Spatial Updating and Domain Expertise: The case of dancers

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Introduction

EXPERT DANCERS OUTPERFORM NON-EXPERTS in various spatial tasks (e.g., mental rotation ability, Jola & Mast, 2005)

Are they also better in Spatial Updating Ability?

- Spatial updating is an essential element of navigation, as individuals keep track of their position and orientation in space relative to static objects (Wiener et al., 2011), even in the absence of visual cues.

If so, what makes them better?

- Dance training or individual predisposition?
- Could spatial updating be improved through dance training in adults with no previous dance experience?

To our knowledge, this is the **first longitudinal attempt to explore the effects of dance training in SUA**.

Materials and Methods

PARTICIPANTS

121 female and male healthy adult participants, aged 18-57 years, matched on a number of variables.

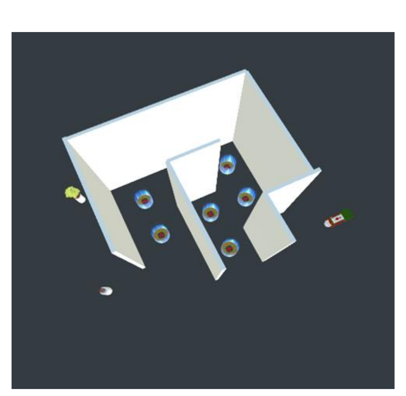
- **Experienced (E)**, *N*=39 (Dance Experience > 10 years)
- **Beginners (B)**, *N*=29 (Dance Experience ≈ 0 at T_1)
- **Controls (C)**, *N*=52 (Dance Experience ≈ 0 at T_1 and T_2)

DATA COLLECTION TIMEFRAME

Baseline Assessment (T_1)	Dance Intervention for Beginners ≈ 4-12 months	Post-Intervention Assessment (T_2)

SPATIAL UPDATING TASK (SUT)

- **SUT tests how well people can update their environment**, and it was completed at T_1 and T_2 by all the participants.



- Individuals were asked to walk through a maze presented in virtual reality and point to a set of previously memorized objects when they reached particular points in the maze.

We are thankful to all the participants and the dance schools for their support. We are also grateful to Maria Panagi for assisting in data collection.

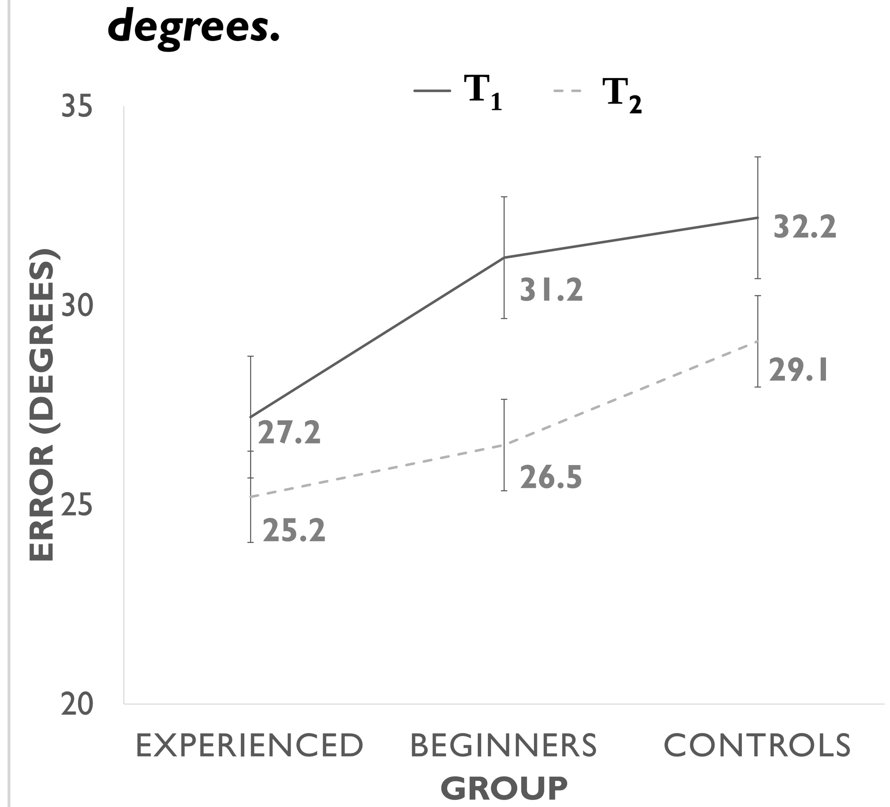
Results

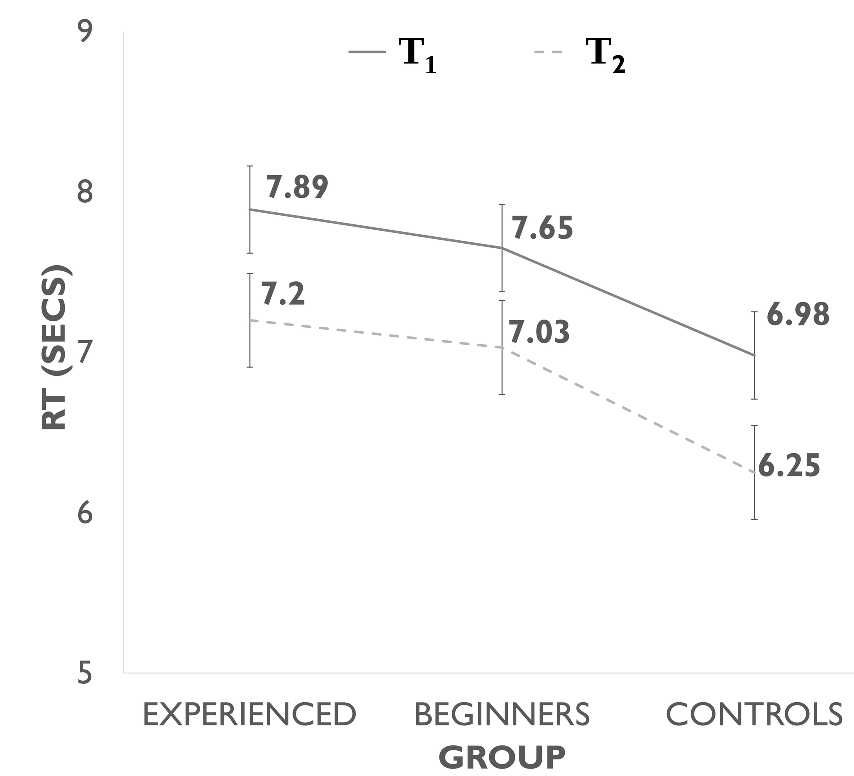
Do Experienced dancers have better Spatial Updating Ability?

- Experienced dancers were more accurate at both time points than Beginners and Controls. However, they were slower.

Could Spatial Updating Ability be improved through dance training in adults with no previous dance experience?

- Experienced, Beginners and Controls performed more accurately and faster at T_2 than at T_1.
- Still, ***Beginners improved the most. Their mean Error was reduced from T_1 to T_2 by 4.7 degrees, while for Experienced by 2 degrees and for Controls 3.1 degrees.***





<u>Data were analysed with **Linear Mixed Effect Models (LMEMs) to capture interindividual variability.** Planned contrasts were also set for Groups and Time Points of Assessment.</u>

	LMEMs for Error (in degrees)	LMEMs for Response Time (RT in secs)
Model 1 – Baseline Assessment (T_1)	χ^2(22)=127.92, *p*<0.001, r^2=.32 (Effect of the Group factor)	χ^2(16)=37.20, *p*=.002, r^2=.41 (Effect of the Group factor)
	E<B, *p*=.05, **B<C**, *p*=.24 (Planned contrasts for 'Group')	**E>B**, *p*>.05, **B>C**, *p*=.19 (Planned contrasts for 'Group')
Model 2 – Post-Intervention Assessment (T_2)	χ^2(22) = 52.73, *p*<.001, r^2=.26 (Effect of the Group factor)	χ^2(16) = 23.07, *p*=.11, r^2=.42 (Effect of the Group factor)
	E<B, *p*=.25, **B<C**, *p*=.08 (Planned contrasts for 'Group')	**E>B**, *p*=.50, **B>C**, *p*=.16 (Planned contrasts for 'Group')
Model 3 – Comparison between Baseline and Post-Intervention Performance (T_1 vs. T_2)	χ^2 (22) = 52.73, *p*<.001, r^2=.26 (Effect of the Group factor)	χ^2(32) =104.26, *p*<.001, r^2=.41 (Effect of the Group factor)
	E<B, *p*>.05, **B<C**, *p*>.05 (Planned contrasts for 'Group')	**E>B**, *p*>.05, **B>C**, *p*>.05 (Planned contrasts for 'Group')
	T_1 > T_2, *p*<.001 (Planned contrasts for 'Time Point')	**T_1 > T_2**, *p*<.001 (only for E & C) (Planned contrasts for 'Time Point')
	E vs. B × T_1 vs. T_2, *p*>.05 **B vs. C × T_1 vs. T_2**, *p*>.05 ('Group' x 'Time Point' effects)	**E vs. B × T_1 vs. T_2**, *p*>.05 **B vs. C × T_1 vs. T_2**, *p*>.05 ('Group' x 'Time Point' effects)

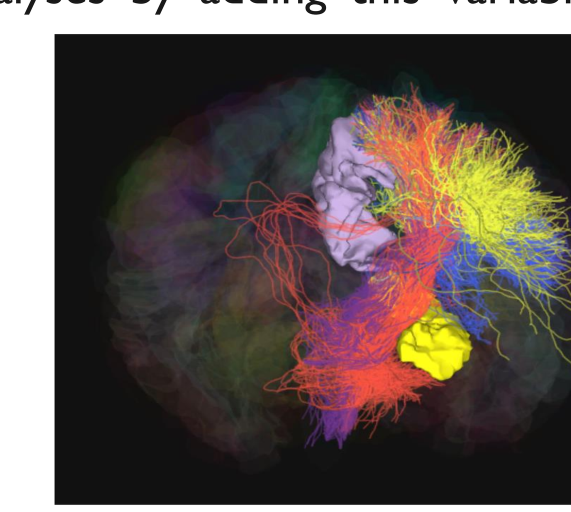
Discussion

1. **Beginners' greatest improvement may indicate cognitive gains from dance practice** (Jola et al., 2011; Keehner & Fischer, 2012), beyond any overall improvement due to task familiarity or other unsystematic factors (e.g., biological or psychological changes in a year; Glisky, 2007). In contrast, the changes in Experienced dancers' spatial updating ability were minor, presumably because they had already experienced the benefits of dance.
2. **Experienced dancers' greater accuracy** may be due to the different strategies they employed while memorizing the arrays (Bläsing et al., 2012) or by differences in brain regions that may have impacted their spatial skills (Hänggi et al., 2010).
3. **Experienced dancers' longer RTs** may be explained by the lack of physical movement in the SUT. Dancers rely more on proprioceptive cues than in vision (Golomer & Dupui, 2000); thus, virtual movement may have tempered their advantage over the other groups.

Future Explorations

Further research is needed to clarify whether dance training enables us to update our external world and successfully navigate our environment.

- Control for practice hours in follow-up analyses by adding this variable as a covariate to the models.
- Neuroimaging data already collected will further investigate **potential changes in beginner dancers' grey and white matter** due to dance training.



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