarly to non-neurologically challenged individuals, and some more so than healthy elderly. Therefore, PD is not a sentence to restricted activities.

Based on the results from the Philadelphia Geriatric Morale Scale, these individuals are not only physically challenged. In their tango classes, some reported feeling like "themselves again", or talked of how their mood was "lightened". Mood has been demonstrated to impact health, and the expression of emotion has certain health benefits (Goodill 2005, p. 44). Our members were able to access some of that expression within themselves during their classes. The effects extended beyond their class period time, they reported.

Adherence to an exercise program may be more likely if it is novel and enjoyable. A study of those at risk of heart failure found that the waltz was just as good as traditional aerobic exercise and that people were happier, which was demonstrated by increases in a measure of quality of life, and greater likeliness to comply with the 'exercise regime' (Belardinelli et al. 2006). People will feel better if their symptoms improve, but feeling better certainly has a tendency to improve symptoms. If the self-reported outcome of DMT treatment on fibromyalgia is considered appropriate for measuring subjective phenomenon pain (Goodill 2005, p. 92), then this study's members' self-reports show extensive benefits for exercise programs of any kind. However, the novelty, the touch, the socialization, interaction and the progressive learning aspect of Argentine tango indubitably reveal a highly flexible, appropriate and enjoyable activity for the healthy elderly and those with PD.

Conclusion

Unquestionably, the results support the idea that exercise in a social setting is very important to the well being of the healthy elderly and those with PD. By all accounts, the majority of participants appreciated their involvement with the program. For some, these effects may be long lasting. The major purpose of this work was to compare a tango dance class, considered a novel movement intervention, with a standard community exercise class. The results illustrate improvements in all measures of falls, gait and balance confidence in those with PD in the tango group as compared with those with PD in the exercise group. Furthermore, the novel aspect of tango and the built-in non-exercise concept of dance made the exercise more pleasurable and as such, promoted adherence to the program.

This study lays the groundwork for further explorations into the specific features of dance, i.e. expressive movement done to a rhythmic pulse, that are most critical to obtain maximal gains in functional mobility. The long-term goals of this work are to establish how partnered expressive movement done to a rhythmic pulse, such as tango, influences functional mobility and to develop optimized therapeutic movement interventions to address balance and gait difficulties associated with PD and normal aging. Future studies are planned that will examine the differential effects of dancing with or without a partner, or different styles of partner dancing. This work may ultimately lead to improved therapeutic movement approaches, employing dance as the principle intervention, that are both enjoyable and effective in addressing balance, turning and gait difficulties associated with aging

and PD and importantly, preventing falls, promoting overall health and improving the quality of life.

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References

Argue, J. (2000) *Parkinson's disease and the art of moving*. Oakland, CA: New Harbinger.

Beauchet, O., Dubost, V., Herrmann, F., Rabilloud, M., Gonthier, R., & Kressig, R. W. (2005). Relationship between dual-task related gait changes and intrinsic risk factors for falls among transitional frail older adults. *Aging clinical and experimental research*, *17*: 270–275.

Belardinelli, R., et al. (2006). *Dancing in patients with chronic heart failure: A new form of exercise training*. Abstract 3957 presented at the meeting of American Heart Association Scientific Sessions.

Berrol, C. (1990) Dance/movement therapy in head injury rehabilitation. *Brain Injury*, *3*: 257–265.

Berrol, C. F., Ooi, W. L., & Katz, S. S. (1997). Dance/movement therapy with older adults who have sustained neurological insult: A demonstration project. *American Journal of Dance Therapy*, *19*: 135–160.

Bloem, B. R., Grimbergen, Y. A. M., Cramer, M., Willemsen, M., & Zwinderman, A. H. (2001). Prospective assessment of falls in Parkinson's disease. *Journal of Neurology*, *248*: 950–958.

Bloem, B. R., van Vugt, J. P. P., & Beckley, D. J. (2001). Postural instability and falls in Parkinson's disease. *Advance in Neurology*, *87*: 209–223.

Braford, T. (1996) *Fit 'N Fun: Home exercises for people with Parkinson's disease. Video and home exercise instruction manual*. St. Louis, MO: Greater St. Louis Chapter of the American Parkinson Disease Association.

Brown, S. B., Martinez, M. J., & Parsons, L. M. (2006). The neural basis of human dance. *Cerebral Cortex*, *16*(8), 1157–1167.

Calne, D. B., Snow, B. J., & Lee, C. (1992). Criteria for diagnosing Parkinson's disease. *Annals of Neurology*, *32*: S125–S127.

Canning, C. G. (2005) The effect of directing attention during walking under dual task conditions in Parkinson's disease. *Parkinsonism Related Disorders*, *11*: 95–99.

Centers for Disease Control and Prevention (CDC) (2004). Web-based injury statistics query and reporting system (WISQUARS) [Online]. National Center for Injury Preventions and Control, Centers for Disease Control and Prevention (producer). Available from: www.cdc.org.ncipc/wisquars.

Chamberlin, M. E., Fulwider, B. D., Sanders, S. L., & Medeiros, J. M. (2005). Does fear of falling influence spatial and temporal gait parameters in elderly persons beyond changes associated with normal aging? *Journal of gerontology*, *60A*: 1163–1167.

Cumming, R. G., & Klineberg, R. J. (1994). Fall frequency and characteristics and the risk of hip fractures. *Journal of the American Geriatrics Society*, *42*: 774–778.

Cusack, S. A., & Thompson, W. J. A. (1998). Mental fitness: Developing a vital aging society. Research and development of an Older Adult Education Program in the context of a

seniors centre in Western Canada. *International Journal of Lifelong Education*, *17*(5), 307–317.
Dobbs, R. J., Charlett, A., Bowes, S. G., O'Neill, C. J., Weller, C., Hughes, J., & Dobbs, S. M. (1993). Is this walk normal?. *Age and Ageing*, *22*: 27–30.
Duncan, P. W., Weiner, D. K., Chandler, J., & Studenski, S. (1990). Functional reach: A new clinical measure of balance. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *45*: M192–197.
Elble, R. J., Thomas, S., Higgins, C., & Colliver, J. (1991). Stride-dependent changes in gait of older people. *Journal of neurology*, *238*: 1–5.
Galletly, R., & Brauer, S. G. (2005). Does the type of concurrent task affect preferred and cued gait in people with Parkinson's disease?. *The Australian Journal of Physiotherapy*, *51*: 175–180.
Giladi, N., & Hausdorff, J. M. (2006). The role of mental function in the pathogenesis of freezing gait in Parkinson's disease. *Journal of the neurological sciences*, *248*(1–2), 173–176.
Goodill, S. W. (2005) *An introduction to medical dance/movement therapy*. London & Philadelphia: Jessica Kingsley Publishers.
Hausdorff, J. M., Rios, D. A., & Edelber, H. K. (2001). Gait variability and fall risk in community-living older adults: a 1-year prospective study. *Archives of physical medicine and rehabilitation*, *82*: 1050–1056.
Hill, K. D., Schwarz, J. A., Kalogeropoulos, A. J., & Gibson, S. J. (1996). Fear of falling revisited. *Archives of Physical Medicine and Rehabilitation*, *77*: 1025–1029.
Hornbrook, M. C., Stevens, V. J., Wingfield, D. J., Hollis, J. F., Greenlick, M. R., & Ory, M. G. (1994). Preventing falls among community-dwelling older persons: results from a randomized trial. *Gerontologist*, *34*(1), 16–23.
Hughes, A. J., Daniels, S. E., Kilford, L., & Lees, A. J. (1992). Accuracy of clinical diagnosis of idiopathic Parkinson's disease: A clinico-pathological study of 100 cases. *Journal of Neurology, Neurosurgery, and Psychiatry*, *55*: 181–184.
Jacobson, A. C., McKinley, P. A., Leroux, A., & Rainville, C. (2005). *Argentine tango dancing as an effective means for improving cognition and complex task performance in at-risk elderly: A feasibility study*. Program No. 757.7 Abstract presented at the meeting of the Society for Neuroscience, Washington, DC, 2005.
Judge, J. O. (2003) Balance training to maintain mobility and prevent disability. *American Journal of Preventive Medicine*, *25*(3Sii), 150–156.
Kudlacek, S., Pietschmann, F., Bernecker, P., Resch, H., & Willvonseder, R. (1997). The impact of a senior dancing program on spinal and peripheral bone mass. *American Journal of Physical Medicine & Rehabilitation*, *76*(6), 477–481.
Lawton, M. P. (1975) The Philadelphia Geriatric Center Morale Scale: A revision. *Journal of Gerontology*, *30*(1), 85–89.
Morris, M. E., Huxham, F. E., McGinley, J., & Iansek, R. (2001). Gait disorders and gait rehabilitation in Parkinson's disease. *Advances in Neurology*, *87*: 347–361.
Morris, M. E., Iansek, R., Matyas, T. A., & Summers, J. J. (1994). Ability to modulate walking cadence remains intact in Parkinson's disease. *Journal of Neurology, Neurosurgery, and Psychiatry*, *57*: 1532–1534.
Morris, M. E., Iansek, R., Matyas, T. A., & Summers, J. J. (1994). The pathogenesis of gait hypokinesia in Parkinson's disease. *Brain*, *117*: 1169–1181.
Morris, M. E., Iansek, R., Matyas, T. A., & Summers, J. J. (1996). Stride length regulation in Parkinson's disease: Normalization strategies and underlying mechanisms. *Brain*, *119*: 551–568.
Morris, M. E., McGinley, J., Huxham, F., Collier, J., & Iansek, R. (1999). Constraints on the kinetic, kinematic, and spatiotemporal parameters of gait in Parkinson's disease. *Human Movement Science*, *18*: 461–483.
Movement Disorder Society Task Force on Rating Scales for Parkinson's Disease.(2003). The Unified Parkinson's Disease Rating Scale (UPDRS): Status and recommendations. *Movement Disorders*, *18*: 738–750.
Murphy, S. L. (2000) Deaths: Final data for 1998. *National Vital Statistics Reports*, *48*(11), 1–105.

Nieuwboer, A., Dom, R., De Weerdt, W., Desloovere, K., Fieuws, S., & Broens-Kaucsik, E. (2001). Abnormalities of the spatiotemporal characteristics of gait at the onset of freezing in Parkinson's disease. *Movement Disorders*, *16*: 1066–1075.

O'Shea, S., Morris, M. E., & Iansek, R. (2002). Dual task interference during gait in people with Parkinson disease: Effects of motor versus cognitive secondary tasks. *Physical Therapy*, *82*: 888–897.

Pedersen, S. W., Öberg, 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*: 67–74.

Powell, L. E., & Myers, A. M. (1995). The activities-specific balance confidence (ABC) scale. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *50A*: M28–34.

Pratt, R. R. (2004) Art, dance, and music therapy. *Physical Medicine and Rehabilitation Clinics of North America*, *15*: 827–841.

Racette, B. A., Rundle, M., Parsian, A., & Perlmutter, J. S. (1999). Evaluation of a screening questionnaire for genetic studies of Parkinson's disease. *American Journal of Medical Genetics*, *88*: 539–543.

Rochester, L., Hetherington, V., Jones, D., Nieuwboer, A., Willems, A. M., Kwakkel, F., & Van Wegen, E. (2004). Attending to the task: Interference effects of functional tasks on walking in Parkinson's disease and the roles of cognition, depression, fatigue, and balance. *Archives of Physical Medicine and Rehabilitation*, *85*: 1578–1585.

Rogers, M. W. (1996) Disorders of posture, balance, and gait in Parkinson's disease. *Clinics in Geriatric Medicine*, *12*: 825–845.

Rogers, M. W., & Mille, M. L. (2003). Lateral stability and falls in older people. *Exercise and sport sciences reviews*, *31*: 182–187.

Rowe, J., & Kahn, R. (1998). *Successful aging*. New York, NY: Pantheon Books.

Rubenstein, L. Z., & Josephson, K. R. (2002). The epidemiology of falls and syncope in the elderly population. *Clinics in Geriatric Medicine*, *18*(2), 141–158.

Sterling, D. A., O'Connor, J. A., & Bonadies, J. (2001). Geriatric falls: injury severity is high and disproportionate to mechanism. *Journal of Trauma-Injury and Critical Care*, *50*: 116–119.

Vellas, B. J., Wayne, S. J., Romero, L., Baumgartner, R. N., Rubenstein, L. Z., & Garry, P. J. (1997). One-leg balance is an important predictor of injurious falls in older persons. *Journal of American Geriatrics Society*, *45*: 735–738.

Westbrook, B. K., & McKibben, H. (1989). Dance/movement therapy with groups of outpatients with Parkinson's disease. *American Journal of Dance Therapy*, *11*: 1.

Woo, J., Ho, C., Lau, J., Chan, G., & Yuen, K. (1995). Age-associated gait changes in the elderly: pathological or physiological? *Neuroepidemiology*, *14*: 65–71.