

Comparing Perceived and Actual Cognitive Lateral Bias in University Dance Majors

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Abstract

Lateral bias (also referred to as lateral preference) is defined as an “innate bias for one side or the other” (Kimmerle, 2010). “Side” of the body is a reference to whether a movement is right dominant or left dominant in its execution. Although all human beings develop a functional lateral bias that is reinforced by the habits in their daily lives, it has been suggested that dance training increases asymmetry because of its over-emphasis on the right side of the body (Mertz et al., 2011). Despite this hypothesis that dance training could be a proponent of lateral bias toward right dominant movement, dancers are encouraged to be symmetrically proficient in their ability to perform movements that are both right dominant and left dominant to avoid choreographic limitation and injury.

While it is difficult to determine if asymmetries are pre-existing in a dancer, there is strong evidence that dancers have a highly-developed proprioceptive sense that allows them to accurately identify relatively minute differences in their own laterality (Jola et al., 2011). The objective of this research was to determine if university dance students’ perception of their lateral bias correlates with their actual lateral bias. This information will help dance researchers to understand the effect of lateral bias on dance training and performance, as well as assist dance teachers in making informed choices about how to develop well-rounded dancers.

Introduction

The goal of most codified dance techniques is to develop holistic, laterally unbiased individuals who are not limited physically or cognitively by a weaker side. Dance styles such as ballet, tap, jazz, and modern are built upon the value of repetition in order to develop difficult skills that involve balance, strength, and flexibility of the whole body. However, previous researchers have noted that in many cases the traditional practice of teaching complex movement sequences (or combinations) on the right side of the body has affected the overall division of practice on the right and left sides of the body. Farrer-Baker *et al* discovered that the repetition of combinations in both contemporary and traditional ballet classes is almost 26% higher on the right side of the body, a discrepancy that increases with the advancement of the students.

It is questionable whether this approach to dance training is harmful to the health and safety of the dancers, or if it compromises their ability to perform choreography on both the right and left sides of the body regardless of preference. Because of the innate laterality of all human beings, influenced by both structural and cultural factors, the difficulty in determining whether physical bias affects preferences in dance training (or if it is the other way around) may have limited the amount of research done in this area. However, there has been some quantitative analysis done of the structural and postural balance of dancers.

Mertz *et al* used a force plate to determine the ground reaction force (GRF) and center of pressure (COF) in different jumping trials performed by skilled ballet dancers. Although the researchers hypothesized that ballet training may contribute to injurious underdevelopment of a non-preferred side, they discovered that, regardless of leg preference, dancers displayed very little GRF absorption and balance ability discrepancy between trials (Mertz et al., 2006). The musculoskeletal analyzation presented in the last decade shows very little structural variance in the lower limb joints of dancers (Kimmerle, 2010).

This evidence alone does not provide proof for the symmetrical result of ballet training. Gloomier *et al* (2009) relatively recently studied the rotational preferences of adolescent dancers verses that of non-dancers with no previous training. Almost half of the untrained individuals showed a rightward turning bias when performing whole body, spontaneous turns, but over 90% of the trained dancers exhibited the same bias. It is clear from these findings that dance training does indeed affect the lateral preference of individuals at least to some extent, but it also likely increases proprioceptive integration of multiple sensory cues.

This hypothesis is supported by the findings of a study done by Jola *et al* (2011). The researchers looked at simple proprioceptive and visual tasks in both dancer and non-dancer populations. For the solely proprioceptive task, the researchers blindfolded the subjects and then placed the index finger of one of their hands on a target in the middle of a glass table. They were then asked to try and locate the position of the marker with the other hand from underneath the table. The visual task consisted of the subjects trying to locate the target from underneath the table without touching it. A third trial combined the visual and proprioceptive cues by having the subjects touch the target while un-blindfolded.

Through this experimental design, it was discovered that dancers had lower error rates across all of the trials, most significantly in the solely proprioceptive tasks. Dancers also showed very little difference in matching errors when switching between dominant and non-dominant hands, while non-dancers displayed a weaker ability to integrate proprioceptive information from multiple joints with their non-preferred hand.

All of this information has led to an awareness of the need for more research to be done in the area of dancers' perception of their own lateral bias. It is apparent that lateral bias exists in every human being regardless of their physical background, but there is inconclusive evidence determining the effect that dance training has on this reality. The dancers participating in this study were asked to learn a twenty-four count phrase of movement and then independently transfer it to the other side of the body while being timed. Two dance professionals (DPs) with over twenty years of teaching experience in a university setting rated the dancers in their ability to transfer the combination accurately. At the end of their participation in the study, the subjects filled out a survey to determine their perception of how they performed. This study looked at dancers' ability to determine their own proficiency in accurately and quickly transferring complex movement sequences from one side to the other when compared to the evaluations of the DPs.

Methods

Seven female and three male undergraduate students between the ages of 18 and 25 participated in this study. They were all training at an advanced level in Ballet and Modern dance techniques at least four times a week for three hours a day at the time of their participation in the study. All participants were healthy and free of musculoskeletal injury or pain. Each participant signed a consent form prior to data collection and all experimental procedures used in this study were approved by the university ethical review board.

Participants were divided into two randomly selected groups. As each subject arrived at the location of the research activities, he or she was led through a pre-determined warmup prior to their involvement in the experimental procedures. (None of the subjects had taken a movement class prior to participating in the research). While being timed, subjects in the first

group learned a 24 count movement phrase (Combination A) on the right side (RS) of the body. The DPs then observed the participant's performance of Combination A. After this, the participant was timed again while independently working to transfer Combination A from the RS to the left side (LS) of the body. When the participant perceived themselves as ready, the DPs observed the transferred combination for accuracy. The whole process was then repeated in reverse as the subjects learned a different 24 count movement phrase (Combination B) on the LS and transferred it to the RS. The second group of participants completed the same research activities, but they learned Combination A on the LS and Combination B on the RS.

In every case, the DPs were present only for the final performance of the combinations. They filled out a rubric for each participant based on a pre-determined set of criteria relative to the expectations of overall dance technique. Figure #1 is an example of the rubric used for this study. The DPs rated each dancer on a scale from one to five (one being poor, three being average, and five being exceptional) in four different categories: overall technical performance, accuracy of direction changes/facings, accuracy of overall body placement, and understanding of sequence.

Figure #1

<i>Accuracy of Combination A on First Side</i>	
Overall Technical Performance	
Accuracy of direction changes/facings	
Accuracy of overall body placement	
Understanding of sequence	

(Example of rubric filled out by DPs to determine the accuracy of combinations learned and transferred by research subjects)

A laterality questionnaire developed by Kimmerle was used as part of the post-participation survey filled out by research subjects after their completion of all research activities. This questionnaire asked participants about their lateral preference for daily activities such as writing, kicking a ball, and climbing stairs. It also requested information about the subjects' lateral preferences for dance skills such as retiré, pirouette, and grande battement in

regards to strength, balance, and flexibility. Participants were then asked which side of the body they preferred to learn combinations on. The purpose of these questions was to get information on possible correlations between preferences for everyday activities and dance skills.

For the second half of the participation survey, subjects were asked to rate their own ability to transfer combinations based upon their participation in the research study. Figure #2 is an example of the survey questions. The subjects rated themselves on the same scale used by the DPs. One category was added for the subjects' perception of their ability to transfer combinations quickly from one side to the other. At the end of the survey, an opportunity was provided for the subjects to share any additional comments on their performance during the research activities.

Figure #2

On a scale from 1 to 5, how would you rate your ability to transfer a combination from right to left -					
with accurate technique?	1	2	3	4	5
with accuracy of direction changes/facings?	1	2	3	4	5
with accuracy of body placement?	1	2	3	4	5
with understanding of sequence?	1	2	3	4	5
quickly?	1	2	3	4	5

(Example of survey filled out by research participants in reflection of their participation in the research study)

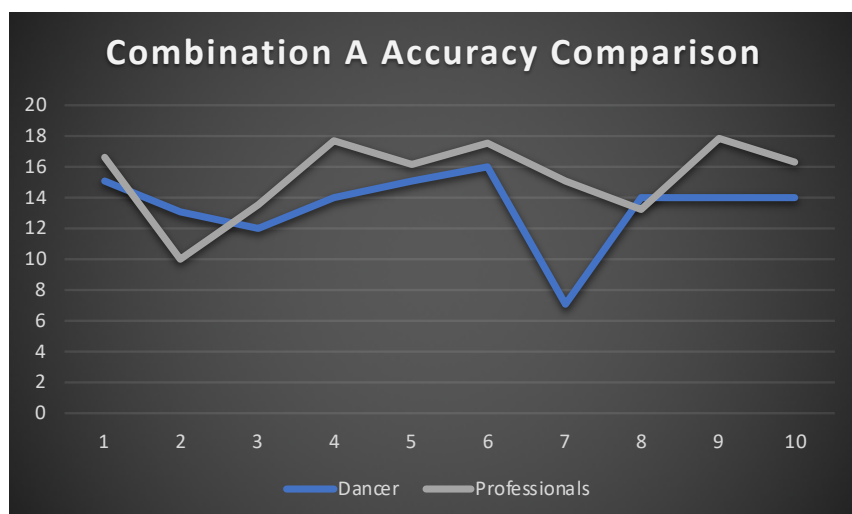
Results

Eight of the ten participants preferred to do all specified daily activities with right dominant side, and all ten had mixed side preferences for the specified dance skills. According to the ratings given by the DPs, nine out of the ten subjects (regardless of what group they were in) learned the combination more accurately on the RS or equal to the LS. Six of the ten dancers transferred the combination more accurately from the LS to the RS and one dancer transferred equally accurately. The remaining three participants transferred more accurately from the RS to

the LS, and all three of them were a part of the second group that learned Combination B on the RS of the body.

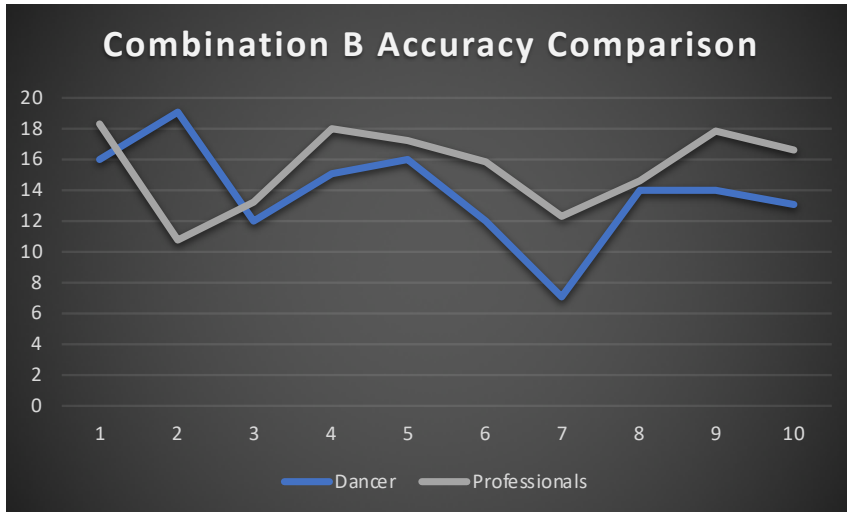
Figures #3 and #4 are graphs depicting comparisons of the accuracy ratings given by the DPs and the ratings given by the participants. Figure #3 contains the ratings from the transfer of Combination A, regardless of the actual side of the body. Figure #4 contains the same information, but from the transfer of Combination B. These figures show that the ratings of the DPs were higher than the ratings that the participants gave themselves in almost every case. There was only one participant whose ratings were substantially higher than those of the DPs. The participants' perception of their accuracy on each side was consistently close to the actual accuracy ratings given by the DPs. Nine out of the ten participants rated themselves correctly or equally when comparing the accuracy of Combination A to that of Combination B. Only one participant rated themselves as transferring more accurately for the incorrect combination.

Figure #3



(A comparison of the accuracy ratings from Combination A of the DPs and the participants)

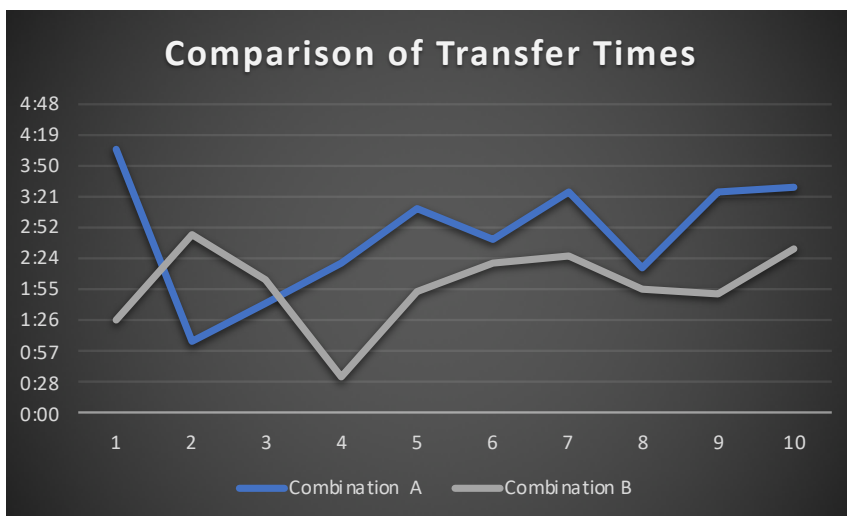
Figure #4



(A comparison of the accuracy ratings from Combination B of the DPs and the participants)

As for time, nine out of the ten participants learned Combination B more quickly, regardless of the group they were in. Figure #5 is a graph depicting a comparison of the transfer times for Combination A and B. Eight of the ten participants transferred Combination B more quickly to the second side. All ten of the participants rated themselves either correctly or equally when comparing the transfer times for the combinations.

Figure #5



(A comparison of the participants' transfer times for Combination A and B)

Discussion

There was little variation within the survey data pertaining to right and left side preferences in daily activities and dance skills for all participants. Eight of the ten participants preferred to do all specified daily activities on the RS of the body and nine of the ten participants learned more accurately on the RS of the body. Since every subject had mixed side preferences for performing the dance skills specified in the survey, it is possible that lateral bias developed outside of the dance classroom has more affect on the learning abilities of dancers than the traditional structure of learning all or most skills and combinations on the RS of the body.

This illustrates the difficulty of separating the influence of non-dance activities from dance training itself. It is nearly impossible to ascertain if lateral preference is increased by dance training without the presence of a control group of non-dancers, although movement sequences appropriate for both dancer and non-dancer populations would be a challenge to identify. The accuracy ratings for the transferred combinations were inconclusive. There was not a significantly higher number of participants who transferred more accurately on either side of the body.

There is sufficient support for the idea that dancers have a highly developed perception of their own accuracy when transferring combinations from one side to the other. Nine of the ten participants rated themselves correctly in comparison to the ratings of the DPs when comparing Combination A to Combination B. Since the participants rated themselves lower than the DPs in the vast majority of cases, it is possible that dancers have such a highly developed awareness of their lateral bias that it is more obvious to them than it is to others. Dance technique may not increase lateral bias itself, but there is evidence that it does increase individuals' accurate recognition of existing lateral bias.

The actual time that the participants took to learn and transfer the combinations was shorter for Combination B (regardless of side) for the majority of cases. This again disproves the hypothesis that dance training increases lateral preference for the RS of the body, at least in regards to learning and transferring movement sequences. These results may have been due to increased comfortability in the situation over time, better understanding of the expectations of

the study, or experience. Some dancers indicated that they felt more prepared to transfer Combination B to the other side because they were already beginning to think about transferring while learning the combination. This indicates that dancers are highly adaptable; they develop the ability to efficiently implement more effective learning practices. All participants were either correct or rated themselves equally in their assessment of the time it took them to transfer the two combinations.

The practice of transferring learned movement sequences from one side to the other independently and quickly in a dance classroom setting may be an effective tool for teaching holistic proprioceptive abilities in spatial awareness and balance, regardless of which side of the body is taught first. The extreme accuracy of the ratings of the participants when compared to the ratings of the DPs and their actual transfer times supports this hypothesis. Dancers have an extremely accurate perception of their individual abilities, often to the point of over-exaggeration.

Dancers also have a well-developed sense of autonomy. All of the participants were able to work independently to transfer the combinations by using their knowledge of the initial side. Even when the sequence was not re-produced completely correctly, the dancers performed confidently for the DPs. Transferring complex movements from one side of the body to the other is more than reversing a sequence. It is a kinesthetic experience that involves use of multiple senses at once, including a broader sense of spatial orientation and muscular control. Dance technique and the traditional classroom setting seem to be teaching these necessary skills (and many more) quite effectively. The challenge of learning dance movements and sequences on the non-preferred side is a challenge that may be beneficial in the training of well-rounded dancers, as well as a refreshing change from the expectations of the students.

Limitations

Limitations of this study might include the small participant pool. Other limitations might have been the participants' low comfort level in the technique chosen for the combinations or their unfamiliarity with the space. Since the research activities took place in a controlled and formal environment and the participants were aware that they were being rated and timed during

their performances, their stress or anxiety might have increased beyond what they would normally experience in a classroom setting. None of the subjects had taken a movement class on the day of the study, which also might have affected the results, despite a warmup being included in the research activities. The dance professionals had contact with the participants prior to the research during technique classes and rehearsals, which may have compromised the impartiality of their ratings.

Conclusion

The information gathered in this study provides support for the hypothesis that dance training increases dancers' awareness of their lateral preferences and enables them to accurately determine their ability to transfer learned combinations from one side of the body to the other. Dance training does not seem to correlate with more pronounced lateral preference. However, it is very difficult to differentiate between lateral biases developed inside and outside of the dance classroom. Outside of this limitation, there is sufficient support for the idea that independently transferring movement sequences from one side to the other in a dance classroom setting may be an effective tool for developing strong kinesthetic and proprioceptive senses.

Further study in this area might include interventions over time in a classroom setting, rather than the one-time trial provided by this research study. Rather than having dancers self-report on their preferred side for daily activities, future research might include an observatory session for these activities, as well as the dance skills listed on the survey. A comparison of dancer and non-dancer populations might also provide useful information as to the extent of increased awareness and kinesthetic ability that dance training provides.

Resources

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