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Effects of a short duration, high dose contact improvisation dance workshop on Parkinson disease: A pilot study☆,☆☆

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Summary
Objectives: This study explored the feasibility and possible benefits of contact improvisation (CI) as an exercise intervention for individuals with PD.
Design: This was an uncontrolled pilot study.
Intervention: Eleven people with PD (H&Y = 2.4 ± 0.4) participated in a workshop of 10 1.5-h CI classes over 2 weeks, dancing with previously trained student CI dancers.
Main outcome measures: Measures of disease severity, balance, functional mobility, and gait were compared 1 week before and after the workshop.
Results: Participants demonstrated improvements on the Unified Parkinson Disease Rating Scale—Motor Subsection and Berg balance scores, along with increased swing and decreased stance percentages during walking. Backward step length also increased. Participants expressed a high level of enjoyment and interest in taking future CI classes.
Conclusions: This pilot study supports the feasibility of CI as an intervention to address mobility limitations associated with PD.

Introduction

People with Parkinson disease (PD) often demonstrate postural instability, gait difficulties, and reduced functional mobility, making them significantly more likely to fall than

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healthy people their age.[1] Frequent falls contribute to subsequent fear of falling and those who experience fear of falling are more likely to become socially isolated and have reduced physical activity.[1] These factors negatively impact the quality of life of people with PD.[2]

Although anti-Parkinson medications and deep brain stimulation help treat the symptoms of PD, neither is fully capable of correcting posture and mobility impairments, nor preventing falls.[3] However, both animal and human studies suggest exercise may improve balance and mobility in PD.[4,5] Recent studies suggest Argentine tango may provide superior benefits to gait and postural stability relative to traditional exercise.[6–8] Benefits from tango were seen in as little as 2 weeks during an intensive program.[9] While tango employs a degree of improvisation, it requires initial memorization of prescribed movement sequences. It also calls for a style and aesthetic that may be intimidating for particular individuals. Alternatively, a free-form improvisation-based dance technique may offer a more accessible form of PD-targeted exercise, while still providing the functional and social benefits demonstrated in other partnered dance interventions.

Contact improvisation (CI) is a partnered modern dance style initially developed by Steve Paxton beginning in 1972[10] and continued by numerous practitioners in the years since, for purposes ranging from social dance, to performance art, to therapy. It is an improvised duet that integrates tactile, visual, and vestibular feedback generated by both partners simultaneously and by the forces of motion and gravity. CI directs the dancer's attention to sensation and non-verbal communication rather than execution of specific movement sequences or visible appearance. In therapeutic practice, CI challenges dancers to continually adapt to unpredictable movement (i.e. weight shifts and mutual support) generated during spontaneous tactile interaction with the dance partner. Furthermore, its quickly accessible form immediately immerses dancers of varied size, age, ability and skill level in the movement experience. CI is frequently utilized among dancers with disabilities, and has been performed successfully by professional integrated dance companies, such as Axis Dance Company (Oakland, CA) and Full Radius (Atlanta, GA). No studies to date have examined CI's therapeutic potential. The goal of this study was to evaluate the feasibility and therapeutic potential of CI as an intervention for individuals with PD. The intervention took the form of a short duration, high dose workshop. We hypothesized that the CI intervention would improve balance, functional mobility, and gait in people with PD. Furthermore, we hypothesized that the degree of improvement with CI would be equal to or greater than gains previously demonstrated by a tango intervention delivered with the same frequency and duration.

Methods

Participants

Eleven participants were recruited from Washington University School of Medicine's Movement Disorders Center and from the St. Louis area. Participants had been previously diagnosed with idiopathic PD according to established criteria[11] and showed benefit from anti-Parkinson medication. Inclusion criteria also included visual acuity of 20/40 or better with or without corrective lenses, ability to walk independently for 10 feet with or without an assistive device and stand for 30 min, normal somatosensory function in the feet, and no history of vestibular disease. Participants were excluded if they had a serious medical problem, history or evidence of neurological deficit other than PD, or history or evidence of orthopedic, muscular, or psychological problem. No participants had taken part in dance classes within the previous 6 months. Of the sample, 64% were female, the mean age was 71.2 ± 6.1 years, and the mean time with PD was 9.0 ± 5.5 years. The average Hoehn and Yahr Score was 2.4 ± 0.4. Hoehn and Yahr staging is on a 1—5 scale, with 1 indicating presence of only unilateral symptoms, 2 indicating presence of bilateral symptoms, 3 indicating presence of bilateral symptoms and postural instability, 4 indicating severe disability but still able to stand or walk independently, and 5 being wheelchair bound or bedridden. Participants reported an average of 4.2 ± 8.8 falls during the previous 6 months. This study had the approval of the Human Research Protection Office at Washington University School of Medicine (protocol 09-0168). All participants provided written informed consent prior to participation in the study.

Data collection

Measures were collected during the week prior to the dance workshop and again during the week following the workshop. Participants were tested on their typical regimen of anti-Parkinson medication(s) at the same time of day, both before and after the workshop. Each participant was evaluated using the Unified Parkinson's Disease Rating Scale—Motor Subscale III (UPDRS),[12,13] and tested on the Berg Balance Scale (BBS),[13,14] Timed Up and Go test (TUG),[15] Five Times Sit-to-Stand Test (5× STS), and Six Minute Walk Test (6MWT).[13] Three forms of gait were assessed using a computerized GAITRite walkway (CIR Systems, Inc., Havertown, PA)[16]: (1) preferred-pace forward walking, (2) fast as possible forward walking,[13] and (3) preferred-pace backward walking. Averages of three trials for each form of gait were analyzed for cadence, velocity, step length, and percentage of the gait cycle spent in stance and swing.[17] Specific, scripted instructions were given for each measure. Participants also completed questionnaires concerning functional mobility and PD, including the Freezing of Gait Questionnaire (FOG),[18] Activities-specific Balance Confidence Scale (ABC),[19] and the thirty-nine item Parkinson's Disease Questionnaire (PDQ-39).[20,21] During post-testing, participants also completed an exit questionnaire that assessed, on a Likert scale, enjoyment and perceived improvements following the dance workshop.

Contact improvisation classes

Participants were instructed in 10 1.5-h contact improvisation classes over a period of 2 weeks. A professional improvisational dance instructor led the workshop. Healthy volunteers previously trained in contact improvisation were employed as dance partners for study participants. Solo warm-ups were conducted using a chair for support. All subsequent exercises utilized a partner. Activities pro-

gressed in difficulty throughout the workshop and focused on balance strategies, weight-sharing, fall management, and spatial awareness using a variety of contact and non-contact partnered improvisation techniques. Partners exchanged frequently throughout each class. Classes also included both demonstration of skills by instructor and volunteer dancers, and lecture components to review techniques and discuss theory for cognitive strategies. Music was played intermittently in the classes. Participants were told that they could respond to the music or ignore it at their individual discretion.

The workshop attempted to employ the four key ingredients that have been recommended for PD-specific exercise programs: (1) practice of cognitive movement strategies to improve transfers; (2) exercises to improve balance; (3) training of joint mobility and muscle power to improve physical capacity; and (4) cueing strategies to improve gait.[24,25]

Throughout this workshop, cognitive strategies were applied to transfers to and from chairs or the floor. Transitioning between levels was broken down into step-by-step components, and participants learned to incorporate support structures - such as a chair, partner or the floor — into their transfers. Additionally, classes incorporated instruction of attention strategies that may help a person to ''fall well''. Specific falling strategies discussed and practiced included: (1) reduction in overall body tension, allowing freely adaptive movement of the limbs, trunk, and neck as one experiences instability; (2) dispersion of weight by rolling or sequencing of body parts through transitions to the floor to reduce the force of impact; (3) use of quadruped positions while moving at floor level; (4) use of continuous, smooth flow of shifting weight between supports. All together, strategies were intended to teach participants that stability in balance is a skill of continuous adaptive movement, rather than of fixity, holding or prevention of movement. Rather than suggesting participants try to ''avoid falling,'' this workshop taught them how to fall more safely.

This CI workshop included several activities often used in conventional balance training. In the workshop, dancers were often encouraged — especially during early training — to close their eyes. This requires a reweighting of sensory inputs, placing a greater emphasis on vestibular, tactile, and proprioceptive sensation to properly maintain balance.[29] The workshop also included techniques of laterally shifting weight toward the limits of stability and standing on a single leg to challenge balance.

In addition to incorporating cognitive movement strategies and balance exercises, CI may also influence joint mobility and muscle strength, though this was not directly measured in the present study. One major focus of CI is the development of weight-sharing techniques. This is when one (or both) dancer pushes weight into a point of contact on his partner. Beginners start with non-weight-bearing contact, and then gradually transfer more weight onto their partner, balancing over a now enlarged base of support in a position outside their normal limits of stability. In order to control the amount of weight exerted on one's partner, CI dancers learn how to use limbs as counterweight ballast — a means of self-balance and body leverage widely applicable to everyday activities. Weight-sharing provides resistance both to the partner receiving weight, and the partner transferring weight, and has the potential to enhance muscle strength as a resistive exercise. With respect to joint mobility, CI techniques encourage the dancer to reach, stretch, and move through ranges not typically utilized in daily activity. Movement toward end-range ROM may be active or passive as dancers push and pull against each other, and has the potential to positively affect joint mobility.

Finally, this CI workshop incorporated cueing strategies of different types. These included rhythmical recurring cues that can influence gait cadence, and one-off cues that provide a focal point to maintain balance during transfers or to help reinitiate movement after freezing.[24] Cues can be visual, tactile, auditory, or cognitive. CI offers visual cues for people with PD to step over or around the limbs of their partner. Shared points of contact in CI may provide tactile cues to the partners and facilitate interaction through this shared site of stabilization or movement. CI techniques, such as rolling, pushing, pulling, or utilizing the negative space around the partner's architecture at any instant may provide cognitive cues for creating movement. Together, cognitive and tactile cues may help stimulate movement responses for people with PD.

Statistical analysis

Paired *t*-tests, using the Mee and Chua method,[22] were used to determine significant differences between pre- and post-test measures ($p = 0.05$) while accounting for regression toward the mean since the study lacked a control group. Regression toward the mean refers to the fact that, in the absence of any intervention, individuals who score poorly on initial evaluation will tend to score higher on a subsequent evaluation. Due to this phenomenon, one could incorrectly conclude that an intervention is effective if the statistical tests used do not account for regression toward the mean. The Mee and Chua[22] method employed herein does take into account the phenomenon of regression to the mean and as such provides a more appropriate evaluation of the effects of an intervention in the case of a study with no control group. Effect sizes (ES) were calculated for each measure. Median and interquartile scores were calculated for responses on the exit questionnaire.

Data comparisons between the contact improvisation workshop and a previous tango workshop[9] of the same frequency and duration were also conducted. Participants in this previous tango workshop were not different from the present CI participants in terms of age, disease duration, or disease severity. The tango sample included 12 people with PD whose average age was 67.2 ± 9.6 with an average disease duration of 9.1 ± 4.6 years and average Hoehn and Yahr score of 2.3 ± 0.4. Two-way repeated measures ANOVAs with Holms—Sidak posthoc tests determined statistical significance for comparisons between groups (contact improvisation vs. tango) and times (pre- and post-test) for the two dance workshops. ANOVAs were conducted using SigmaStat software (Systat, Chicago, IL).

Results

All participants completed the study. Significant improvements were seen in the BBS and UPDRS scores. Of the

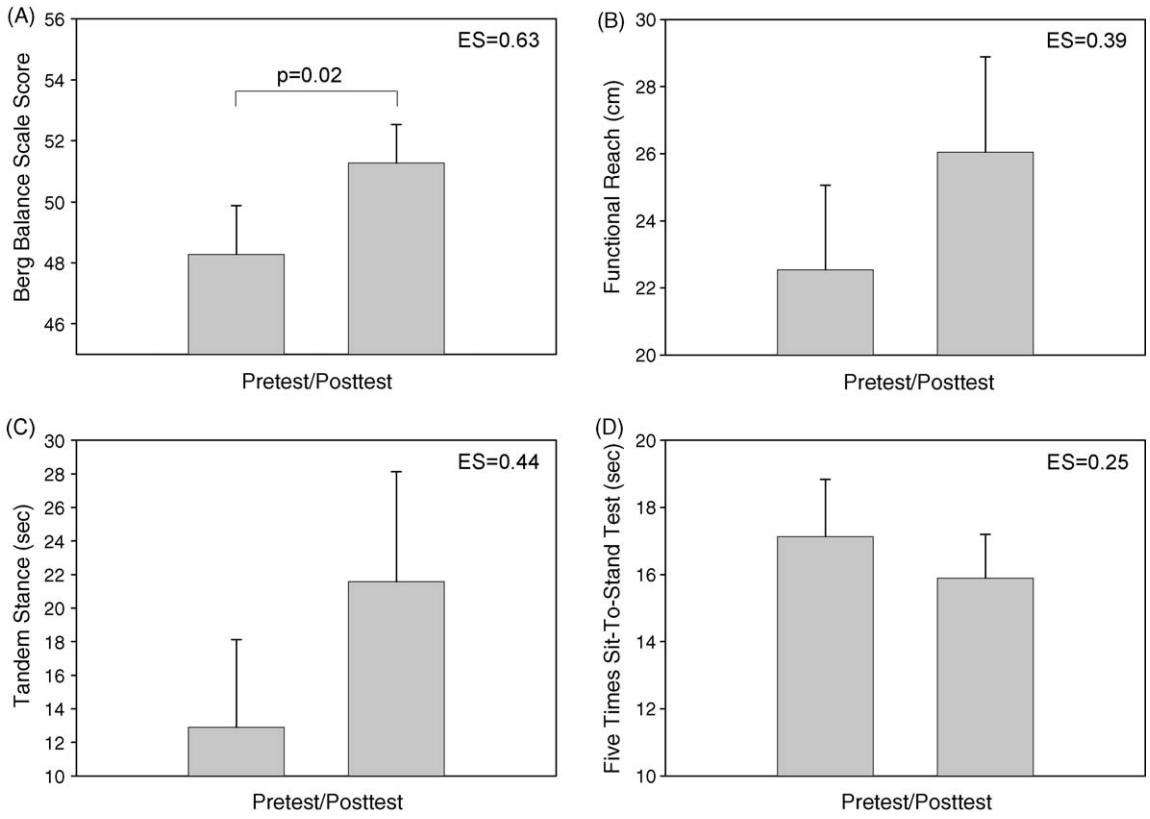

Figure 1 Functional mobility and balance measures before and after a 2-week intensive CI intervention. (A) Berg balance scores significantly improved. (B) Functional reach showed a non-significant trend toward improvement. (C) Tandem stance measure of balance showed a non-significant trend toward improvement. (D) Five times sit-to-stand test time did not demonstrate a significant change. ES = effect size. Error bars = standard error.

Table 1 Gait measures for forward, fast forward, and backward walking.

	Forward	Fast forward	Backward
Velocity (m/s)	Pre = 1.3 ± 0.05 Post = 1.3 ± 0.04 ES = 0.38	Pre = 1.8 ± 0.08 Post = 1.8 ± 0.07 ES = 0.22	Pre = 0.6 ± 0.07 Post = 0.8 ± 0.07 ES = 0.70
Step length (m)	Pre = 61.9 ± 2.4 Post = 62.8 ± 2.2 ES = 0.13	Pre = 71.5 ± 2.8 Post = 72.8 ± 3.0 ES = 0.15	Pre = 31.3 ± 3.5 Post = 35.8 ± 3.1 ES = 0.42
Cadence (steps/min)	Pre = 107.9 ± 2.0 Post = 111.2 ± 2.9 ES = 0.40	Pre = 129.9 ± 4.7 Post = 131.8 ± 4.6 ES = 0.12	Pre = 105.6 ± 4.8 Post = 118.5 ± 6.8 ES = 0.66
% Cycle in stance	**Pre = 64.1 ± 0.26** **Post = 63.57 ± 0.33** **ES = -0.48***	Pre = 61.6 ± 0.30 Post = 61.2 ± 0.48 ES = −0.33	Pre = 67.5 ± 1.1 Post = 67.0 ± 0.87 ES = −0.14
% Cycle in swing	**Pre = 35.9 ± 0.26** **Post = 36.4 ± 0.33** **ES = 0.49****	Pre = 38.4 ± 0.30 Post = 38.8 ± 0.48 ES = 0.33	Pre = 33.2 ± 1.4 Post = 33.0 ± 0.87 ES = 0.05

Values are means ± standard errors. ES = effect size.
* $p = 0.018$.
** $p = 0.016$.

Table 2 Contact improvisation vs. tango forward walking comparison.

	Contact improvisation $n = 11$	Tango $n = 12$	p-Values
Berg	**Pre = 48.3 ± 1.6** **Post = 51.3 ± 1.3** **ES = 0.63** ***p* = 0.022***	**Pre = 47.8 ± 0.93** **Post = 50.6 ± 1.0** **ES = 0.83** ***p* = 0.007***	Group: NSD **Time: *p* = 0.000*** Group w/in pre: ND Group w/in post: ND
UPDRS	**Pre = 26.9 ± 3.5** **Post = 21.5 ± 2.0** **ES = −0.57** ***p* = 0.016***	**Pre = 32.9 ± 2.1** **Post = 28.3 ± 2.0** **ES = −0.63** ***p* = 0.029***	Group: NSD **Time: *p* = 0.000*** Group w/in pre: ND Group w/in post: ND
6MWT (m)	Pre = 465.3 ± 20.5 Post = 469.1 ± 18.7 ES = 0.06 $p = 0.426$	Pre = 347.9 ± 22.3 Post = 383.7 ± 35.3 ES = 0.35 $p = 0.17$	**Group: *p* = 0.004*** Time: NSD **Group w/in pre: *p* = 0.003*** **Group w/in post: *p* = 0.024***
TUG (s)	Pre = 9.6 ± 0.60 Post = 9.1 ± 0.54 ES = −0.27 $p = 0.055$	Pre = 13.1 ± 1.7 Post = 11.1 ± 1.4 ES = −0.38 $p = 0.11$	Group: $p = 0.058$ Time: $p = 0.222$ Group × time: $p = 0.456$
Stance % (forward)	**Pre = 64.1 ± 0.26** **Post = 63.6 ± 0.33** **ES = −0.48** ***p* = 0.018***	**Pre = 65.4 ± 0.54** **Post = 63.6 ± 1.8** **ES = −1.0** ***p* = 0.003***	Group: ND **Time: *p* = 0.010*** **Group w/in pre: *p* = 0.036*** Group w/in post: ND
Swing % (forward)	**Pre = 35.9 ± 0.26** **Post = 36.4 ± 0.33** **ES = 0.49** ***p* = 0.016***	**Pre = 34.6 ± 0.54** **Post = 36.8 ± 0.88** **ES = 0.88** ***p* = 0.021***	Group: NSD **Time: *p* = 0.029*** Group w/in pre: ND Group w/in post: ND
Backward step length (cm)	Pre = 31.3 ± 3.5 Post = 35.8 ± 3.1 ES = 0.42 $p = 0.096$	Pre = 29.4 ± 3.7 Post = 36.8 ± 4.7 ES = 0.51 $p = 0.08$	Group: NSD **Time: *p* = 0.002*** Group w/in pre: ND Group w/in post: ND

Values are means ± standard errors.
Two-way RM-ANOVAs with Holm—Sidak posthoc tests determined differences between groups ($p = 0.05$).
ND = no difference.
* $p \leq 0.05$

other functional mobility and balance measures, functional reach and tandem stance demonstrated non-significant gains (Fig. 1). Percentage of the gait cycle spent in stance decreased significantly and percentage of the gait cycle spent in swing increased significantly. Step length in backward walking also increased, though not significantly (Table 1). Refer to Table 2 for other mobility measures.

There were no significant differences between the results from the contact improvisation workshop and those following a similar tango workshop (Table 2). Both dance interventions produced improvements in BBS, UPDRS, and percentage of the gait cycle spent in both stance and swing phase, with smaller improvements in backward walking step length.

Discussion

This pilot study explored the feasibility and therapeutic possibilities of CI as therapy for individuals with PD, demonstrating that CI is a feasible and potentially beneficial intervention for individuals with PD. Improvements noted with participation in CI appear to be similar to those obtained through tango, another form of dance that has been studied previously as a therapeutic intervention for those with PD. This study is novel in that it is the first to scientifically evaluate the therapeutic effects of therapy. This pilot work sets the stage for future studies with larger samples and appropriate control groups.

Comparison to previous studies

Argentine tango has been demonstrated effective as an exercise program for the improvement of functional mobility and balance in people with PD. Compared to other forms of exercise, tango may be more enjoyable and may make greater contributions to health-related quality of life.[26] Furthermore, gains in balance have been seen with as little as 2 weeks of intensive tango intervention.

Tango is considered as an improvisational dance. The leading partner is free to sequence movement patterns and interpret music tempo, exercising substantial freedom and latitude while dancing. However, before such freedom

is possible, both partners must first learn numerous footwork patterns, during which specific steps are performed in succession according to rhythmical timing. This skill requires rapid integration of somatosensory information, cognitive planning, and motor output. The memorization and execution of tango steps may be difficult for some learners, perhaps more so for people with PD who may have impaired sensorimotor integration. In contrast, CI's improvisational nature makes transmission quick since there is no set vocabulary to learn; one can begin to practice it almost immediately. The lowered importance of public performance in CI also expands the range of ''acceptable bodies'' able to do the dance form.[28] CI may therefore be a more easily and immediately accessible alternative for some people with PD.

Additionally, because CI's style is not based on visual appeal, but rather in functional physics, practice of CI teaches a person to spontaneously adapt to surprises with natural, efficient uses of body leverage and weight redistribution. Once learned, skills may be easily practicable at home, and also potentially generalized to everyday activities.

Given the similar, positive effects upon functional mobility and balance, both CI and tango appear to be appropriate interventions for people with PD. 6 of the 11 individuals in the CI study had also participated in previous tango studies. These individuals had participated in tango no more recently than 12 months prior to the CI study, and none had been dancing in the year leading up to the CI study. When asked to compare their experiences, the 6 subjects who had participated in both the present CI and previous tango studies commented primarily on the difference in learning style. Only one person commented that she preferred following specific instructions. However, the overwhelming majority of responses indicated a preference for CI over tango. Comments included, ''Tango had too much concentration on memorizing steps. I felt much more at ease in the contact improvisation class,'' ''[CI] encouraged self expression/individual movements,'' and ''Contact improvisation far exceeded [tango] in enabling me to move freely.''

For any intervention to be effective, compliance is essential and participant enjoyment is critical. All 11 participants completed the CI intensive workshop, dancing in 10 1.5-h classes over a period of 2 weeks. In the exit questionnaire, participants ''strongly agreed'' with both of the statements ''I enjoyed participating in this exercise program,'' and ''If classes continued to be offered I would keep participating.'' Based on the study's positive feedback and remarkably low attrition rate, it can be suggested that contact improvisation is a feasible intervention for people with PD and may have potential for application in community settings.

Strengths and limitations

This is the first study to explore the therapeutic potential of CI. This exploration of novel forms of dance is important because CI, as compared to many other partnered dance forms, may be more accessible to people of differing physical and cognitive ability levels. CI may be specifically and ideally suited for those with PD because it incorporates all four of the elements recommended for PD-specific exercise programs. The teaching of strategies for falling may be particularly important in PD, as fear of falling may itself contribute to future falls.[1,27] Contact improvisation emphasizes falling as a skill to develop rather than an error to be avoided.[28] If such strategies and skills increase confidence, fear of falling may be reduced, which may in itself reduce potential falls. And when falling cannot be avoided, it may be accomplished more gently, reducing impact, minimizing risk of injury. CI is, by its improvisational nature, also ideally suited to provide challenging and unpredictable postural perturbations, as induced by physical contact with a partner. Training a person to make quick adaptations to unanticipated changes in their environment or their own postural alignment mimics the real world situations that may create falls.

This study is limited by the lack of a control group and the use of historical tango data for comparison, rather than randomization to CI and tango. In addition, it is unclear whether confounding factors may have contributed to the improvements we note. The administration of this study employed a professional CI teacher with 13 years experience, as well as previously trained student CI dancers as partners for the participants with PD. Further study is needed to determine if these factors are necessary to gain the benefits observed. Additional consideration should be given in adapting CI training methods to populations with PD. Although principles and practice of CI are easy for beginners to learn, PD communities wishing to practice this form may want to consider the potential significance of skilled instruction and partnering to ensure safe progression of training.

Implications and future directions

While this work suggests that CI may be considered as an alternative approach to exercise for those with PD and perhaps for other populations, as an uncontrolled pilot study we can only surmise why CI may improve balance and functional mobility. Further studies are needed to determine the neurological effects of activities like CI. CI may be beneficial not only for people with PD but also for a general elderly population in addressing concerns associated with aging including (but not limited to) loss of flexibility/mobility, loss of motor control/balance, and depression associated with diminished social interaction and touch deprivation.[30] CI promotes continuous, large-surface tactile connection between dance partners that, when introduced gradually, is comfortable and non-threatening. During our workshop, several participants casually reported that the physical contact was among CI's main value to them, whereas touch is diminished in their lives. CI offers an activity that provides such a high ''dose'' of mutual human contact that is not inherently combative or sexual. Thus contact improvisation may be well suited for working with elderly people to improve overall quality of life.

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