Assessment of Balance and Cognitive Function in Youth Gymnasts

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Abstract. International recruitment of female gymnast identifies children from the age of 4 years old. This study focuses on measuring components of gymnastics, using validated equipment to assess balance, reaction time, and working memory of level 4-5 gymnasts. 16 competitive female gymnasts (6-13year olds) were recruited. Single leg and Tandem Balance Test measured sway and stability while holding an iPod. Reaction time and memory was measured through a sequence of screens asking the subject to touch a point on the iPod as fast as possible and memorize a list of words, then tested recall of the word list. Results suggested no significance between trials 1, 2, and 3 on balance, reaction time and working memory.

1. Introduction (Describe your idea)

Gymnastics is a popular sport that has little research done in cognitive function, reaction time, and balance. Muscle coordination is developed through practice of skills in sports; theory has suggested that practice overtime develops a mastery of skills [1]. 16 gymnasts were assessed using Smart Phone software designed to assess balance, cognitive function, and reaction time.

This study can be beneficial for future use of the smart phone software in different ways for all athletes. Balance, reaction time, and working memory are used in a variety of sports. Participants in this study will benefit from greater knowledge and understanding of their balance [2], reaction time, and working memory. A data base will be created from the data collected from the research and will aid further research into the measurement of balance, reaction time, and working memory.

2. Experiment, Results, Discussion, and Significance (Describe how you developed your idea)

Balance was measured standing on the right leg while holding the left leg out in front. The start button was pushed and a 10 second measure of balance was recorded. The gymnast held the iPod against her chest while balance was measured. Balance was measured a second time with the gymnast placing her feet in tandem stance. The gymnast pushed start and closed her eyes and brought the iPod to her chest and held for 10 seconds. Reaction time and memory was measured through a sequence of screens asking the subject to touch a point on the iPod as fast as possible and memorize a list of words, then tested on recall. The data was recorded onto an excel program and SPSS software analyzed the data. Descriptive statistics are seen in Table 1.

Table 1 Means and Standard Deviation for the Three Time trials

	Time1	Std. Deviation1	Time2	Std. Deviation2	Time3	Std. Deviation3
Balance Single Leg	.681	2.725	.503	2.014	.644	2.574
Balance Tandem	.770	3.081	3.141	12.564	.707	2.827
Reaction Single Box	.012	.047	.012	.048	.015	.059
Reaction Four Boxes	.023	.057	.014	.057	.034	.136
Work Memory Word	2.633	10.534	1.986	7.945	1.737	6.950
Work Memory Pattern	.458	1.834	.645	2.582	.583	2.330

Results showed that tandem stance scores were higher than single leg balance scores, suggesting that the gymnast balanced with less sway on one leg than with a tandem stance. Visual cues were not present for the tandem stance as the gymnasts were prompted to close their eyes. Two gymnasts had higher tandem stance scores in the second trial that caused a standard deviation of four times the standard deviation of the first and third trial. The environment in which the gymnasts were tested could have contributed to the presence of the outlier scores. Noise, skill training,

and interaction from other gymnasts factor into a busy environment. The standard deviation of the working memory wordlist decreased after each trial, demonstrating that working memory increased with practice from the gymnast. Reaction single box time for all 3 trials of standard deviation was within ±.011 seconds. Reaction four boxes required focus on four boxes instead of one. The four boxes challenged the gymnast's focus and hand speed, representing hand/eye coordination. Overall no significant difference was found between the three trials.

3. Conclusions

Gymnastics requires balance, focus, and quick response. Gymnasts of different ages and cognitive abilities perform at different skill levels. This study provides valuable data for the gymnast and the coach on the strengths and weaknesses of each gymnast. Balance is frequently performed on one leg in the gymnast's floor routine as well as on the balance beam; transference of muscle memory patterns from both events could be a factor in the balance performance during testing. Single leg balance stance scored lower demonstrating less sway of the gymnasts than tandem stance. This is an example of transfer of training of single leg balance stance on the balance beam and floor. Age could present an assumption of better balance, quicker reaction time [3] and cognitive function. A study with gymnasts involving balance, reaction time, and working memory should involve a larger group of gymnasts with varying levels of skill. Our data was skewed by two high scores for balance in trial 2 by two different gymnasts. The standard deviation in the second trial was tripled from the first trial, possibly due to distraction from the testing environment. The gymnast's demonstrated an increase in working memory over the three trials, shown through a decrease in standard deviation for each trial. A larger group of gymnasts would allow those two girls to be excluded from the study, allowing for more reliability in the statistical analysis. Future studies will include a larger group of gymnasts and will set parameters that control such factors as, the number of participants in the testing environment.

References

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