EFFECT OF BALLET-EXPERIENCE OF 12-YEAR-OLD FEMALE CHILDREN ON THE LEARNING OF DYNAMIC BALANCE CONTROL

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The purpose of this study was to examine whether previous regular experience in ballet enhance the learning balance task on the balance testing board. Eighteen healthy female children aged twelve including eight with more than three years ballet-experience and eight without the ballet-experience participated. Dynamic balance learning consisting of 3 sessions, which were pre-training and post-training with practices, and retention with no practice, were performed on the balance testing board. The interval between each session was one week. The stability was measured while the subject performed balance task on the same balance testing board placed on an AMTI force platform. The stability was defined as the sum of center of pressure (COP) and center of body mass (COM) mono directional displacements; and the variance of the end tip of the balance board displacement in vertical direction. Two way ANOVA for repeated-measures (2 groups × 3 sessions) revealed statistically significant ($P<.05$) increases in postural stability for the test immediately following training and the retention test in both groups. Although interaction effect indicated greater improvement in non-experienced group, the stability of the group with experience in ballet far exceeded that of the group without experience, about all the variables of each session. Our results suggest that experience in ballet up to being twelve year old have positive influence on the learning dynamic balance control task.

KEY WORDS: Ballet experience; Learning; Development; Dynamic balance; Children

INTRODUCTION:

Many researchers, nowadays, have devoted their investigation about dynamic balance, relying on the body's ability to integrate visual, vestibular and somato-sensory systems, and the coordination between posture and movement to minimize degrees of freedom. At the sensory level, if a dynamic conflict situation occurs, the human brain must select the most appropriate sense for the task by vestibular information about head orientation in space (Wegener et al., 1997). Peterson et al.(2006) found through SOT(sensory organization test) that the integration of sensory information is reached and matured at the age of 12 years old, which was comparable to the test results of adults. These findings differ from earlier research (Shumway-Cook & Woollacott, 1985) that reported adult-like postural control, including overall amounts of postural sway, response to perturbations and the use of sensory information in children.

A specific postural experience could be considered as an intrinsic constraint, which leads to modification in the patterns of functional adaptation in the perceptive motor space (Gautier, et al., 2007). The experience of ballet-based movements, demanding balance, are expected to have an extremely advanced sense of awareness regarding the posture and motion of their bodies, and can enhance balance abilities (Crotts et al., 1996; Gerbino et al., 2006). Many researchers have been explored simple forms of learning about balance, with the understanding that these simple forms of learning are attributed to the acquisition of more complex skills. Thus, the purpose of this study was to examine whether previous regular experience in ballet before 12 year old enhances the learning of balance task on a balance testing board or not. It was hypothesized that the experience of training in ballet would modify the integration process so that ballet-experienced children would have more improvement in dynamic balance adaptations.

METHODS:

Subjects: Participants were sixteen healthy children, 8 with more than 3 years experience and 8 without the experience. Children without experience in ballet also had no regular experience in physical activity at their daily living before ages of twelve. The age of all the individuals in both groups was 12.

Table 1: The characteristics of subjects

Groups	Ballet-experienced	Non- experienced
Age(yrs)	12	12
Weight(kg)	36.41 ± 5.8	36.04 ± 7.27
Height(m)	148 ± 9.16	144.2 ± 6.18

Training: The subject was required to get in the Romberg position (M´egrot et al., 2002) on the balance testing board (0.6m × 0.32m × 0.165m) and asked to practice maintaining their balance for 7 minutes. During instruction, on the board the subject must be not to stand still, but to adjust posture continuously to learn balance. Both groups received the same feedback about learning balance such as “Pay attention to your internal body”. Assessments were conducted on pre-test after training for 5 days, then post-test after training for 6 days, and lastly the retention test after no training for 7 days, as shown in Table 2.

Table 2: Conducted periods of the experiments

Ballet-Experience	Pre-training (1st session) 5 days	Pre test	Post-training (2nd session) 6 days	Post test	No-training (3nd session) 7 days	Retention test
Non-Experience						

Experimental Procedure and Data Collection: Subjects stood barefoot on the balance testing board placed on a force platform and were asked to stand with their arms relaxed comfortably at their sides, and two feet shoulder width apart in the middle on the balance testing board. Subjects were firstly leaned to the left side as at rest as possible, and then started to maintain balance along our light cue. The reason that the subjects were asked to start their motion after perceiving our light cue was in order to synchronize the standard for assessing balance during 20s for all the individuals with the start of data collection. Each trial was performed eight times for a total of 20s each.

A force platform (AMTI, OR-6) was used to record COP at a sampling frequency of 1000Hz. Motion analysis system (seven cameras, QTM) was collected at 100 Hz to be synchronized with the force plate data. All marker data were low-pass filtered using a second order Butterworth filter with cut-off frequency of 6 Hz and interpolated with a maximum gap fill of 10 frames

Data analysis: The following parameters were computed: Total length of COP and COM inter-sample mono directional displacements (Cornilleau-Peres et al., 2005); LPD and LMD respectively, and the variance of the pivot displacement of the platform on the horizontal position (16.5cm in height); VPD. Two experimental group levels (with experience vs. without experience) with three sessions (Pre, Post, and Retention test) analyses of variance (ANOVAs) with repeated measures on the second factor were utilized for the COP, COG, and the motion of platform variables using a SPSS 13.0 software. The level for significant differences was set at $p < 0.05$.

RESULTS:

2 way ANOVAs with repeated measures revealed that a significant interaction between groups and sessions was observed for LPD, F=15.627, P=.000, and there were significant differences between B-Expt (F=16.099, P=.001) and Non-Expt (F= 14.84, P=.002) for LPD. There was a statistically significant interaction between sessions and groups for LMD only for non-expt group (F=9.291, P=.009). In addition, there was a statistically significant difference in three sessions in terms of VPD for both groups, F=54.825, P=.000, and F=4.791, P=.046, respectively. However, there was no statistical interaction between sessions and groups for VPD. (Fig 1)

Table 3: Mean and Standard Deviation of all recorded variables

Period	Pre		Post		Retention	
Group	**B-Expt**	**N-Expt**	**B-Expt**	**N-Expt**	**B-Expt**	**N-Expt**
LPD(mm)	5632±1429	9929±1027	4722±1155	5826±1629	4840±964	6346±1222
LMD (m)	0.89±0.34	1.87±0.88	0.92±0.24	1.21±0.2	0.65±0.21	1.32±0.19
VPD (m)	121±16.2	127±12.25	90±23.08	114±15	93±15.7	103±11.08

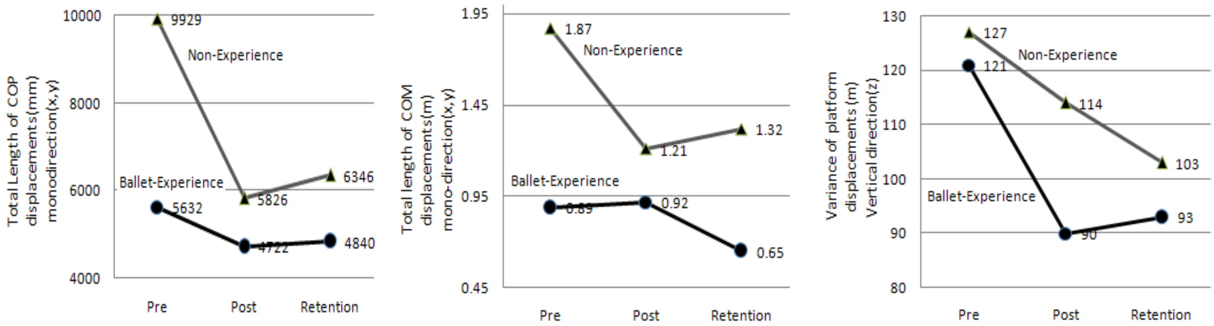

Figure 1: Total length of COP, COM displacement, and platform displacement, respectively

DISCUSSION:

Numerous studies about the difference between ballet-participating individuals and other athletes have been shown the effectiveness of ballet training on balance performance for static or dynamic balance tasks, such as eyes closed and foam mat surface tests (Crotts et al., 1996). However, our research was to demonstrate the effect of learning improvement in dynamic balance according to whether the subject had experience in ballet before 12 years old or not, observed by assessing the achievement of not how to use the platform but how to maintain their balance on the platform.

According to our results, children with experience tended to minimize their body movements more on the platform during learning than children without experience (Fig. 1). Unlike our hypothesis, the learning effect was statistically shown at both groups immediately in following training and the retention test, and there were statistically significant ($P<.05$) increases in less sway (LPD) for both over the three sessions. Even a statistical significance in difference about LMD was shown for the non-experienced group. It assumed that it is likely because the 12-year-old children increase the ability to make better use of the sensory information that was being received, shown as earlier research (Peterson et al., 2006). However, although greater improvement was observed in non-experienced group than in ballet-experienced group, the stability of the group with experience far exceeded that of the group without experience, for all the variables for each session. Therefore, we assumed that ceiling effects in the learning processes were represented by the ballet-experienced group of which the changes in the performance levels became increasingly insensitive to the changes in the learning occurred as they practiced, so that it was more difficult for them to improve the skill.

Both groups had the same tendency to use their arms to assist in maintaining dynamic balance. However, it was likely that the more they learned, the less the ballet-experienced children used their arms.

Furthermore, it is observed for children with the experience that only a small range of their motion about center of gravity was used at pre-testing (Fig 1). This maybe because during learning ballet they were instructed to balance by maintaining upper body posture important in ballet movement skills (Ramsay et al., 2001). Therefore, they had lower scores in pre-testing than in post-testing for the total length of COM displacements. Even though they may have moved their ankles and legs more in pre-testing only to stand on the platform and then although the platform was more tilt in pre-testing, the COM values on were presented to seem that they perform greater in pre-testing than post-testing.

After all, we suggested that although the interaction effect was presented at both groups, group with ballet experience was superior to balance.

CONCLUSION:

In conclusion, the children with experience in ballet before 12 years old learned balance better than the children that had no experience so that this experience has a positive effect on the learning of dynamic balance control tasks.

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