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INVESTIGATING STATIC AND DYNAMIC SPATIAL ABILITIES IN DANCERS

Natalie McElroy[1], Erica Barhorst-Cates[1], Jeanine K. Stefanucci[1], & Margaret R. Tarampi[2]
Department of Psychology
[1]University of Utah, [2]University of Hartford

Introduction

Prior research has found that people who have careers that require high levels of spatial ability (e.g., radar operators, sport players, army officers) also show an increased ability to dynamically track multiple, randomly moving targets (Barker, Allen, & McGeorge, 2010). Multiple object tracking (MOT) is the ability to track multiple moving objects simultaneously and could be considered a measure of dynamic spatial ability, which has traditionally been thought of as a skill set that simply requires making judgements about moving objects (Halpren, 2000). Dance is a skill that requires high levels of dynamic spatial ability. Specifically, dancers must keep track of who is next to them to synchronize with their group, while simultaneously performing detailed movements with their own feet, hands, and body. Research on dance has not focused on quantifying dynamic spatial ability through object tracking. The current study investigated whether dancers' spatial expertise is rooted in superior dynamic but not static spatial ability. Prior work has shown that dance training may not affect static spatial ability, so here we test whether it could provide an advantage in more dynamic tasks (Jola, Davis, & Haggard, 2011) (Tarampi, Guess, Stefanucci, & Creem-Regehr, 2009). Findings could have implications for the training of dynamic spatial ability and may be helpful for success and entry into STEM (Science, Technology, Engineering, and Math) fields.

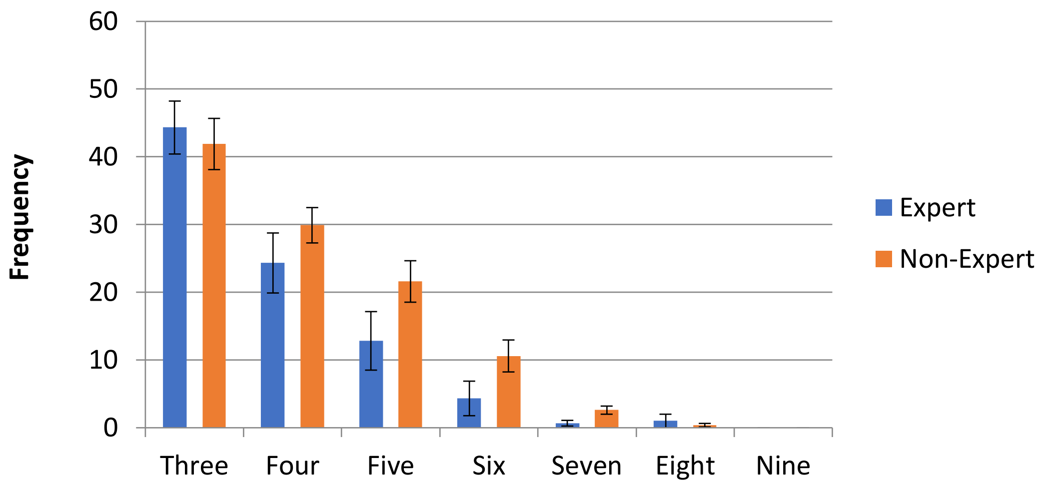
Methods

The study consisted of two samples: 6 expert dancers and 10 non-expert dancers. Participants were all female. We defined an expert dancer as someone who has had 10+ years of dance experience. Each participant in the expert dancer sample had prior dance experience, including, but not limited to, at least 10 years in an organized dance class. There was a total of 3 tasks the participants were asked to complete: Multiple Object Tracking (MOT; dynamic ability task), Mental Rotation Task (MRT; static ability task), and a questionnaire. Participants completed the MOT or MRT task first and then completed the other (counterbalanced). Lastly, they completed the questionnaire. For the MRT test, participants had a timed 5-minute practice session followed with 2 sections that were 3 minutes per section with 10 questions in a section (MRT; Vandenberg & Kuse, 1978). The task required participants to mentally rotate cube forms in different configurations, but because the judgements are made based on static 2D images, we considered the MRT to be a static spatial ability test. The MOT is a timed multiple object tracking task in order to measure dynamic spatial ability (MOT; Pylyshyn & Storm, 1988). Objects appear on a screen and participants are told which to track. The objects begin moving and when they stop, participants report where the tracked objects ended in location. The first 7 participants completed 21 practice trials followed by 245 experimental trials. We trimmed the MOT task down to 7 practice trials followed by 210 experimental trials. We also decreased the speed from 5 to 4, increased the cue retrieval time from 1 to 3, and eliminated 1-2 number of targets so there would only be 3-7 targets available to track. In the final questionnaire, participants completed two questionnaires: Vividness of Movement Imagery Questionnaire (VMIQ-2; Roberts, Callow, Hardy, Markland, & Bringer, 2008) and Vividness of Visual Imagery Questionnaire (VVIQ-2; Marks, 1995). Then they gave a detailed account of their dance experience and filled out the Spatial Activity Survey (Newcombe, Bandura and Taylor, 1983) regarding their experience with activities rated as spatial (81 questions regarding specific type of activities). Participants concluded the questionnaire with their frequency (or lack thereof) in regard to their video game experience.

Results

Descriptive statistics showed the average age: 19 (expert dancers are 19 (SD = 1.21), non-expert dancers are 20 (SD= 3.16)). There was no significant difference in age between groups. Figure 1 shows the total accuracy on the MOT task for each group (expert dancer vs. non-expert); it represents how many times a participant was able to track a certain number of targets (i.e. if 7 targets were presented and they selected 5 correct targets then they were given credit for it – this did not contribute to their percent accuracy). The overall mean of both groups was 20.94 (SD = 24.67) with a percent accuracy of .087.

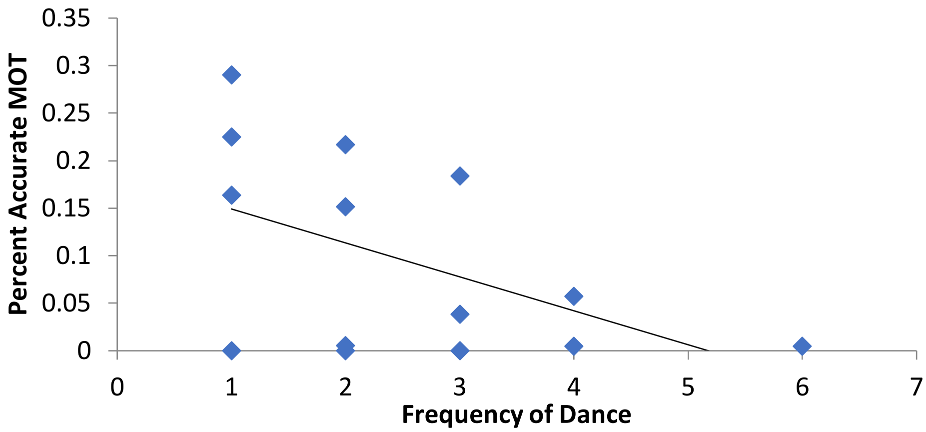
Figure 1 - MOT Task



y-axis: how many times the participant tracked x amount of targets
x-axis: number of targets the participant successfully tracked

Figure 2 shows the relationship between how frequently a dancer practices with their percent accuracy on the MOT task, $r = -.499$, $p = .07$. The correlation was trending toward significant but was in the opposite direction with more frequent dance trending toward less accuracy on MOT.

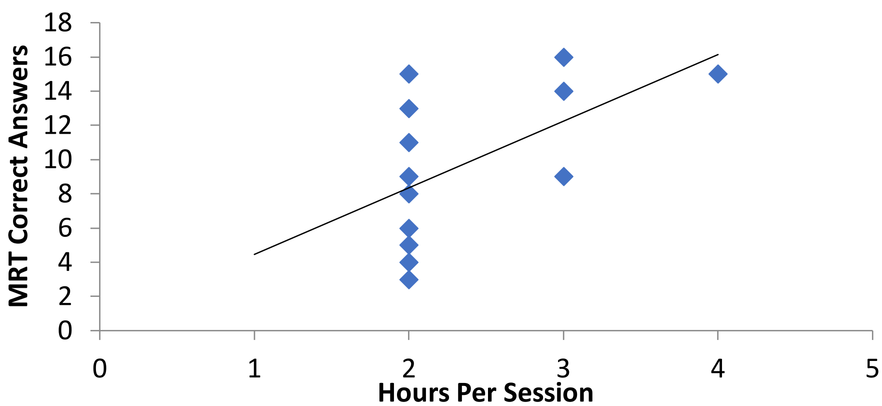
Figure 2 - MOT Task – Percent Accuracy & Frequency of Dance



y-axis: participant selected the correct number of targets that were originally presented
x-axis: daily (1), weekly (2), monthly (3) once every 6 months (4), once a year (5), never (6)

Average correct answers for all participants on the MRT was 10.47 (SD 4.52). Figure 3 shows the correlation between expert dancers' frequency and rate of practice with their performance on the MRT, $r = .674$, $p = .016$. The figure clearly shows that longer time spent practicing was related to better performance on the MRT. Dancers' mean MRT performance was 9.2 (SE = 1.94) while non-expert MRT was 11.33 (SE = 1.47).

Figure 3 - MRT Task



y-axis: correct answers on MRT task (out of 20)
x-axis: less than one hour (1), 1-3 hours (2), 4-10 hours (3), 10+ hours (4)

We ran a preliminary analysis on the variables from the gaming questionnaire and found no significant effect. Future research will look at how the Vividness of Visual/Movement Imagery has an impact on results.

Discussion

Our hypotheses were partially supported. First, there was a positive correlation between total MRT and duration of dance practice, on average. That is, the more intense the dancer (more time spent in a session), the better they performed on the MRT. We found a trending effect (p = .07) for frequency of dance and percent accuracy on the MOT task, but it was in the opposite than predicted direction (with more dance relating to worse performance). However, this relationship was largely driven by one outlier, so more dancers need to be tested before strong conclusions could be made. Further, future research should expand the definition of an expert dancer. We believe the current definition leaves out a population of people who do not fit into the guidelines we adopted; thus leading to a smaller than desired group of people who fit our criteria for expertise. Overall, this study provides some initial evidence to suggest that dancers may experience a benefit in some types of spatial skills due to their training.

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