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Blindfolded for Science: An Integration of Dance as Therapy for Visually Impaired or Blind Individuals

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Blindfolded for Science:

An Integration of Dance as Therapy for Visually Impaired or Blind Individuals

By
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ABSTRACT

Sight is used by our brain as a connecting bridge between other sensory input and stimuli from the world. Since humans are visual creatures, we heavily rely on vision to interact with our environments. Because of this role, impaired vision can diminish a person's confidence in movement, introducing an increased fear of falling ultimately impacting posture. Previous research suggests that these limitations can be overcome through the use of Dance/Movement Therapy, a current form of psychological therapy. Although beneficial to the mental health of participants in the American Dance Therapy Association, the physical effects that dance can have on the human body when visually impaired are not as thoroughly examined. This project investigated the sport of dance and compared the effects that vision state and dance experience had on orientation and posture. Students with minimal dance experience were compared to students with extensive dance experience both before and after one month of blindfolded dance training. They were also compared to students with minimal dance experience who were sighted during the dance training. Although not significant, the blindfolded dance training appeared to improve posture and orientation and is promising as a form of physical therapy for visually impaired or blind individuals, however further research is necessary.

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INTRODUCTION

BACKGROUND

In 1990, there was a global population of 38 million blind and about 6 times that number (110 million) were visually impaired and at risk for completely losing their sight (Thylefors et al. 1995). The number of blind individuals across the globe has since decreased by about 2 million by 2017 but increased in individuals with moderate to severe visual impairments by 107 million, which totals to about 3% of the world population living with vision impairment (Bode 2017). Visual impairment increases the probability of unemployment, depression and anxiety disorders, being in a vehicle collision, and the likelihood of falling (WHO 2017). Although blindness and vision impairments directly affect the individual, the physical and psychological implications also negatively impact the quality of life for their families (WHO 2017). Despite solutions in place and progress made, the impact of blindness remains.

Although all sensory systems are important for full human function and interaction, vision exceeds as the dominating sense. Politzer (2008) and other researchers (Better Vision 2012) calculated that 80-85% of our cognition and activities are facilitated through vision. In fact, majority of human activities are dependent on sight (WHO 2017). Not only does sight allow processing of visual information but it also acts as a connecting bridge between visual and other sensory input to assist in understanding external stimuli. Due to the magnitude of visual reliance, removal or loss of sight introduces a plethora of challenges that are often difficult to overcome. Though there are many types of limitations such as mental/psychological, emotional, and social, the physical restrictions are most important to examine for this study.

Lacking optimal vision diminishes an individual's ability to effectively interact with one's environment, affecting aspects of movement that are naturally compensated with posture such as gait, balance, and orientation (Alotabi et. al. 2016). Due to the physical restrictions, movement confidence also declines when vision is impaired. An evaluation on the relationship between confidence and posture, by Briñol and others, found that the two were directly proportional: as confidence decreases, posture decreases (Briñol et al. 2009). Correction of posture in blind individuals is suggested to be most effective when treated with a multidisciplinary approach (Alotabi et al 2016). An exceptional approach would be to combine the advantages of art and science through the integration of dance as a physical therapy. Dance has many known health benefits but most research using dance as therapy for blind or visually impaired individuals focuses more on the mental and psychological wellness than the physical benefits. Mental and psychological wellness is more associated with the artistic part of dance while the physical benefits are more correlated with the athletic portion of dance. A dance therapy currently practiced for the visually impaired or blind individuals is called Dance/Movement Therapy (DMT). DMT is defined as the "psychotherapeutic use of movement to promote emotional, social, cognitive, and physical integration…for the purpose of improving health and well-being" (Welling 2014). Although DMT was developed with the idea of improving physical abilities using therapeutic dance and movement, their analyses focus more on psychological health improvements.

PURPOSE

The purpose of this study was to investigate the sport of dance and compare the effects that dance experience and vision state have on orientation and posture. Loss of optimal vision decreases the individuals' movement confidence, which ultimately has a negative effect on their posture. Thus, I chose to examine orientation and posture. There were two main questions considered; what effects does dance experience have on orientation and posture and what effects does vision state have on orientation and posture?

HYPOTHESIS AND PREDICTIONS

I expect both dance experience and vision state to have a positive effect on orientation and posture. In other words, the more dance experience and blindfolded training, the better orientation and posture. I predict that prior to the experimental dance training, the dancers should have more accurate orientation and better posture than the non-dancers. There should be no initial difference in orientation and posture between the two non-dancer groups. Orientation and posture is expected to improve for all groups after the month-long dance training, however, the blindfolded non-dancers should show greater improvements than both blindfolded dancers and sighted non-dancers.

METHODS

RECRUITMENT

The first steps included recruiting volunteer students between the ages of 18 and 35 from Western Oregon University using flyers and all-student emails (see flyer in appendix). Both the email and flyers included a brief, slightly deceptive description of my thesis to avoid leading participants to purposefully focus on the factors under study; orientation and posture. Rather than disclosing my actual thesis, I used the deception that I was “studying to see if we can use eye-closed dance training to overcome the visual limitations we have as humans”. In addition to the deceptive description, I altered the title to “Blindfolded for Science: Eye-closed Training for Dancers” to better fit the deception. After recruiting, volunteers accessed the online survey via the link provided on the flyers or in the email. The online survey covered the individual's mobility, sensory ability, restrictions, as well as dance experience (see online survey in appendix).

Criteria for selection of volunteers were based on the sensory abilities such as audioception (hearing) and ophthalmoception (vision). Because I was testing for effects of vision, the subjects needed full visual operation or at least have and use corrective devices such as contact lenses or prescription glasses during the study. Full audioception was important to control since blindfolded groups needed to use their other senses in replacement of vision during the training and testing. The sensory abilities of each participant were not directly tested for but instead based on responses to the survey questions.

A pool of 17 volunteers were split into two categories based on previous dance experience; 6 volunteers into the "dancer" group and 11 into the "non-dancer" groups. The "dancer" group included participants who have 3 or more years of experience dancing at a studio, on a dance team, or have taken 3 or more dance courses at a university. Volunteers who had less than three years of experience in a dance studio, dance team, or have taken less than 3 dance courses were placed in the "non-dancer" groups. Non-dancers were then separated by sight; 7 volunteers in the "sighted" group, the other 4 in the "blindfolded" group. Since there weren't enough dancers to separate into two groups, all 6 dancer participants were placed in a "blindfolded" group. The sighted dancer group was not as important for this study because there is enough research on the physical benefits of dance with sighted dancers as the subjects. Separation of volunteers into blindfolded and sighted groups was based on availability during practice times. At this stage, I had three groups: blindfolded dancers, blindfolded non-dancers, and sighted non-dancers. In attempt to ensure accuracy of results, I asked all volunteers to refrain from practicing at home or sharing information about their trainings or testing to other volunteers.

TESTING AND TRAINING

Individuals were assessed through various movement tests that measured orientation and posture before the dance training. Orientation was measured using two different movement routines to record their ability to walk in a straight line and ability to orient themselves correctly in space by performing angle changes largest to smallest

(360°, 180°, 90° and 45°). Posture was measured using a simple analysis of both head and shoulder positions while stationary. All tests were recorded with three action cameras located accordingly: front-facing, side-facing, and aerial-suspended cameras. Regardless of which group participants were placed in (blindfolded or sighted), they were blindfolded during all movement tests for both the pre-tests and post-tests. Before the testing began, I placed dots on 4 points on both side of the participants bodies to ensure more accurate postural and orientational measurements (Fig. 1).

First, to minimize parallax, I positioned participants in the center of all three cameras to face the front camera, then instructed them to stand still while I “prepared” the cameras. While they stood, I distracted them by discussing what was going to happen next but recorded them to later use for the postural analysis. In between each movement test I guided and positioned participants with their toes lined up with the “start” line marked on the floor so they stood directly in front of and faced the front-facing camera. To test their ability to travel in a straight line, they were instructed to walk forward as naturally as possible until told to stop. To test their angle change abilities, participants were instructed to walk forward three steps, pause for two seconds, turn the specified angle, then walk forward three more steps. This occurred directly beneath the aerial camera.

After pre-testing, groups came in independently for dance training. Practices ran one hour per week for a total of four weeks. The dance training began with a short warm-up and the remainder of the hour was spent learning the dance routine. Blindfolded dancers and blindfolded non-dancers were both blindfolded during this training, while the sighted non-dancers were trained without blindfolds. Teaching techniques remained identical for each group, which included primarily verbal instruction and, if needed, instruction using physical-contact demonstrations. For example, if I was explaining to the group to stretch their right arm above their head at a 45-degree angle and they were struggling to understand the explanation, I would ask for permission then guide their arm to the correct location. Although techniques were consistent, it is important to note that each group needed varying amounts of verbal and physical instruction. After the month-long training, individuals were given post-tests identical to the pre-test. Following the post-test for each participant, I did a private deception debrief with each individual informing them of the deception, purpose of deception, true factors under study, and gave them an opportunity to withdraw from the study (see deception debrief in appendix).

DATA EXTRACTION AND ANALYSIS

The movement analysis software, Kinovea, was used to analyze and extract measurements from the video recordings (Charmant 2006). Head position was measured as the angle from ear-shoulder-hip while shoulder position was measured as the angle from shoulder-hip-ankle bone using the dots as guidance to those points on their bodies (Fig. 1). All postural measurements were taken from the side-facing camera recordings while the subjects were asked to stand still to ensure the most accurate profile positioning. To measure their ability to travel in a straight line, the angle was measured between the ideal path and the actual path taken (Fig. 2). As for the angle changes, a line was drawn across the shoulders and a 90-degree angle was placed on top to represent the individual's heading. The same was done after they completed the angle change. The angle between those two headings was recorded and used to calculate the percent error for each of the four angle changes (Fig. 3). Data for all angle changes were extracted from the aerial-suspended camera recordings for a "birds-eye-view" to allow more accurate angle measurements.

ANOVAs were run comparing the three groups for each of the measurements for pre-test and post-tests. Although there were three distinct treatments, the predictions required comparisons between only two groups at a time. Thus, t-tests were run regardless of the one-way ANOVA results. Unpaired t-tests assuming unequal variances

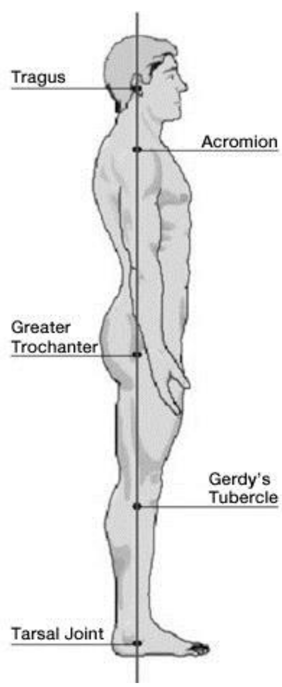


Figure 1. Diagram of points used for postural analysis.

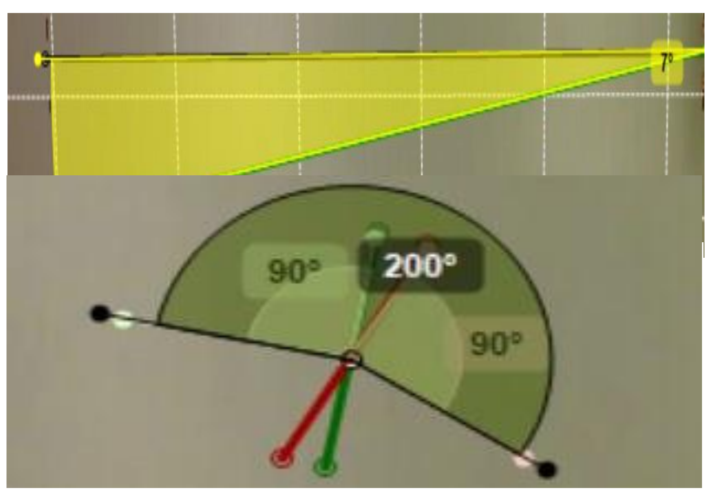


Figure 3. Technique used to measure angle changes. Green objects represent the initial heading and red objects represent heading after the angle change. Black angle measures the actual angle rotated.

were run for each measurement, comparing pre-test results between blindfolded dancers and sighted non-dancers (to compare effects of dance experience) and between blindfolded non-dancers and sighted non-dancers (to compare effects of vision state). The same t-tests were run comparing the post-test data between those same group pairings. To analyze the effect that dance training had on each group, paired t-tests were run comparing the pre-tests to post-tests for each group.

RESULTS

ONE-WAY ANOVAS

The pre-test one-way ANOVAs for both orientation and posture were not significant except for the 45° angle and shoulder position (Table 1). All one-way ANOVAs for post-test orientation and posture were not significant among treatments (Table 1). The remainder of the results section focuses on first comparing the effects of dance and then the effects of sight on orientation and posture using t-tests to determine significance. All patterns in the data are described along with corresponding p-values and significant results ($p < 0.05$) are noted where applicable.

Table 1. P-values for one-way ANOVAs comparing the blindfolded dancers (BD), blindfolded non-dancers (BN), and sighted non-dancers (SN) before and after the dance training for each postural and orientational measurement. The * represents a significant p-value ($p < 0.05$).

	Deviation Angle	360°	180°	90°	45°	Head Position	Shoulder Position
Pre-Test	0.4513	0.8860	0.1379	0.1672	0.0311*	0.7738	0.0167*
Post-Test	0.0973	0.6409	0.0612	0.5766	0.3818	0.6123	0.4433

DANCE EXPERIENCE

ORIENTATION: PRE-TEST

There was no significant difference in initial ability to travel in a straight line or rotating a 360° between the blindfolded dancer (BD) and blindfolded non-dancer (BN) groups (Fig. 4A, 4B; p = 0.43 and 0.45). The blindfolded dancers performed more accurate 180° angle changes than the blindfolded non-dancers (Fig. 4C; BD=6.48 +/- 5.6%, BN=10.8 +/- 5.1%; p=0.089). Reversing this pattern, the blindfolded dancers performed significantly less accurate 90° angle changes with about twice the percent error of the blindfolded non-dancers (Fig. 4D; BD= 16.5 +/- 5.1%, BN= 8.2 +/- 9.1%; p= 0.034). About the same results occurred for the 45° angle change where the dancers had twice the error of the blindfolded non-dancers (Fig. 4E; BD= 24.8 +/-25.6%, BN=12.4 +/- 7.2%; p=0.15).

ORIENTATION: POST-TEST

The deviation angle for blindfolded dancers was about half that of the blindfolded non-dancers for the straight-line test (Fig. 4A; BD= 4.7 +/- 4.3, BN= 8.6 +/- 5.0; p=0.080). Similar to the pre-test, the two groups ability to rotate a 360° were about the same (Fig. 4B; p=0.38). In contrast, there was a significant difference between the blindfolded dancers and blindfolded non-dancers 180° rotation where the blindfolded dancer percent error was about triple the non-dancer percent error (Fig. 4C; BD = 13.6 +/- 8.4%, BN= 4.7 +/- 4.2%; p= 0.025). Percent errors for both the blindfolded dancer and non-dancer groups were about the same for the 90° angle change (Fig. 4D; p= 0.29).

The blindfolded dancers rotated the 45° angle more accurately than the blindfolded non-dancers (Fig. 4E; BD= 15.6 +/- 21.4%, BN= 26.0 +/- 19.8; p=0.19).

ORIENTATION: PRE-TEST vs POST-TEST

The blindfolded dancer's ability to travel in a straight line increased in accuracy following the blindfolded dance training (Fig. 4A; pre= 8.2 +/- 7.7, post= 4.7 +/- 4.3; p= 0.21). On the other hand, the blindfolded non-dancers stayed about the same (Fig. 4A; p=0.29). Although both the blindfolded dancers and blindfolded non-dancers 360° angle change improved, the blindfolded non-dancers had a greater improvement (Fig. 4B; BD=10.7 +/- 7.7% to 8.5 +/- 9.3%, BN= 11.71 +/- 17.6% to 7.3 +/- 4.2%; p= 0.33 and 0.25). The blindfolded dancers' percent error doubled for the 180° rotation (Fig. 4C; pre= 6.5 +/- 5.6%, post=13.6 +/- 8.4%; p= 0.048). On the other hand, the blindfolded non-dancers 180° rotation significantly improved (Fig. 4C; pre=10.8 +/- 5.1%, post= 4.7 +/- 4.2%; p= 0.005). Both the blindfolded dancers and non-dancers decreased in accuracy for rotating a 90° angle (Fig. 4D; p= 0.32 and 0.23). As for the 45° angle change, the blindfolded dancer group increased in accuracy while the non-dancers' percent error almost doubled (Fig. 4E; BD= 24.8 +/- 25.6% to 15.6 +/- 21.4%, BN= 12.4 +/- 7.2% to 26.0 +/- 19.8%; p= 0.25 and 0.034).

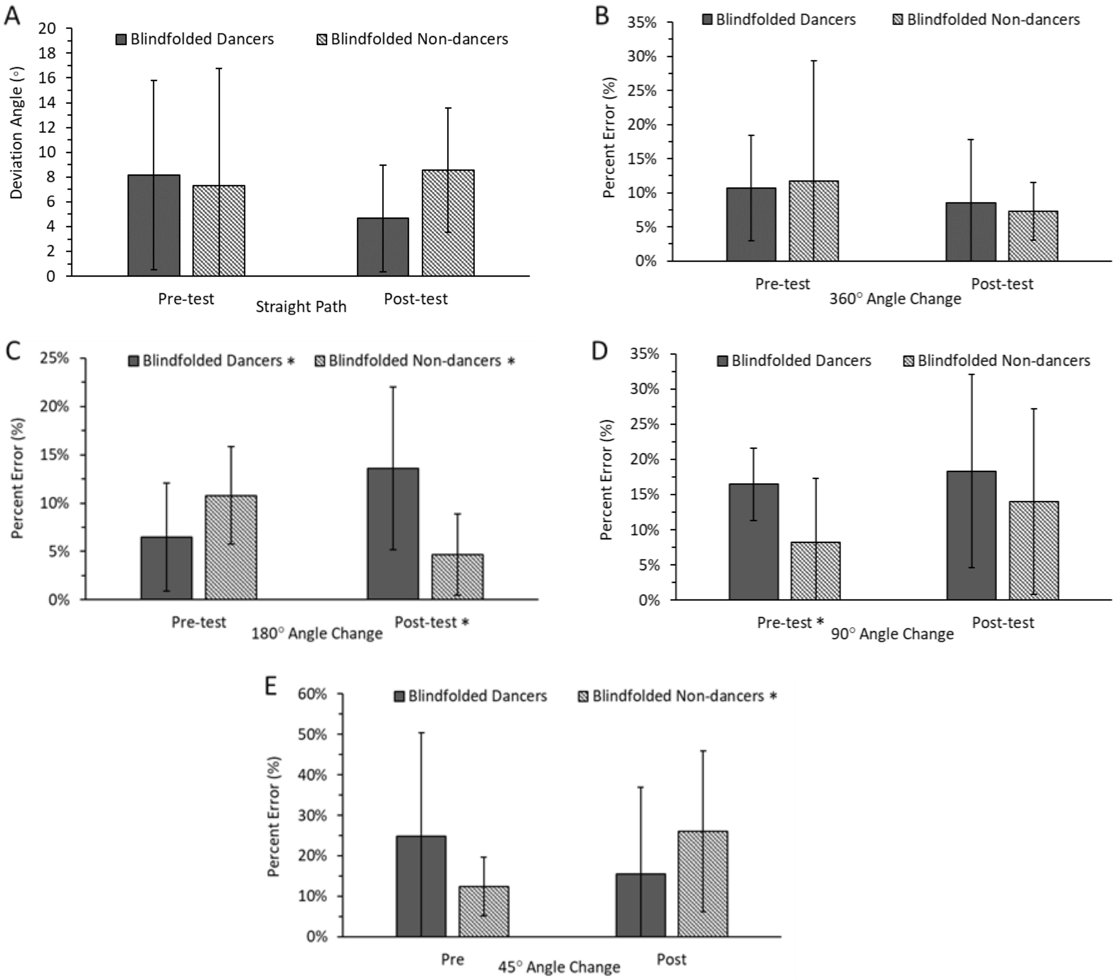


Figure 4. Compares effects that blindfolded dance training and previous dance experience had on orientation. A) Average deviation from a straight path. B) Average percent error for rotating a 360° angle. C) Average percent error for rotating a 180° angle. D) Average percent error for rotating a 90° angle. E) Average percent error for rotating a 45° angle. Error bars represent standard deviation and * represents p-value < 0.05 ($n_{BD}=6$, $n_{BN}=7$; note that the scales vary across figures)

POSTURE: PRE-TEST

Head position for both blindfolded dancer and non-dancer groups were almost the exact same (Fig. 5A; p= 0.41). The blindfolded dancers' shoulder position was initially better than the blindfolded non-dancers (Fig. 5B; BD= 1.5 +/- 0.8%, BN= 2.8 +/- 1.9%; p= 0.072).

POSTURE: POST-TEST

Head position was about the same for both blindfolded groups (Fig. 5A; p= 0.45). Shoulder position after the blindfolded training was less accurate for the blindfolded non-dancer group than the blindfolded dancer group (Fig. 5B; BD= 3.7 +/- 2.2%, BN= 5.2 +/- 2.6%; p= 0.14)

POSTURE: PRE-TEST vs POST-TEST

Head position was similar between the pre-test and post-test for both blindfolded dancer and non-dancer groups (Fig. 5A; p= 0.42 and 0.38). Accuracy of shoulder posture significantly declined for both the blindfolded dancer and blindfolded non-dancer groups (Fig. 5B; BD= 1.5 +/- 0.8% to 3.7 +/- 2.2%, BN= 2.8 +/- 2.0% to 5.2 +/- 2.6%; p= 0.020 and 0.034).

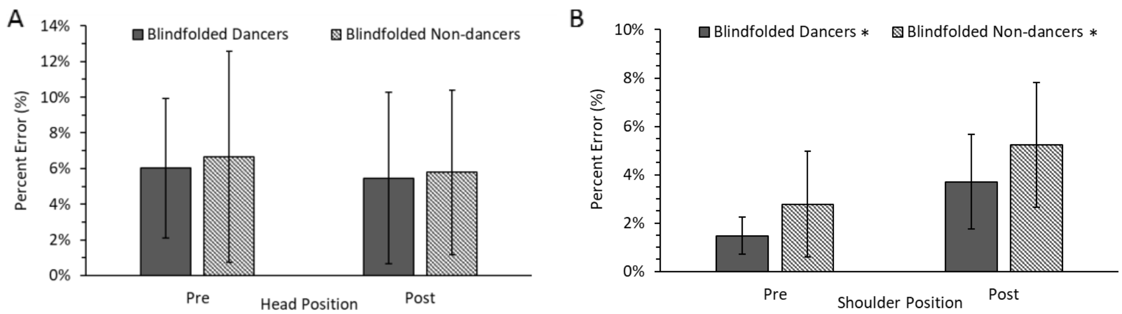


Figure 5. Compares effects that blindfolded dance training and previous dance experience had on posture. A) Average percent error of head position (measured ear-shoulder-hip; Fig. 1). B) Average percent error of shoulder position (measured shoulder-hip-ankle; Fig. 1). Error bars represent standard deviation and * represents p-value < 0.05 (n_{BD}=6, n_{BN}=7; note that the scales vary across figures)

VISION STATE

ORIENTATION: PRE-TEST

The blindfolded non-dancers deviated from a straight path more than the sighted non-dancers (SN) (Fig. 6A; BN= 7.3 +/- 9.5, SN= 2.0 +/- 2.2; p= 0.10). Both non-dancer groups had similar percent errors for the 360° and 90° angle changes (Fig. 6B and 6D; p= 0.37 and 0.32). Conversely, there was a significant difference between the non-dancer groups for the 180° angle change where the sighted group were more accurate (Fig. 6C; BN= 10.8 +/- 5.1%, SN= 4.9 +/- 2.5%; p= 0.015). In general, the sighted non-dancers had an error for the 45° angle change that was about 8 times greater than the blindfolded non-dancers (Fig. 6E; SN= 95.6 +/- 92.7%, BN= 12.4 +/- 7.2%; p= 0.086).

ORIENTATION: POST-TEST

After the dance training, the blindfolded non-dancers had a larger percent error than the sighted non-dancers for the straight-line test (Fig. 6A; BN= 8.6 +/- 5.0%, SN= 2.8

+/- 1.3%; p= 0.011). Both non-dancer groups had similar errors in rotating both a 360° and 180° angle (Fig 6B and 6C; p= 0.18 and 0.36). For the 90° angle change, the percent errors were also about the same (Fig. 6D; p= 0.26). In contrast from this pattern, the blindfolded non-dancers' average accuracy was better than the sighted non-dancers' for the 45° angle change (Fig. 6E; BN= 26.0 +/- 19.8%, SN= 67.8 +/- 119.4%; p=0.27).

ORIENTATION: PRE-TEST vs POST-TEST

Deviations from a straight path before and after the dance training were the about same for both the blindfolded and sighted non-dancer groups (Fig. 6A; p= 0.29 and 0.30). Both non-dancer groups increased in accuracy for rotating a 360° angle after the dance training (Fig. 6B; BN= 11.7 +/- 17.6% to 7.3 +/- 4.2%, SN= 15.2 +/- 16.3% to 4.5 +/- 4.4%; p= 0.25 and 0.11). The two non-dancer groups had opposite results for both the 180° and 45° angle changes. For the 180° rotation, the blindfolded non-dancers significantly improved in accuracy while the sighted non-dancers slightly declined (Fig. 6C; BN= 10.8 +/- 5.1% to 4.7 +/- 4.2%, SN= 4.9 +/- 2.5% t0 6.0 +/- 6.1%; p= 0.005 and 0.36). On the other hand, the blindfolded non-dancer group significantly declined in accuracy for the 45° angle change while the sighted non-dancers accuracy increased Fig. 6E; BN= 12.4 +/- 7.2% to 26.0 +/- 19.8%, SN= 95.6 +/- 92.7 to 67.8 +/- 119.4; p= 0.034 and 0.30). As for the 90° angle change, the blindfolded non-dancers declined in accuracy while the sighted group stayed about the same (Fig. 6D; BN= 8.3 +/- 9.1% to 14.0 +/- 13.2; p= 0.23 and 0.38).

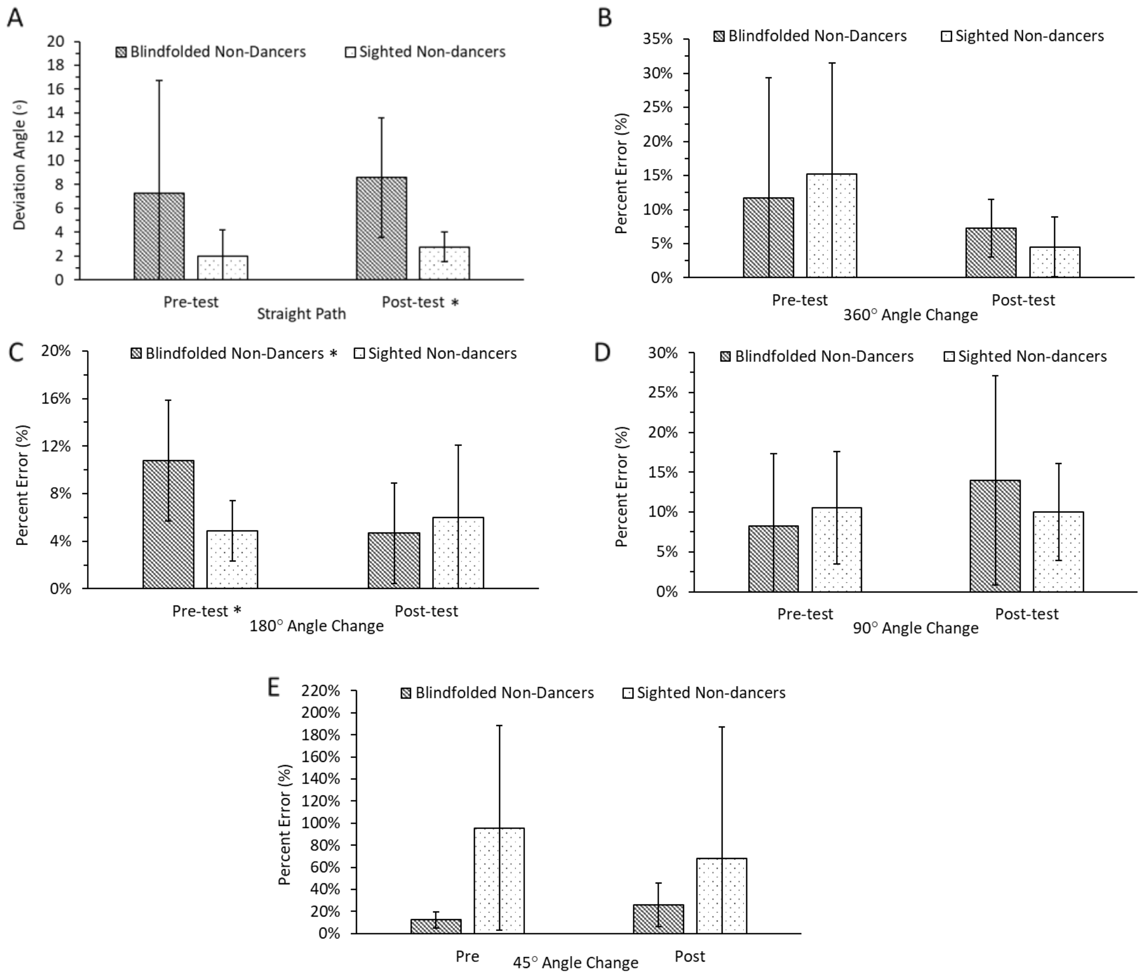


Figure 6. Compares effects that dance training and vision state had on orientation. A) Average deviation from a straight path. B) Average percent error for rotating a 360° angle. C) Average percent error for rotating a 180° angle. D) Average percent error for rotating a 90° angle. E) Average percent error for rotating a 45° angle. Error bars represent standard deviation and * represents p-value < 0.05 (n_{BN}=7, n_{SN}=4; note that the scales vary across figures)

POSTURE: PRE-TEST

Head posture of the two non-dancer groups was about the same (Fig. 7A; p= 0.21). However, shoulder position was more accurately aligned in the blindfolded non-dancers than the sighted non-dancers (Fig 7B; BN= 2.8 +/- 2.0%, SN= 5.0 +/- 2.0%; p= 0.06).

POSTURE: POST-TEST

The head position for the blindfolded non-dancer group was less accurate than the sighted non-dancer group (Fig. 7A; BN= 5.8 +/- 4.6%, SN= 3.5 +/- 3.3%; p= 0.18). Shoulder position, however, was the about the same for both non-dancer groups (Fig. 7B; p= 0.47).

POSTURE: PRE-TEST vs POST-TEST

Head position accuracy slightly increased from pre-test to post-tests for both non-dancer groups (Fig. 7A; BN= 6.7 +/- 5.9% to 5.8 +/- 4.6%, SN= 4.6 +/- 1.9% to 3.5 +/- 3.3%; p= 0.38 and 0.29). The blindfolded non-dancers' shoulder position significantly declined further from ideal (Fig. 7B; pre= 3.0 +/- 2.0%, post= 5.0 +/- 2.6%; p= 0.034). Shoulder position for the sighted non-dancers, however, stayed the same (Fig 7B; p= 0.46).

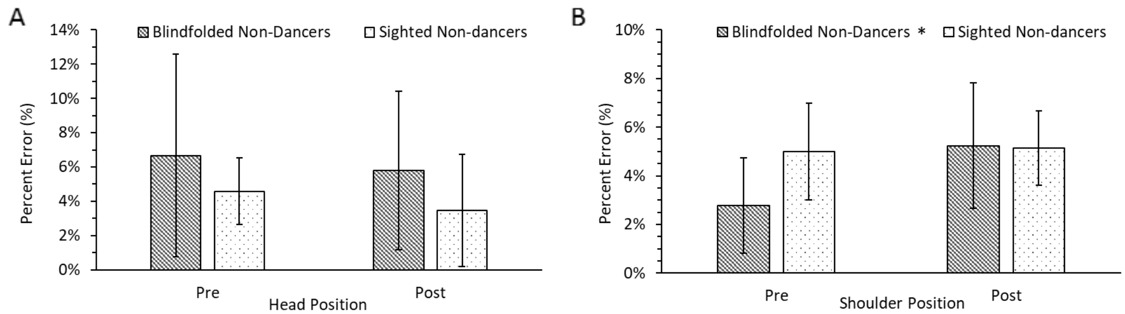


Figure 7. Compares effects that dance training and vision state had on posture. A) Average percent error of head position (measured ear-shoulder-hip; Fig. 1). B) Average percent error of shoulder position (measured shoulder-hip-ankle; Fig. 1). Error bars represent standard deviation and * represents p-value < 0.05 (n_{BN}=7, n_{SN}=4; note that the scales vary across figures)

DISCUSSION

DANCE EXPERIENCE

ORIENTATION: PRE-TEST

Because dance is known to improve orientation, I expected the experienced dancer group to have more accurate initial results for each of the movement tests than the non-dancers. Previous dance experience seemed to have no effect in ability to travel in a straight line before blindfolded dance training (Fig. 4A). Although there was no initial difference, the dancers' ability to walk in a straight line improved by about 50% while the non-dancers declined (Fig. 4A). I predicted an initial difference between the dancers and non-dancer's orientation with more accurate orientation in the dancer group; however, this did not occur. Initially, the dancers were more accurate at rotating 360° and 180° angles but the differences in percent errors were not significant (Fig. 4B, 4C). On the other hand, the dancers were less accurate than the non-dancers for the initial straight-line and 45° and 90° angle change tests (Fig. 4A, 4D, 4E). Interestingly, the non-dancers were significantly more accurate at rotating a 90° angle before the blindfolded dance training (Fig. 4D).

Over the course of the experiment, the blindfolded dancers were more difficult to teach, and took longer to learn the dance routine than the blindfolded non-dancers; this lead to the realization that normal dance training is geared towards vision dependency. When a dancer is training, they rely on the mirrors for visual feedback (Hutt 2015). Although dance instructors give physical assistance to correctly position the dancers body, the dancers not only use muscle memory, but also use their reflections to make visual connections to supplement the memory. Muscle memory is less dependent on skeletal muscle and more dependent on the neural connections created when a specific movement is performed, which allows mindless performance of that very same task later (Shusterman 2011). In addition to the physical assistance, the choreographers commonly use visual demonstrations to teach the dancers. The aspect of mirrors/vision dependency as part of training in a regular dance class may be the reason the dancers in this study didn't have more accurate initial orientation than the non-dancers.

ORIENTATION: POST-TEST

I predicted that the blindfolded non-dancers would show greater improvements in orientation than the blindfolded dancers following the training. After the blindfolded dance training, the dancers' mean accuracy in traveling in a straight line and rotating 45° and 360° angles slightly improved, albeit not significantly (Fig. 4A, 4B, 4E). The dancers' mean accuracy in rotating 90° and 180° angles decreased (Fig. 4C, 4D). The blindfolded dance training also improved the non-dancers' mean ability to rotate 180° and 360° angles, with a significant improvement for their 180° angle change that was much greater than the dancers, who instead declined in accuracy (Fig. 4C). Their 360° angle change also showed a greater improvement than the dancers, but not significantly (Fig. 4B). Although not entirely conclusive, the non-dancers were generally less accurate with rotating the smaller angles (45° and 90°) than the larger angles (180° and 360°) (Fig. 4B, 4C, 4D, 4E). Overall, previous dance experience did not seem to have a significant effect on orientation either initially or after the blindfolded training.

POSTURE

Before training, I expected the experienced dancer group to have better posture than the non-dancers since they have greater dance experience. The two blindfolded groups had about the same initial head posture, yet the blindfolded dancers had slightly better head posture and about twice as more accurate shoulder posture than the blindfolded non-dancer group (Fig. 5). Overall, initial posture was better in the blindfolded dancer group (Fig. 5).

After the blindfolded training, I expected the blindfolded non-dancers to have greater postural improvements than the blindfolded dancers. The blindfolded non-dancers head posture only improved by about 1% while their shoulder posture declined significantly (Fig. 5). I found similar results for the blindfolded dancers where their head posture slightly improved, but their shoulder posture declined significantly (Fig. 5).

Although recently mentioned, it's important to note that the shoulder position for both the blindfolded groups declined significantly further from ideal after the blindfolded dance training (Fig. 5B). I will present a possible cause to this decline after discussing the effects that vision state had on posture.

VISION STATE

ORIENTATION: PRE-TEST

Vision state also seemed to not have a significant effect on orientation. I predicted there would be no initial difference in orientation between the blindfolded and sighted non-dancer groups. Although the statistics supported this prediction among most measurements, it is important to note the distinguished visual differences in initial straight-line deviation and 45° percent errors (Fig. 6A, 6E). The sighted non-dancers had significantly stronger results with their initial 180° angle change than the blindfolded non-dancers (Fig. 6C). The discrepancies in initial abilities may be due to the unequal sample sizes of 7 blindfolded non-dancers and 4 sighted non-dancers.

ORIENTATION: POST-TEST

After the dance training, the blindfolded non-dancers, who were blindfolded for both the testing and training, were expected to have greater improvements in orientation than the sighted non-dancers, who were sighted for the training yet tested while blindfolded. Statistically, this was only supported for the 180° angle change test where the blindfolded non-dancers show significant improvements and the sighted non-dancers had minimal change from initial (Fig. 6C). Like dance experience, vision state also had no significant effect on ability to travel in a straight line and rather than improving this ability, it declined for both the blindfolded and sighted non-dancer groups (Fig. 6A). Although the results were not significant, majority of the movement tests for the sighted non-dancers appeared to be more accurate after the dance training than the blindfolded non-dancers, with the exceptions of 45° and 180° angle changes (Fig. 6). Again, the small sample size of 4 for the sighted non-dancers is important to note.

POSTURE

Both the blindfolded and sighted non-dancers were expected to have similar postures before the dance training. Then, after the dance training, the blindfolded non-dancers were expected to have great improvements than the sighted non-dancers. Although not statistically significant, the sighted non-dancers were closer to the ideal head posture than the blindfolded non-dancers both before and after the dance training (Fig. 7A). Both blindfolded and sighted non-dancer groups head position improved after the training but neither of the improvements were significant (Fig. 7A). Interestingly, the sighted non-dancer group had better initial head position than the blindfolded non-dancers yet worse initial shoulder position (Fig. 7A, 7B). Shoulder alignment accuracy declined for both groups after dance training and their percent errors were almost the exact same (Fig. 7).

The post-tests were administered during the week of midterms for many of my participants, which is a factor I had not considered when scheduling my study. This may be the reason for the significant decline in shoulder position since midterms include an increase in study time and stress, both of which can influence posture. Another important note; one participant mentioned in conversation that their effort during the post-test was less than their effort for pre-test because of the developed familiarity. If efforts of other participant were similar, it likely affected all other post-test results as well.

CONCLUSION

Overall, previous dance experience did not influence orientation or posture. Almost all participants in the blindfolded dancer group had more than 5 years of dance experience but it would be interesting to see the results of professional level dancers compared to “non-dancers”. Additionally, the recency of their dance training may have impacted the results as well. A few dancers in the study had over 5 years of dance experience yet hadn’t taken dance classes in years. The results may have been different if all dancer participants were actively training during the study.

Although not significant, the blindfolded dance training appeared to slightly improve head posture and some aspects of orientation. As mentioned before, there was a difference in sample sizes between the two non-dancer groups due to my participants availability/schedules. Also, while previous research suggested that four weeks of blindfolded dance training was sufficient (Hutt 2015), I believe that either longer or more frequent practices, training for more than one month, or a combination of the three may be necessary for more accurate results.

Aside from Dance/Movement Therapy, there is no extensive research on how dance specifically affects sensory compensations in the visually impaired or blind. It was found that eye-closed dance training caused a switch from visual reliance to proprioceptive dependency in dancers (Hutt 2015). The switch to proprioception is connected to balance but suggests that removing sight allows a redirection of focus from one sense (the lost sense) to another. The redirection is similar to a neurological process called cross-modal plasticity that allows recruitment of neural connections from a lost sense to "enhance" other intact senses (Hoover et al. 2011). Research focusing on neural reorganization found that the loss of vision resulted in dramatic improvements in the brains integrative capabilities of multisensory neurons (Merabet and Pascual Leon 2010). Although the results of this study were not entirely conclusive, using dance as a form a physical therapy for visually impaired or blind individuals is promising; however, further research is necessary.

APPENDICES:

WOU INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL LETTER

Western Oregon
UNIVERSITY

September 13, 2017

TO: Karisa Merrill

RE: Project Title: Blindfolded for Science: An Integration of Dance as Therapy for Visually Impaired
IRB #: 957
Study approval period: September 13, 2017 – September 13, 2018

Dear Karisa,

On 9/13/17 the WOU Institutional Review Board (IRB) approved the above project protocol for the period indicated above. It was the determination of the IRB that your study qualified for expedited review based on the federal requirements for expedited category #7. This category is restricted to research that poses minimal risk to participants and includes research on individual or group characteristics or behavior utilizing survey, interview, or focus group methodology. No subjects may be involved in this study prior to the IRB approval date listed above.

It is your responsibility to report promptly to the WOU IRB any adverse events or unanticipated problems involving risks to subjects or others. Additionally, you must contact the WOU IRB prior to implementing any changes in your study which may have bearing on the rights and welfare of the research participants including change in design, population targeted, and/or consent process. Protocol modifications must be approved by the IRB prior to implementation. Finally, should your study exceed the study approval period noted above, your protocol must be reapproved. Please contact the IRB chair to facilitate this process at irb@wou.edu.

We appreciate your dedication to the ethical conduct of human subject research at Western Oregon University and your continued commitment to human subject research protections. If you have any questions, please feel free to contact myself or any other member of the WOU IRB.

Good luck in your research activities.

Sincerely,

Ethan McMahan, Ph.D.
Chair, WOU Institutional Review Board

Vice President for Academic Affairs
345 Monmouth Ave. N. • Monmouth, OR 97361 • 503.838.8271 • 503.838.8116 (fax) • wou.edu

FLYER

WESTERN OREGON UNIVERSITY
Division of Natural Sciences/Mathematics

Blindfolded for Science: Eye-closed Training for Dancers

PARTICIPANTS NEEDED FOR SENIOR THESIS RESEARCH

Background:

Sight is used by our brain as connecting bridge between other sensory input and stimuli from the world. Since humans are very visual creatures, we heavily rely on vision to interact with our environments. Dancers also rely on vision in training and performance. Previous research suggests that the sensory limitation of vision can be overcome by increasing an individual's movement confidence through the use of Dance/Movement Therapy (Takahasi, 2015). This research aims to study if eye-closed dance training can be used to overcome these sensory limitations to benefit dancers as well as the lives of visually impaired individuals.

Methods:

As participants in this study, you will be asked to complete an online survey first. Once you completed the survey, you will receive an email from the primary researcher (Karisa Merrill) about your placement and for further scheduling. You will be asked to attend a total of 6 one-hour sessions: 1 pre-test, 4 rehearsals, and 1 post-test.

In appreciation for your time, there may be opportunities for extra-credit in WOU dance courses that you are enrolled in during the study.

How to get involved:

Take the following online survey to begin; https://www.surveymonkey.com/r/KF8NS2K
**be sure to enter the exact web address to find the correct survey*

Contact Information:

Karisa Merrill (primary researcher) – kmerrill14@mail.wou.edu

Dr. Karen Haberman (thesis advisor) – *habermk!@mail.wou.edu*

This study has been review and approved by the Institutional Review Board of Western Oregon University. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of Institutional Review Board at *(503) 838-9200* or *irb@mail.wou.edu*.

ONLINE SURVEY

Eye-closed Training for Dancers

1. Consent

By participating in the survey, I hereby certify that I am 18 years or older and give my consent to participate in the research study entitled "Blindfolded for Science: Eye-closed Training for Dance" details of which have been provided to me through email, including anticipated benefits, risks, and potential complications. I understand that upon completion of this survey I will receive an email from Karisa stating my final participation in the research and that she will contact me for further scheduling.

* 1. Please sign your name below if you read and agree to the consent shown above.

First Name

Last Name

Next

Powered by

SurveyMonkey

See how easy it is to create a survey.

Eye-closed Training for Dancers

2. Personal Information

These questions relate to your personal information. If you feel uncomfortable with any question, you are free to skip the questions and move on to the next.

2. What is your age?

- ◯ Younger than 18
- ◯ 18 to 25
- ◯ 26 to 35
- ◯ 36 or older

3. Which of the following low vision aids do you use? (check all that apply)

- ☐ Contacts
- ☐ Glasses
- ☐ Not applicable
- ☐ Other (please specify)

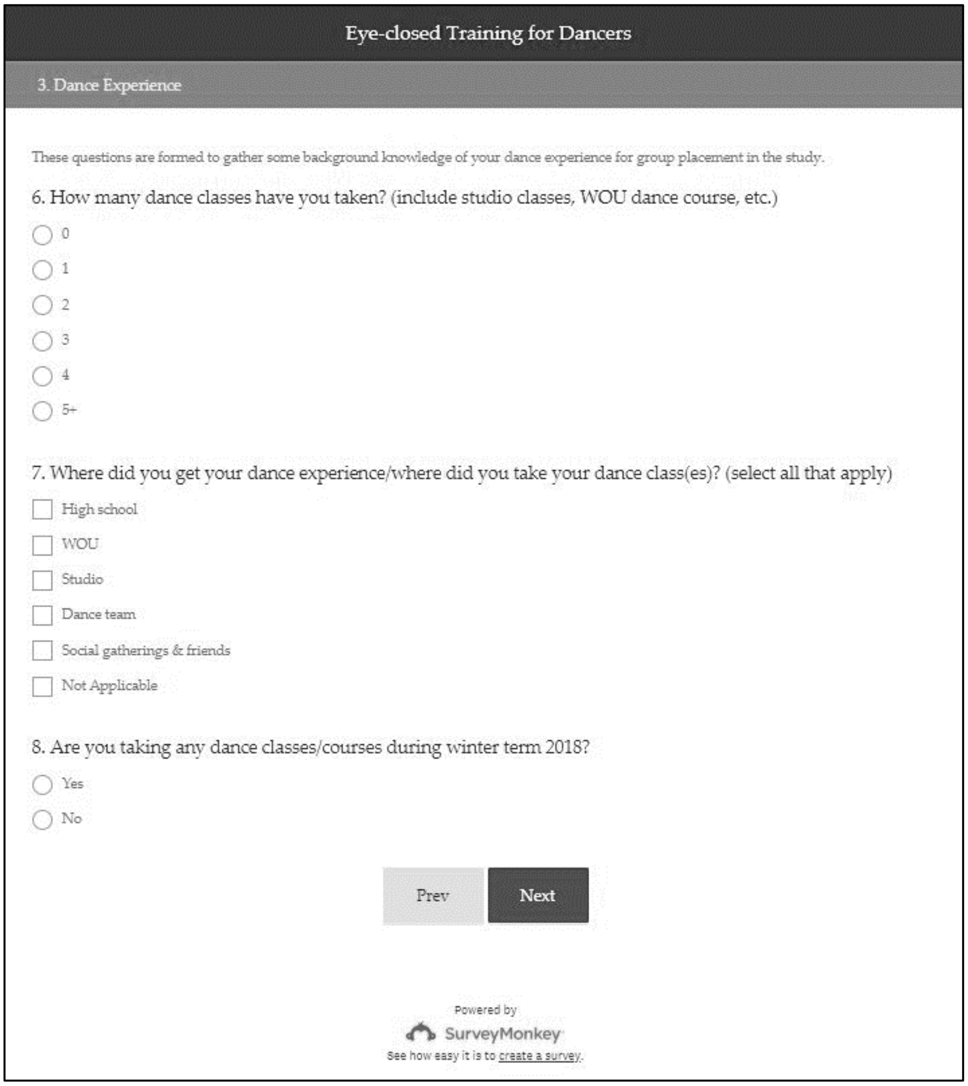
4. Do you need and use any assistive hearing devices?

- ◯ Yes, I need them and use them
- ◯ No, I do not need them
- ◯ Yes, I need them but do not use them

5. Do you have any constraints regarding your ability to move? (i.e. broken limb, bad knee, etc.)

- ◯ No
- ◯ Yes (please specify)

Prev Next



Eye-closed Training for Dancers

3. Dance Experience

These questions are formed to gather some background knowledge of your dance experience for group placement in the study.

6. How many dance classes have you taken? (include studio classes, WOU dance course, etc.)

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5+

7. Where did you get your dance experience/where did you take your dance class(es)? (select all that apply)

- ☐ High school
- ☐ WOU
- ☐ Studio
- ☐ Dance team
- ☐ Social gatherings & friends
- ☐ Not Applicable

8. Are you taking any dance classes/courses during winter term 2018?

- ◯ Yes
- ◯ No

Prev Next

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SurveyMonkey
See how easy it is to create a survey.

Eye-closed Training for Dancers

4. Almost done!

After you enter your email, press "done" to finish the survey.

Thank you for your interest and participation in my thesis project! You will receive a follow-up email from kmerrill14@mail.wou.edu to the email you provide.

Thanks again,
Karisa

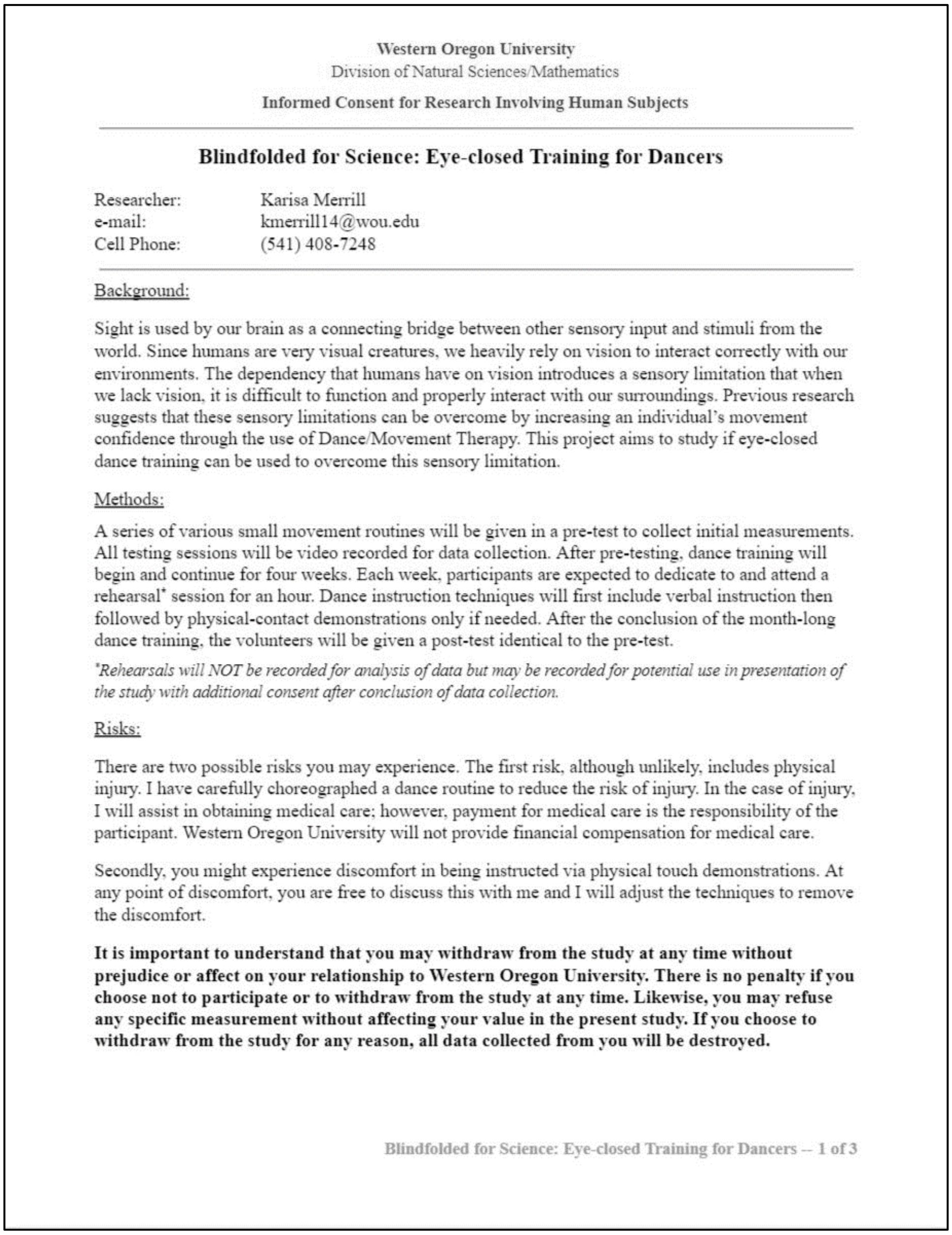
* 9. At what email address would you like to be contacted?

Prev Done

Powered by
SurveyMonkey
See how easy it is to create a survey.

CONSENT FORMS

ONLINE CONSENT FORM



Western Oregon University
Division of Natural Sciences/Mathematics

Informed Consent for Research Involving Human Subjects

Blindfolded for Science: Eye-closed Training for Dancers

Researcher:	Karisa Merrill
e-mail:	kmerrill14@wou.edu
Cell Phone:	(541) 408-7248

Background:

Sight is used by our brain as a connecting bridge between other sensory input and stimuli from the world. Since humans are very visual creatures, we heavily rely on vision to interact correctly with our environments. The dependency that humans have on vision introduces a sensory limitation that when we lack vision, it is difficult to function and properly interact with our surroundings. Previous research suggests that these sensory limitations can be overcome by increasing an individual's movement confidence through the use of Dance/Movement Therapy. This project aims to study if eye-closed dance training can be used to overcome this sensory limitation.

Methods:

A series of various small movement routines will be given in a pre-test to collect initial measurements. All testing sessions will be video recorded for data collection. After pre-testing, dance training will begin and continue for four weeks. Each week, participants are expected to dedicate to and attend a rehearsal* session for an hour. Dance instruction techniques will first include verbal instruction then followed by physical-contact demonstrations only if needed. After the conclusion of the month-long dance training, the volunteers will be given a post-test identical to the pre-test.

**Rehearsals will NOT be recorded for analysis of data but may be recorded for potential use in presentation of the study with additional consent after conclusion of data collection.*

Risks:

There are two possible risks you may experience. The first risk, although unlikely, includes physical injury. I have carefully choreographed a dance routine to reduce the risk of injury. In the case of injury, I will assist in obtaining medical care; however, payment for medical care is the responsibility of the participant. Western Oregon University will not provide financial compensation for medical care.

Secondly, you might experience discomfort in being instructed via physical touch demonstrations. At any point of discomfort, you are free to discuss this with me and I will adjust the techniques to remove the discomfort.

It is important to understand that you may withdraw from the study at any time without prejudice or affect on your relationship to Western Oregon University. There is no penalty if you choose not to participate or to withdraw from the study at any time. Likewise, you may refuse any specific measurement without affecting your value in the present study. If you choose to withdraw from the study for any reason, all data collected from you will be destroyed.

Blindfolded for Science: Eye-closed Training for Dancers -- 1 of 3

Western Oregon University
Division of Natural Sciences/Mathematics

Informed Consent for Research Involving Human Subjects

Compensation/Benefits:

Although there are no financial compensations, there may be opportunities for extra credit in WOU dance courses if you are enrolled during the fall term of 2017. You may also experience one or more of the many known physical and psychological benefits of dance. Along with others, you may also benefit from knowing you are helping a co-student in their senior thesis.

Survey:

Your participation begins by taking the following linked survey: https://www.surveymonkey.com/r/KF8NS2K.

Participation in this ~4 minute survey will act as your consent to only the online survey. This online survey will allow me to track completers by email for communication purposes and scheduling for the remainder of the study. Your responses to the survey will **not** be anonymous for purposes of group placement, but **will** remain confidential. To ensure confidentiality, I will remove any personal identifiers after coding is completed. At our first meeting, you will be given an additional survey that will serve as consent for the physical portion of the study.

The results of this study will be used in my honors thesis and may be used in reports, presentations, and publications but your name or identity will not be known/used unless further consent has been given for presentation purposes.

If you have any questions concerning the research project, please contact me, Karisa Merrill, by phone at (514) 408-7248 or via email at kmerrill14@mail.wou.eu or my advisor Dr. Karen Haberman at habermk@mail.wou.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of Institutional Review Board at (503) 838-9200 or irb@mail.wou.edu.

Thank you,

Karisa Merrill
Undergraduate student
WOU Honors Program

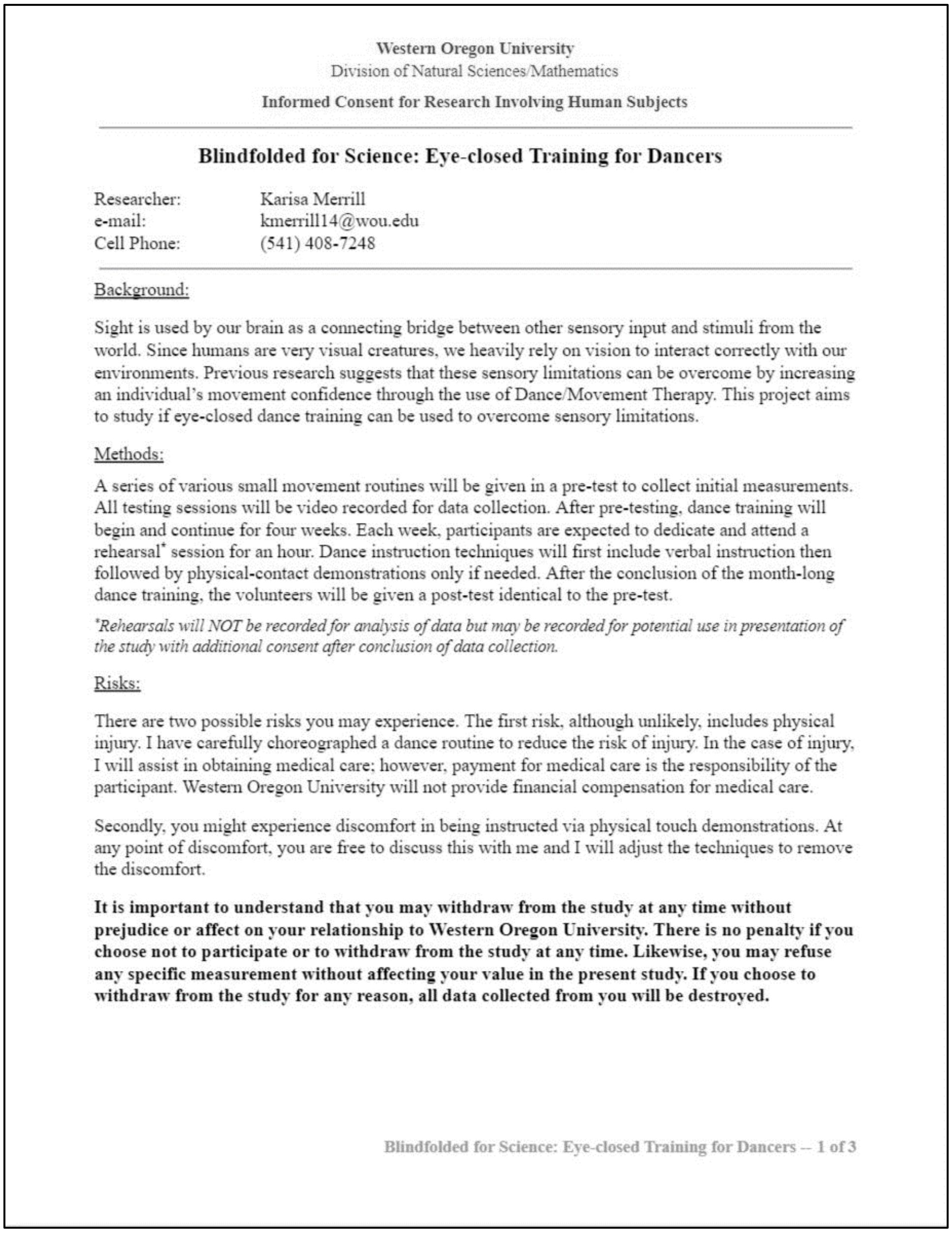
Western Oregon University
Division of Natural Sciences/Mathematics

Informed Consent for Research Involving Human Subjects

The following statement was placed at the beginning of the online survey:

By participating in the survey, I hereby certify that I am 18 years or older and give my consent to participate in the research study entitled "Blindfolded for Science: Eye-closed Training for Dance" details of which have been provided to me through email and/or as a handout given to me in person, including anticipated benefits, risks, and potential complications. I understand that upon completion of this survey I will receive an email from Karisa stating my final participation in the research and that she will contact me for further scheduling.

PHYSICAL CONSENT FORM



Western Oregon University
Division of Natural Sciences/Mathematics

Informed Consent for Research Involving Human Subjects

Blindfolded for Science: Eye-closed Training for Dancers

Researcher: Karisa Merrill
e-mail: kmerrill14@wou.edu
Cell Phone: (541) 408-7248

Background:

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Methods:

A series of various small movement routines will be given in a pre-test to collect initial measurements. All testing sessions will be video recorded for data collection. After pre-testing, dance training will begin and continue for four weeks. Each week, participants are expected to dedicate and attend a rehearsal* session for an hour. Dance instruction techniques will first include verbal instruction then followed by physical-contact demonstrations only if needed. After the conclusion of the month-long dance training, the volunteers will be given a post-test identical to the pre-test.

**Rehearsals will NOT be recorded for analysis of data but may be recorded for potential use in presentation of the study with additional consent after conclusion of data collection.*

Risks:

There are two possible risks you may experience. The first risk, although unlikely, includes physical injury. I have carefully choreographed a dance routine to reduce the risk of injury. In the case of injury, I will assist in obtaining medical care; however, payment for medical care is the responsibility of the participant. Western Oregon University will not provide financial compensation for medical care.

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It is important to understand that you may withdraw from the study at any time without prejudice or affect on your relationship to Western Oregon University. There is no penalty if you choose not to participate or to withdraw from the study at any time. Likewise, you may refuse any specific measurement without affecting your value in the present study. If you choose to withdraw from the study for any reason, all data collected from you will be destroyed.

Western Oregon University
Division of Natural Sciences/Mathematics

Informed Consent for Research Involving Human Subjects

Compensation/Benefits:

Although there are no financial compensations, there may be opportunities for extra credit in WOU dance courses if you are enrolled during the fall term of 2017. You may also experience one or more of the many known physical and psychological benefits of dance. Along with others, you may also benefit from knowing you are helping a co-student in their senior thesis.

Survey:

Your participation began by taking the following linked survey: https://www.surveymonkey.com/r/KF8NS2K. Participation in the survey acted as your consent to only the online survey.

The results of this study will be used in my honors thesis and may be used in reports, presentations, and publications but your name or identity will not be known/used unless further consent has been given for presentation purposes.

If you have any questions concerning the research project, please contact me, Karisa Merrill, by phone at (514) 408-7248 or via email at kmerrill14@mail.wou.eu or my advisor Dr. Karen Haberman at habermk@mail.wou.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of Institutional Review Board at (503) 838-9200 or irb@mail.wou.edu.

Thank you,

Karisa Merrill
Undergraduate student
WOU Honors Program

Western Oregon University
Division of Natural Sciences/Mathematics

Informed Consent for Research Involving Human Subjects

I ______________________________, hereby give my consent to participate in the research study entitled "Blindfolded for Science: Eye-closed Training for Dance" details of which have been provided to me (via email and physical copy of both the "Physical" and "Survey" consent forms), including anticipated benefits, risks, and potential complications.

I fully understand that I may withdraw from this research project at any time without prejudice or affect on my college/athletic standing and that any data connected to me will be destroyed upon my withdrawal. I also understand that I am free to ask questions about any techniques or procedures that will be undertaken.

I also understand that in the unlikely event of physical injury resulting from research procedures that the investigators will assist the subjects in obtaining medical care; however, payment for the medical care will be the responsibility of the subject. Western Oregon University will not provide financial compensation for medical care.

Finally, I understand that the information obtained from me during the course of this study will be kept confidential unless I consent to its release.

____
Participant Name (printed)

____
Participant Signature

DECEPTION DEBRIEF

Deception:

Blindfolded for Science: Eye-closed Training for Dancers

Sight is used by our brain as a connecting bridge between other sensory input and stimuli from the world. Since humans are very visual creatures, we heavily rely on vision to interact correctly with our environments. Previous research suggests that these sensory limitations can be overcome by increasing an individual's movement confidence through the use of Dance/Movement Therapy. This project aims to study if eye-closed dance training can be used to overcome sensory limitations.

Actual Title/Background/Purpose:

Blindfolded for Science:
An Integration of Dance as Therapy for Visually Impaired or Blind Individuals

Sight is used by our brain as a connecting bridge between other sensory input and stimuli from the world. Since humans are very visual creatures, we heavily rely on our vision to interact with our environments. Because of this role, visual impairments can affect various important aspects of an individual's life. Impaired vision can diminish a person's confidence in movement and can introduce a fear of falling, which can limit an individual in their interactions with the rest of the world. Previous research suggests that these limitations can be overcome by increasing the individual's movement confidence through the use of Dance/Movement Therapy, a form of psychological therapy. Although it has been beneficial to the mental health of participants in the American Dance Therapy Association, the physical effects that dance can have on the human body when visually impaired are not as thoroughly examined. This project will examine the sport of dance and compare the effects that vision state (blindfolded versus non-blindfolded) and dance experience (dancers versus non-dancers) have on orientation and posture.

Disclosure:

Because you volunteered for my thesis with the deception, you now have the opportunity to withdraw from the study. Are you okay with the deception? If you are not comfortable with the actual study, please let me know and all data tied to your name up to this point will be destroyed.

ACKNOWLEDGEMENTS

Special recognition to Dr. Karen Haberman, my thesis advisor, for her continuous advice and support throughout the two-year process of my thesis from development to completion, thank you!

I would also like to recognize my 17 WOU student participants. They maintained enthusiasm all 6 weeks and are the reason my research was possible, thank you!

A huge thanks to WOU Biology Department for selecting my research for the Walker Award. Without the WOU Walker Award, I would not have had access to the necessary equipment such as the cameras, tripods, blindfolds, etc. Their support was incredibly necessary and helpful!

Another important recognition to the WOU Dance Department for allowing me to use their dance studio and the WOU Physical Plant for assistance in installing the ceiling camera mount.

I would like to recognize Gavin Keulks for encouraging me to challenge myself and gave me guidance through the development and proposal, and both Dr. Mike LeMaster and Jose Aldo Cervantes for assisting, supporting, and encouraging me throughout the entire process.

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