

LEARNING AND PRACTICING DANCE PHRASES WITH AND WITHOUT A  
MIRROR: A COMPARISON STUDY

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A Thesis

Presented to

The Faculty of the Department of Kinesiology

Sam Houston State University

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In Partial Fulfillment

of the Requirements for the Degree of

Master of Science

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by

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May, 2020

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## ABSTRACT

Weber, Emily E., *Learning and practicing dance phrases with and without a mirror: A comparison study*. Master of Science (Kinesiology), May 2020, Sam Houston State University, Huntsville, Texas.

Mirrors are commonplace in dance studios; however, there has been no research that has looked at when the mirrors are most beneficial during the learning of dance phrases. Mirror visual feedback has been found to increase neural activity for attention and cognitive control (Deconick et al. 2015) as well as enhance performance and induce neuroplasticity (Rjosk et al. 2017). Mixed results have been observed with the use of mirrors during learning. Dearborn and Ross (2006) and Radall and Adame (2003) found a benefit of mirrors for dancers, and power clean movements were better with the use of mirrors (Sewall et al., 1988). However, mirrors were not found to improve balance or Pilates movements (Notamicola et al. 2014; Lynch et al. 2009). The varied results could be due to experience levels or the type of movement activity. The aim of this study was to determine if mirrors were more beneficial at the demonstration and explanation (DEMO) or practice (PRAC) phase for learning the dance phrase. Twenty experienced dancers were randomly placed in one of three groups. Group one (N=7, age M=21, Dance years M=14 +-2) had DEMO with mirror, PRAC no mirror. Group two (N=7, age M=20, Dance years M= 8+-5) had DEMO no mirror, PRAC with mirror). Group three (N=6, age M=20, Dance years M=9 +-5) had DEMO with mirror, PRAC with mirror. Videos of each participant's dance performance of the dance phrase were blind reviewed by four independent experienced dance instructors for movement accuracy and timing/musicality errors on scales of one to five, with five equal to no errors and one is equal to seven or more errors. The results of a Kruskal-Wallis one-way ANOVA test

were not significant for accuracy ( $H= 3.53$ , 2 d.f.,  $p= .171$ ) or errors ( $H=4.55$ , 2 d.f.,  $p= .103$ ). Results showed group one, which used the mirror only during demonstration and explanation to have the highest accuracy, while group two, which used the mirror only during practice, showed the best timing. Group three, which used the mirror during the demonstration and explanation phase and the practice phase (similar to traditional dance training), had the most errors in accuracy and the second-most errors in timing. These data suggest there may be learning benefits from removing the mirror during either the demonstration phase of the practice phase as well as that additional research is warranted to determine the effect of experience level and learning strategies used with and without mirrors present.

**KEY WORDS:** Mirror visual feedback, Dance, Motor learning, Learning, Practicing.

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## **CHAPTER I**

### **Introduction**

#### **Purpose**

The purpose of this study is to determine at which phase of learning a mirror is most effective as it relates to the learning and retention of a dance movement phrase; at the demonstration and explanation stage of learning or at the practice stage.

#### **Hypothesis**

The mirror is most effective for the purpose of retention and performance when it is used at the demonstration and explanation learning phase.

#### **Literature Review**

“Mirrors have been a part of the dance environment for so long that many teachers and dancers do not even question their presence as a learning tool,” (Krasnow and Wilmerding 2015, 241). Mirror therapy has been used in the rehabilitation process for many conditions including stroke, hemiparesis, and phantom limb pain. There has been a significant amount of research covering the effectiveness of this form of therapy on a myriad of conditions as well as what happens in the brain as a response (Deconick, Smorenburg, Benham, Ledebt, Feltham, and Savelsbergh 2015). Mirror visual feedback provides the individual with concurrent visual information which can be helpful when learning motor skills (Lynch, Chalmers, Knutzen, and Martin 2009). No research has been conducted to investigate at which phase of the learning process a mirror is most effective for learning, the demonstration and explanation phase or the practice phase.

A literature review conducted in 2015 examined the literature researching the effect of mirror visual feedback therapy on the brain and the possible neurological factors



involved (Deconinck et al. 2015). After reviewing the 33 articles which investigated this effect, the authors concluded that areas of the brain associated with attention and cognitive control respond to mirror visual feedback with increased activity. Deconinck & colleagues (2015) also concluded that in patients that have lost motor control to a hand or arm the ipsilateral primary motor cortex (M1) responds to mirror visual feedback with an increase in excitability which then projects to the untrained hand/arm and found evidence to support the theory that these projections are the result of training with mirror visual feedback. Mirror visual feedback clearly has a significant influence on the motor network specifically with an increase in cognitive penetration in all action controls. When comparing healthy individuals to those that have experienced a stroke, both respond to mirror visual feedback in the areas of the brain that are associated with attentional processes with an increase in neural activity. The variety of methodologies used as well as a lack of insight into the neural connectivity do not provide clarity to the actual cognitive activity that occurs when using mirror visual feedback and supports the need for additional research related to the use of mirrors in learning and providing feedback when learning and relearning motor skills.

More recent research has attempted to further the investigation of these underlying neural mechanisms. One study examined the effects of direct, mirrored, and blocked visual feedback as it relates to the excitability of the M1 cortex and intracortical inhibition/facilitation in a state of rest as well as phased unilateral finger movement task in 11 healthy individuals (Kumru, Albu, Pelayo, Rothwell, Opisso, Leon, Soler, and Tomoros 2016). Blocked visual feedback was provided by using an opaque block in place of a mirror which prevented the participants from using reflection to complete the

motor task. EMG recordings were taken from the first dorsal interosseous muscle and from the abductor digiti minimi muscles of the nondominant hand. Paired pulse transcranial magnetic stimulation (ppTMS) was used to evaluate both short intracortical inhibition as well as short intracortical facilitation. The task was to move the index finger of the participant's dominant hand to a dot 2cm away. Results from this study indicate that cortical disinhibition can be induced with mirror visual feedback when used during the performance of a motor task. The authors concluded that when compared to blocked visual feedback, mirror visual feedback is a critical mechanism for encouraging changes in intracortical inhibition. Rjock et al. (2017) examined the neural correlates of mirror visual feedback-induced performance improvements by studying resting-state fMRI. This study specifically aimed to look beyond the functional changes in the primary motor cortex as well as those which control functions of visual attention and perceptual-motor coordination (Rjosk, Lepsien, Kaminski, Hoff, Sehm, Stelle, Villringer, and Ragert, 2017). An rs-fMRI was performed on 35 healthy participants both before and after a complex ball-rotation task was completed by each participant. Analysis of the performance improvement of the untrained left hand was used as an outcome measure. The results of the study indicated that the group that was provided mirror visual feedback demonstrated greater improvements in performance and the resting state fMRI showed that there was an increase in connectivity in the left visual cortex in the mirrored group. Analysis comparing the non-mirrored and mirrored groups showed there were alterations that indicate brain plasticity related to functional learning in the mirrored group.

Each of these studies concluded that mirror visual feedback appears to enhance motor performance which is indicative of induced neuroplasticity. This is of particular

interest to those working in neurorehabilitation with patients that have lost motor skills due to a brain injury. The results also reinforce the use of mirror in dance learning however, it still does not fully explain when during learning is best facilitated with the use of mirrors during the learning process.

There has been very little research of the use of mirrors in learning motor skills, specifically the comparison of learning with and without mirrors and the research has had mixed results (Dearborn et al. 2006; Notarnicola et al. 2014; Radell et al. 2003; Sewall et al. 1988). Dearborn and Ross (2006) conducted a study that examined dancers' ability to learn and retain dance phrases that were learned with and without a mirror. Dancers were split into two groups, both of which learned a phrase of dance. One group learned with a mirror and the other group learned without a mirror. Two weeks later the dancers returned and performed the dance phrase and were recorded. The performances were scored by dance teachers as well as through the use of the Dance Dance Revolution game. Analysis of these scores found that the group that learned with a mirror performed better than those that learned without a mirror. The dance phrases that were taught were from the Dance Dance Revolution game, however it was noted that one phrase, though of the same level of difficulty per the game, was found to be more difficult than the other phrase that was taught. This discrepancy in the difficulty of the dance phrases may have affected the performance and scores of the dance phrases; however, since both groups learned both phrases, this effect would be less than if different phrases were assigned to different groups. The authors note that this discrepancy added some difficulty to the analysis of the data. Future research should carefully control the dance phrases used to

ensure they meet the needs of the project and allow the researcher to measure the pros and cons of using a mirror during demonstration and practice.

Mirror use in learning a specific weight-lifting technique was examined by Sewall, Reeve, and Day (1988). Participants were taught the power clean movement by watching an instructional video and were able to practice the movement at intervals throughout the video. One group was encouraged to use the mirror as an aid and the other group was not encouraged even though the mirror was present, it was not presented as a learning aid. Scores from the performance indicate that the group that was encouraged to use the mirror scored higher than those that were not encouraged to use the mirror. This suggests that when the participants were encouraged to use mirror, they did so as a learning tool which resulted in better performance. Because the mirror was present for both groups, this study cannot guarantee that it was not a factor in both group's performance improvements.

In contrast to research by Dearborn and Sewall, others have found that learning with a mirror is less effective than learning without one. Radell and Adame (2003) examined the progress of two beginning ballet classes offered at Emory University. One class took place in a studio with mirrors and the other took place in a studio without mirrors. Performances of the same adagio and grand allegro phrases were videotaped at weeks 5 and 14 of the term. When the semester ended, the videotapes from both classes were viewed by ballet teachers and each dancer was scored on skill level. Results indicated that the nonmirrored class demonstrated a significant increase in skill for adagio and that the mirrored class did not show significant increases in scores for either the adagio or the grand allegro. The authors concluded that based on these results, skill

acquisition of dancers may be reduced by mirror use in the ballet classroom. The comparison of a mirrored and non-mirrored studio in ballet has also been examined with a focus on balance improvement. To investigate this, sixty-four dancers between the ages of 9 and 10 were selected and divided into two groups of thirty-two (Notarnicola, Maccagnano, Pesce, Di Pierro, Tafuri, and Moretti 2014). One group attended lessons with a mirror and the other group attended lessons without a mirror. Each student's balance was evaluated at the start of the study and after 6 months of lessons using the BESS (Balance Error Scoring System) which consists of performing three different stances (double limb, single limb, and tandem) each on two different surfaces (firm and foam). Results showed no significant difference in the groups both at the start of the study and after six months of lessons. The authors concluded that the use of mirrors in a ballet classroom does not significantly improve the acquisition of balance for the dancers. These data suggest the experience level may be a factor in the use and benefits of mirror feedback.

When the use of mirrors in learning Pilates was examined, similar results were found. The star movement from the mat Pilates series was used to examine the effect of the mirror. In this movement the subject has to support their body using their ipsilateral hand and foot to hold the body in a straight line, similar to what is referred to as the side plank position (Lynch Chalmers, Knutzen and Martin 2009). Each group (mirrored and non-mirrored) participated in a sixty-minute Pilates class twice weekly for eight weeks. At the conclusion of the study period there were no differences in the performance of the star movement between the groups. The authors found these results indicated that the use of mirrors in the classroom for visual feedback while learning did not positively affect

later performance of the skill when mirrors were no longer present. These data may suggest the benefits from mirrors may be skill dependent as well.

These mixed results could be due to a few different factors. Radell and Adame used beginning ballet students. The skill level of the student could play a significant role in how helpful the mirror is to that student and their ability to use the information the mirror provides. Krasnow and Wilmerding (2015) in their discussion of mirror use in dance training found that the level of the dancer can affect how much of a benefit they gain from the use of the mirror for movement retention. They observed that advanced dancers have developed the cognitive skills needed to be able to use the information provided by the mirror whereas beginner dancers seem more distracted by this information. The type of exercise could be a factor as well. Radell and Adame (2003) only examined two exercises, adage and grand allegro. In the case of the adage, as Krasnow and Wilmerding (2015) noted, to a beginner the mirror may have been more of a distraction than a learning aid. In both the mirrored and nonmirrored groups there were no significant increases in the skill level of the grand allegro exercise. Using the mirror during grand allegro exercises can be difficult, especially for a beginner. Grand allegro exercises are large jumping and leaping movements that travel across the room. Notarnicola and colleagues (2014) found that mirror use did not improve balance in young dancers however, it was noted that improvements in both groups were the result of training over time and not a mirror as there were no significant differences between groups. Lynch and colleagues (2009) examined mirror use with a Pilates movement and found a mirror was not beneficial for learning as the later performance of that skill in the absence of a mirror was not improved. This may be an example of feedback dependency

in which “if sensory feedback such as visual cueing from the mirror is present in the early stages of learning, the learner’s need for that feedback does not diminish as the learner becomes more advanced” (Krasnow and Wilmerding 2015). It should also be noted that using a mirror during mat Pilates would be difficult as the exercises are performed laying on the back, side, or stomach with just a couple of exercises that are propped up on one or both arms. The movement selected was performed holding one’s self up on one arm and one leg so the participant was able to see themselves in the mirror, but this is just one movement. These data may also suggest the benefits from mirrors may be skill dependent as well.

The mixed results of these studies demonstrate that there is a need for further research to determine when a mirror is most beneficial in aiding the learning process. As discussed, the mirror may not be helpful to every student at every level or even for all types of exercise. Research does indicate that mirrors can aid in retention, but that might also vary by the age of the individual as well. Additional research may shed some light on these questions.

It is evident that a mirror can aid in the learning of motor skills, though how and when the mirror provides this benefit is not as well understood. Dancers that learn choreography with mirrors retain that choreography better than those that learned choreography without a mirror. When dancers move to the stage to perform there is no mirror available to assist them. This leads one to question if the practice should also occur without a mirror and if so, when should that aid be removed so that the dancers can develop the kinesthetic, proprioceptive, and neuromuscular knowledge that is necessary for performance. This may also be true for the patient that relearns lost skills with the use

of mirror, but then has to be able to perform those same daily tasks in life without the aid of a mirror.



## CHAPTER II

### Methods

Participants were recruited from the Iowa State University Dance Program. All participants were eighteen years of age or older, had at least two years of dance training, and a minimum of one year of training in either ballet or modern dance technique, and had not sustained an injury in the previous six months. Upon being recruited, participants read and signed a consent form and filled out a short questionnaire about their previous and current dance training, age, any injuries in the previous six months, and whether or not they have had a technique class without a mirror present (see Appendix A). Each participant was then provided information about the study schedule, as well as his or her participant code number. This study was approved by the Sam Houston State University's Institutional Review Board prior to starting data collection.

### Procedures

Twenty participants were randomly assigned to one of three groups which differed based on mirror use. Group one had a mirror present during the demonstration and explanation phase (DEMO); however, they practiced (PRAC) without the mirror. Group two had no mirror during DEMO, however they practiced with the mirror. Group three which was the control group had a mirror during both the DEMO and PRAC phases, similar to a standard dance environment. All three groups performed without the mirror, which is similar to most dance performance situations. Participants were required to attend three sessions as a part of the study. At the first session participants learned a movement phrase of thirty-two counts of music with their group and that groups assigned learning condition (mirror or no mirror). The second session which was five days after

the first session was a practice session at which participants practiced as a group in their assigned practice condition. The third session which was two days after the practice session was the performance session (no mirrors for all three groups). Participants performed the movement phrase individually with no mirror and their performance was videotaped to be used in the independent scoring. The video was taken from the front of the room or the audience perspective.

### **Demographics**

Participants were all undergraduate students at Iowa State University and attending dance classes in the dance program. Average age between the three groups was 20 and 21 years of age. Years of dance training varied significantly. Group one included seven participants with an average age of 21 years and average years of dance training 14 +-2 years. Group two included seven participants with an average age of 20 years and average years of dance training 8 +-5 years. Group three included six participants with an average age of 20 years and years of dance training 9 +-5 years. Current number of training hours also varied between groups. Group one had the largest average number of current training hours at 7.29 hours per week. Groups two and three had less with 4.93 and 4.08 hours respectively.

### **Phrase Selection/Development**

The movement phrase consisted of 32 counts of movement. Steps selected were those that are not frequently performed together as a common phrase such as tombé pas de bourrée from ballet. This was to ensure that the participants actually had to learn the movement phrase and not rely on previous knowledge of common movement phrases. None of the steps required any amount of extreme range of motion. All extensions were

at ninety degrees (hip height) or lower. The phrase did test attention to detail such as hips are facing front, but the upper body is rotated to the side or gaze remaining front or following the hand. Music selected was of a moderate tempo with a clear down beat. The entire movement phrase only moved a few steps in each direction and did not travel across the space. The movement phrase was taught in eight count increments and followed the same order of demonstration. First the eight counts were demonstrated in full, then again with counts, again with explanation of details (height of limb, facing of body segment), with music and verbal counts, and last with just music. Following the teaching of each count of eight, one full demonstration of the entire 32 count phrase was provided with music. This is how dance phrases are typically taught in a studio setting. At the practice session the participants practiced the phrase three times with music. No demonstration or explanation was provided at the practice session and questions or discussion were not allowed.

### **Evaluator Selection**

Four evaluators of similar qualifications were asked to view the video of each participant and score them. All evaluators had at least five years of teaching experience as well as experience in choreographing and directing, and all evaluators were members of Dance Masters of Mid America a dance teacher organization that requires its' members to either have completed a bachelor's degree in dance or to have passed an exam in at least one genre of dance in order to become a member.

### **Video Scoring**

Scoring was based on the number of errors for two categories accuracy and timing. Scores ranged from one to five with one being the lowest score and five being

the highest score. A score of five indicated that there were no errors, while a score of one indicated that there were seven or more errors. The scores in between were separated by increments of two. Evaluators were provided with scoring sheets that contained a rubric for how to score each participant (see Appendix B). Once each evaluator scored each participant, the evaluator returned all of the participant score sheets for data entry into a spreadsheet to be analyzed.

### **Analysis**

Data were entered into the spreadsheet and the scores were evaluated for interrater reliability. Four evaluators were used to allow for outliers to be removed. If one score was more than two units above or below the mean, this score was removed. Less than 10% of scores were removed due to this variability. Average scores and the average number of errors were then calculated for both accuracy and timing for each participant.

The Kruskal-Wallis one-way ANOVA statistical test was used to evaluate the data. This test evaluates the differences between three or more treatments (or populations) using a separate sample for each treatment condition (Thomas, Nelson, and Silverman 2015, 195). This test was used as a non-parametric method to test the rank scores given by the evaluators. Scores for accuracy and timing were analyzed.

## CHAPTER III

### Results

The results of a Kruskal-Wallis test were not significant for accuracy ( $H= 3.53$ , 2 d.f.,  $p = .171$ ) or errors ( $H= 4.55$ , 2 d.f.,  $p = .103$ ). Results showed group one, which had mirrors during DEMO, to have the highest accuracy with an average error score of 1.49, while group two, which had mirrors during PRAC, showed the best timing with an average timing score of 0.74 errors (see Figure 1). Group three which had the use of the mirror for both DEMO and PRAC scored lowest for average accuracy with a score of 2.85 errors and only slightly better than group one for timing with score of 2.07 errors where group one scored 2.24. Participants in group one had more dance training experience ( $M = 13.7$  yrs) than participants of groups two or three ( $M = 7.1$  yrs and 8.3 yrs, respectively), and the additional amount of training experience was significant ( $F = 3.644$ ,  $df_{2,17}$ ,  $p = .048$ ) (see Figure 2). The number of hours each group spent training, on average, was also different; however, the difference was non-significant ( $F = 1.492$ ,  $df_{2,17}$ ,  $p = .253$ ). These data suggest additional data is warranted to determine the effect of experience level and learning strategies used with or without mirrors present.

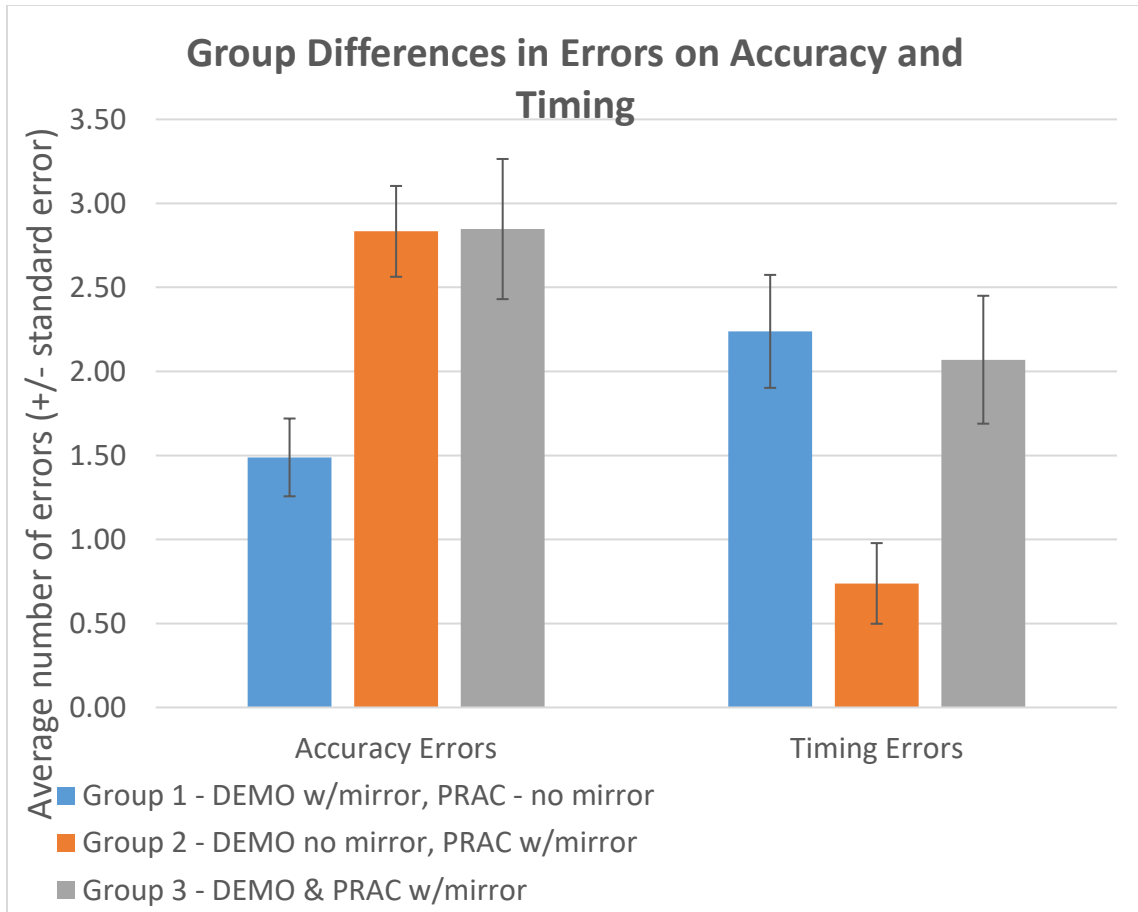


Figure 1. Group Differences in Number of Errors for Accuracy and Timing (DEMO = demonstration and explanation phase, PRAC = Practice phase).

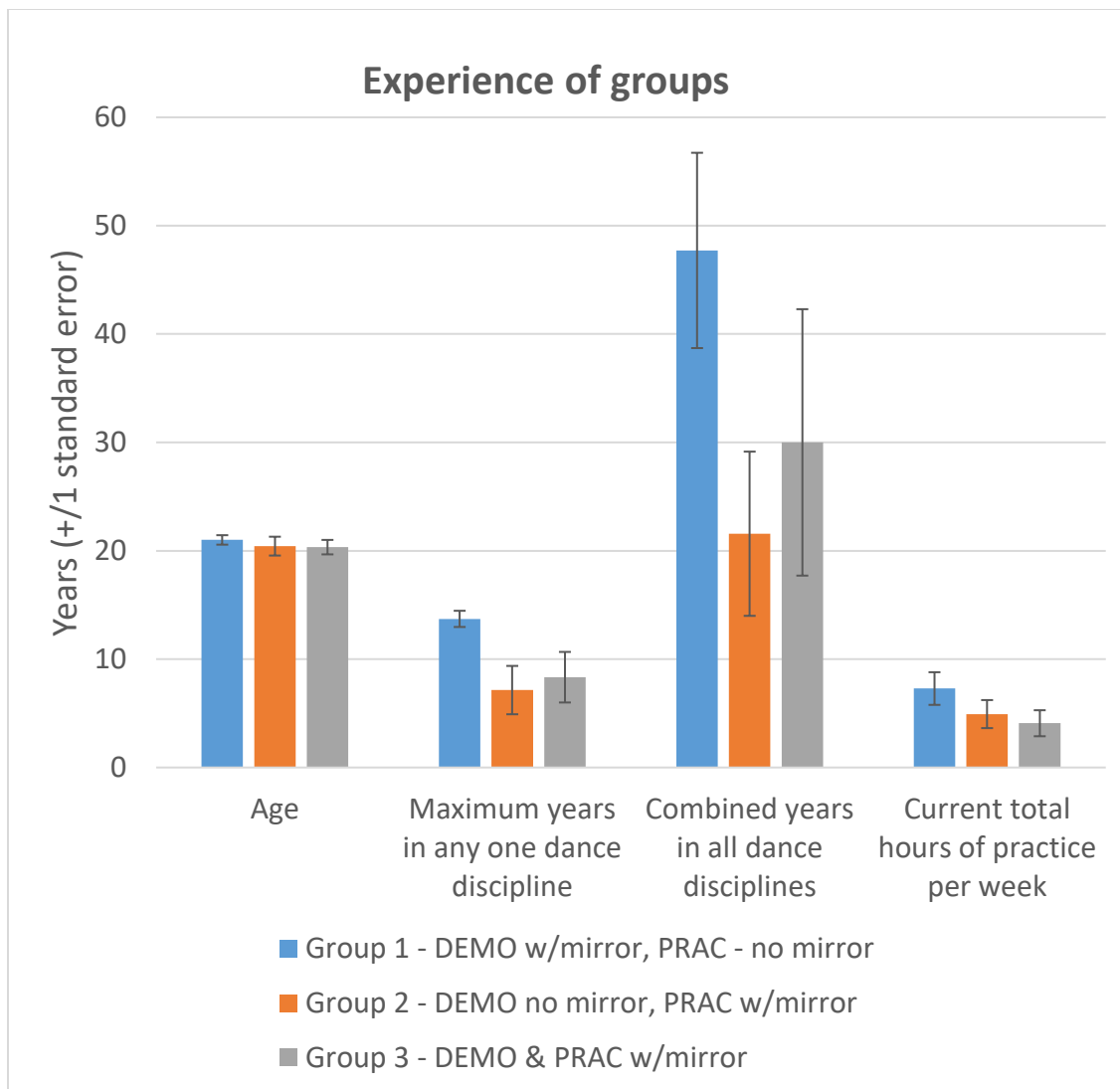


Figure 2. Experience of Groups.

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This thesis follows the style and format of *Journal of Dance Education*.

## CHAPTER IV

### Discussion

The participants varied in number of years of dance experience with some only meeting the required minimum of two years of dance training and others with as many as 15 years of dance training. Learning choreography as well as how to use the mirror as a learning tool are skills that are developed over a period of time and with training. Participants of this study learned a 32-count phrase of choreography. For more novice dancers with less training, this may be more challenging than for those with more extensive training especially those with a significant amount of performing experience. Within group one the dancers with the most previous and current training had the highest scores for accuracy. This may indicate that previous development and current practice of these learning skills assisted in their higher accuracy scores. This could also indicate those participants with more experience do not need to practice with the mirror to improve accuracy.

Group two learned the movement phrase without the mirror and practiced it with the mirror. This group scored higher for timing accuracy. Timing accuracy in dance may also be referred to as musicality or performing the correct steps on the correct count or note in the music as well as how long a position is held. The second group may have relied more heavily on other sensory inputs when learning the movement phrase in the absence of the mirror such as the kinesthetic feel of the movement and when that movement happens in the music. It is also possible that this group scored lower for accuracy of the movement because they were unable to see the demonstration of the



movement both in front of them as well it's reflection in the mirror resulting in the loss of the some of the details of the movement phrase.

The scores of the three groups indicate that learning with the mirror and practicing without it results in greater accuracy of movement, and that learning without the mirror and practicing with it results in greater accuracy of timing. It also indicates that learning and practicing with the mirror results is a lower accuracy for both movement and timing. Dance is typically taught and practiced with the conditions of group three with a mirror constantly present until the dancers are on stage for dress rehearsal. However, the results of this study may indicate that practicing without the mirror before moving to the stage may increase the accuracy of the movement. In more practical applications, this may indicate that when patients are relearning movement skills that have been lost, that a period of time practicing without a mirror could assist in the transition of those skills from a clinical setting to the real world.

Developing a greater kinesthetic awareness has been discussed in the research of mirror use and dance training. Dancing requires one to use both visual input and proprioception together. Radall and Adame (2003) theorized that the mirror is a distraction that inhibits dancers from shifting their attention to that kinesthetic sense. An awareness of both is encouraged and developed throughout dance training. Brodie and Lobel (2008) described this as dancers practicing the "splitting of their awareness between bodily and visual input." Krasnow and Wilmerding (2015, 241) also discuss the feedback dependency that can happen when the mirror is constantly present. When a skill is practiced for an extended period of time with a specific type of sensory information present, it will be more difficult to complete that task when the feedback is no longer

present. This may also be true for the patient learning or relearning a motor skill. If they are used to the mirror always being present to assist and provide feedback, encouragement to shift ones' awareness from the visual feedback to the kinesthetic awareness (or how the body feels when the movement or position is correct) may be beneficial. Feedback dependency may not be specific to dancers.

Radell and colleagues (2017) have also conducted research examining the use of the mirror in the ballet classroom and its' effect on beginning and advanced level student's bodie image and self-perception. The beginning level students found that they were more aware of their body with the mirror present and some reported feelings of negative body image. Among the more advanced students, participants reported a relationship with the mirror that had several aspects. They acknowledged the mirror as a learning tool that they had been trained to use it to analyze and correct their movements, but that it also made them more aware of their body and could lead to additional criticism of oneself and their body shape. However, the advanced dancers also observed that they try to concentrate their focus on the feel of the movement and not just how it looks in the mirror. This supports the views of Krasnow and Wilmerding (2015, 241) as well as Brodie and Lobel (2008) who stressed the importance of developing a kinesthetic awareness and not relying entirely on the mirror for feedback. The comparisons made in the study also support Krasnow and Wilmerding's (2015, 241) observation that more advanced dancers are better equipped to use the mirror as a tool instead of a distraction. Findings from the current study also appear to support these observations as the participants with more previous training scored higher than those with less experience.

The findings of this study align with those found by Dearborn and Ross (2006) as well as Sewall and colleagues (1988). In both studies, the use of the mirror resulted in an increase in performance scores. The study conducted by Sewall and colleagues encouraged one group of participants regularly to use the mirror while practicing the power clean movement that was just demonstrated for them. This group performed better than the group that was not encouraged to use the mirror following demonstration. The Dearborn and Ross (2006) study found that the participants that learned with the mirror also performed more accurately than those that did not learn with mirror. Dearborn does not discuss the variance in number of years of dance training though there was a range in years of 4 to 16. The authors do theorize that those with more training in certain genres of dance such as tap and modern dance tended to follow along with the demonstrator instead of shifting their focus between watching the demonstrator and observing themselves doing the movement in the mirror. There is the possibility that some genres of dance either through dance type or teaching method, will result in the dancer having a tendency to follow the demonstration instead of using the mirror for visual feedback and splitting their attention between the demonstration and the mirror to ensure that their movements match what is being demonstrated.

### **Limitations**

This study did encounter some limitations. The sample size was small with only 20 participants. These participants also varied in number of years of dance experience from the minimum of two years of dance training to as many as 15 years of dance training. As previously discussed, the level of the dancer and the amount of training experience may be a factor in learning movement. Learning to use the mirror as a tool

instead of a distraction is a skill that has to be developed. Additional research with a larger sample of participants with more similar dance experience may provide more information and better understanding of the mechanisms at play.

## CHAPTER V

### Conclusions

The mirror can play a role in learning movement. Research has indicated that the use of a mirror can aid in neuroplasticity and enhance performance however the mirror may not be beneficial in the learning of every type of movement. Experience level could also be a factor in developing the skills to use the mirror as a learning tool. The results of this study did not produce a significant difference between the three groups. However, there were differences in the scores that indicate that further research is necessary in order to further elucidate this question. Using both visual input and kinesthetic awareness may provide a greater benefit to motor learning and result in greater accuracy of movement. Understanding how or when mirrors are most beneficial and when removing them can facilitate learning can transform how dance is taught and improve learning for dancers of all ages and experience level.

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This dissertation follows the style and format of *Journal of Dance Education*.

## REFERENCES

- Brodie, Julie, and Elin E. Lobel. 2008. "More than Just a Mirror Image: The Visual System and Other Modes of Learning and Performing Dance." *Journal of Dance Education* 8, no. 1: 23-31, doi: 10.1080/15290824.2008.10387355
- Dearborn, Karen, and Rachel Ross. 2006. "Dance Learning and the Mirror: Comparison Study of Dance Phrase Learning with and without Mirrors." *Journal of Dance Education* 6, no. 4: 109-115, doi: 10.1080/15290824.2006.10387323
- Deconick, Frederik J.A., Ana R. P Smorenburg, Alex Benham, Annick Ledebt, Max G. Feltham, and Geert J. P. Savelsbergh. 2015. "Reflections on Mirror Therapy: A Systemic Review of the Effect of Mirror Visual Feedback on the Brain." *Neurorehabilitation and Neural Repair* 29, no. 4: 349-361. doi: 10.1177/1545968314546134
- Krasnow, Donna H., and M. Virginia Wilmerding. 2015. *Motor Learning and Control for Dance Principles and Practices for Performers and Teachers*. Champaign, IL: Human Kinetics
- Kumru, Hatice, Sergiu Albu, Raul Pelayo, John Rothwell, Eloy Opisso, Daniel Leon, Dolor Soler, and Josep Maria Tormos. 2016. "Motor Cortex Plasticity During Unilateral Finger Movement with Mirror Visual Feedback," *Neural Plasticity*. doi: 10.1155/2016/6087896
- Lynch, Jennifer A., Gordon R. Chalmers, Kathleen M. Knutzen, and LeaAnn T. Martin. 2009. "Effect on Performance of Learning a Pilates Skill with or without a Mirror." *Journal of Bodywork and Movement Therapies* 13, 283-290. Doi: 10.1016/j.jbmt.2008.09.003

- Notarnicola, Angela, Guiseppa Maccagnano, Vito Pesce, Silvia Di Pierro, Silvio Tafuri, and Biagio Moretti. 2014. "Effect of Teaching with or without Mirror on Balance in Young Female Ballet Students," *BioMed Central* 7, no. 426, doi: 10.1186/1756-0500-7-426
- Radall, Sally A., and Daniel D. Adame. 2003. "Effect of Teaching with Mirrors on Ballet Dance Performance." *Perceptual and Motor Skills* 97, 960-964.
- Radell, Sally A., Margaret L. Keneman, Mara P. Mandradjieff, Daniel D. Adame, and Steven P. Cole. 2017. "Comparison Study of Body Image Satisfaction Between Beginning- and Advanced-Level Female Ballet Students." *Journal of Dance Medicine & Science*, 21(4). doi: 10.12678/1-89-313X.21.4.135
- Rjosk, Viola, Joran Lepsien, Elisabeth Kaminski, Maike Hoff, Bernhard Sehm, Christopher J. Steele, Arno Villringer, and Patrick Ragert. 2017. "Neural Correlates of Mirror Visual Feedback-Induced Performance Improvements: A Resting-State fMRI Study." *Frontiers in Human Neuroscience* 11, 54, doi: 10.3389/fnhum.2017.00054
- Sewall, Leslie Paul, T. Gilmore Reeve, and Robert A. Day. 1988. "Effect of Concurrent Visual Feedback on Acquisition of a Weightlifting Skill." *Perceptual and Motor Skills* 67, 715-718
- Thomas, Jerry R., and Jack K. Nelson, Stephen J. Silverman. (2005) 2015. *Research Methods in Physical Activity*. Champaign, IL: Human Kinetics

**APPENDIX A**

Participant Code: \_\_\_\_\_

## Participant Questionnaire

1. How many years of training do you have in the following genres of dance?

- Ballet: \_\_\_\_\_
- Modern: \_\_\_\_\_
- Jazz: \_\_\_\_\_
- Tap: \_\_\_\_\_
- Lyrical: \_\_\_\_\_
- Contemporary: \_\_\_\_\_
- Hip Hop: \_\_\_\_\_

2. How many hours of training do you currently participate in each week in the following genres of dance?

- Ballet: \_\_\_\_\_
- Modern: \_\_\_\_\_
- Jazz: \_\_\_\_\_
- Tap: \_\_\_\_\_
- Lyrical: \_\_\_\_\_
- Contemporary: \_\_\_\_\_
- Hip Hop: \_\_\_\_\_

3. Age (must be 18 years of age or older to participate): \_\_\_\_\_

4. Have you sustained an injury in the last six months? \_\_\_\_\_

5. Have you trained in ballet or modern technique in a studio without a mirror? \_\_\_\_\_



## APPENDIX B

Participant Code: \_\_\_\_\_

### Participant Performance Score Sheet

**Rubric:** For each section scores are based on number of errors

- 5: No errors
- 4: 1-2 errors
- 3: 3-4 errors
- 2: 5-6 errors
- 1: 7-8 errors

**Accuracy:**

Criteria: Movement matches what was demonstrated. Body is placed in the same manner (arms out to the side or down, leg lifted at the same degree such as 30,45, or 90 degrees, head and body facing the direction, foot placement). No steps are missed. Steps are performed in the correct order.

- Number of errors: \_\_\_\_\_
- Score: \_\_\_\_\_

**Timing / Musicality:**

Criteria: Steps are performed on the correct note or beat. The dancer finishes with the music not before or after the end of the music.

- Number of errors: \_\_\_\_\_
- Score: \_\_\_\_\_

Score	1	2	3	4	5
<b>Accuracy</b>					No Errors
<b>Timing/Musicality</b>					No Errors

## APPENDIX C



TO: Emily Weber Jennifer Didier

FROM: SHSU IRB

PROJECT TITLE: Learning and practicing dance phrases with and without a mirror, a comparison study

PROTOCOL #: IRB-2019-276

SUBMISSION TYPE: Initial

ACTION: Approved

DECISION DATE: October 4, 2019

ADMINISTRATIVE CHECK-IN DATE: October 4, 2020

EXPEDITED REVIEW CATEGORY: 6. Collection of data from voice, video, digital, or image recordings made for research purposes.

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Greetings,

The above-referenced submission has been reviewed by the IRB and it has been Approved. Because this study received expedited review and the IRB determined that a renewal submission is not needed, this decision does not necessarily expire; however, you will be receiving an email notification on the anniversary of this study approval, which will be on October 4, 2020 ( NOTE: please review the reminder information below regarding Study Administrative Check-In). This study approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

## VITA

### EMILY E. WEBER

#### EDUCATION

Sam Houston State University  
**MS Kinesiology** **2020**  
 Thesis: Learning and practicing dance phrases with and without a mirror: A comparison study

University of Iowa  
**BA Dance** **2010**

#### TEACHING EXPERIENCE

Iowa Ballet Academy  
**Instructor – Beginning Ballet, Pro 2 Ballet and Modern, Pro 4 Ballet and Pointe, Progressing Ballet Technique** **2012**  
 Teach multiple levels of ballet, pointe, modern dance, and progressing ballet technique in the pre-professional training division at Iowa Ballet Academy as well as beginning ballet in the recreational open division.

Charlee’s Elite School of Dance  
**Instructor - Ballet** **2016**  
 Taught multiple levels of ballet to the competition teams at the dance studio.

Devine Dancers  
**Instructor – Ballet and Pointe** **2010**  
 Taught multiple levels of ballet and pointe to the competition teams at the dance studio.

#### RELATED EXPERIENCE

Iowa Dance Theatre  
**Rehearsal Director** **2017 –**  
**Present**  
 Choreography and rehearse sections of ballets and provide warm class prior to performance.

Yaro Dance Company  
**Ballet Mistress** **2018 –**  
**Present**  
 Set and rehearse choreography for fall and winter performances and assist with the backstage production of each show.

## PUBLICATIONS AND PAPERS

*“Learning and practicing dance phrases with and without a mirror, a comparison study”*

Thesis

2020

## LANGUAGES

English– native language

French– speak, read, and write with moderate proficiency

## MEMBERSHIPS

Dance Masters of Mid America

National Dance Education Organization

North American Society for the Psychology of Sport and Physical Activity  
(NASPSPA)