H11

Cognitive Benefits and Neural Processing Following Early and Continued Arts Training in Dance

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INTRODUCTION

Transfer of Knowledge For over a century it has been questioned whether the knowledge gained through studying particular topics might transfer to the acquisition of knowledge in other domains[1] - a ***cognitive benefit***

NEW QUESTION: Does early and maintained ***Dance*** training lead to cognitive benefits in other domains?

Brain Areas for Processing Dance Research has shown Dancers have increased activations in human mirror systems (including ***parietal cortex*** and ***superior parietal lobe***) when viewing dance movements at which they are expert.[2,3]

NEW QUESTION: Which brain areas are involved in any cognitive benefits from early and maintained Dance training?

METHODS

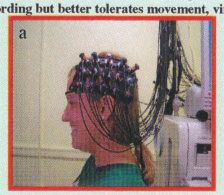
PARTICIPANTS

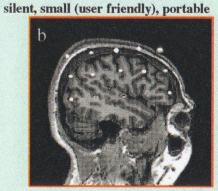
	Group	n	Language Proficiency	Ravens Progressive Matrices	SAT
Exp 1	Dancers*	15	> 80%	> 80%	p > .05
	Non-dancers +	15			
Exp 2	Dancers*	11	> 80%	> 80%	p > .05
	Non-dancers*	11			

* 8+ years continuous dance training, started before age 7, professional performances, active dancer prior to testing, practices dance avg. 7 hours p.w., finds pleasurable (on personal scale)
\+ < 4 years TOTAL Arts training (Dance, Music, Theater), not pleasurable

NEUROIMAGING - NEAR INFRARED SPECTROSCOPY (NIRS)

NIRS measures changes in the brain's oxygen level density (BOLD), yielding measures of deoxygenated and oxygenated hemoglobin, with very good temporal (~<5s HR, Sampling Rate=10 x p.s.) and very good spatial resolution suitable for higher cognitive studies (~4cm depth); comparable to fMRI recording but better tolerates movement, virtually silent, small (user friendly), portable





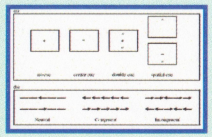
- **3x5 Optode Array** was positioned on participants' heads bilaterally using rigorous anatomical localization measures **(see a above)**
- **10-20** temporal coordinates (T3/T4) were identified and served as anchor points for the 3x5 optode array[4]
- **MRI Neuroanatomical Co-Registration** was conducted by having participants (N = 9) wear a 3x5 array with vitamin-E capsules in MRI **(see b above)**

DATA ACQUISITION & ANALYSIS WITH NIRS

- NIRS signals were recorded using a ***Hitachi 48 channel ETG-4000*** with lasers set at 698nm and 830nm
- Data were analyzed and evaluated with a Matlab-based analysis package designed by Shalinsky to solve the modified Beer-Lambert equation[5].

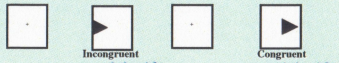
EXPERIMENT 1 BEHAVIORAL

1. ***Language*** **Semantic/Syntactic Competence[6]**
   Task: Plausibility judgments of Subject-Object sentences
2. ***Attention***
   a. **Attention Network Task[7]**



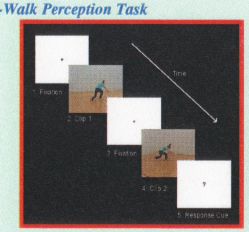
Task: View a cue (a) then indicate the direction the Middle Arrow is pointing (b)
Different cues evaluate subcomponents of the cognitive attentional network: alerting, orienting, & executive

b. **Stimulus Response Compatibility[8]**



Task: DIRECTION Arrow Pointing or POSITION of Arrow on the Screen
Evaluates attentional abilities when faced with *interference* (congruency) and *task switching* (direction/position)

3. ***Dance-Walk Perception Task***



Task: View 2 WALK clips OR 2 DANCE clips. Is movement in clips same or different?

EXPERIMENT 2 BEHAVIORAL & NEUROIMAGING

Dance-Walk Perception Task (see 3 above)

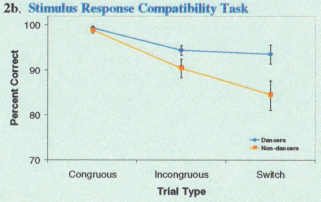
RESULTS

EXPERIMENT 1

1. **Semantic/Syntactic Competence - No difference between groups p > .05**

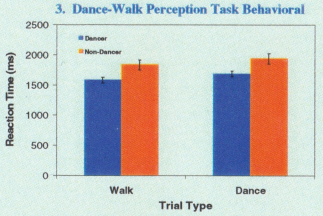
2a. **Attention Network Task - No differences between groups p > .05**

2b. **Stimulus Response Compatibility Task**



Dancers *more accurate* than Non-dancers on first trial after task switch p < .025

3. **Dance-Walk Perception Task Behavioral**



All participants *faster* on Walk trials than Dance trials p < .001

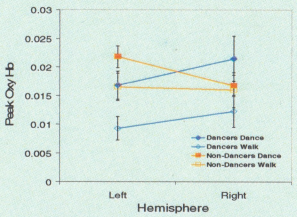
Dancers *faster* than Non-dancers on all trials p < .015

EXPERIMENT 2

Dance-Walk Perception Task Behavioral & Neuroimaging

Behavioral results pattern replicated!

ROI Frontal – Parietal Analyses



Significant group x hemisphere interaction for Dance trials p < .025

Dancers recruit more *right* Frontal-Parietal on Dance trials

Non-Dancers recruit more *left* Frontal-Parietal on Dance trials

NO differences on Walk trials p > .1

DISCUSSION

Dancers with early and maintained training show ***cognitive benefits***

- ***Dancers*** are more accurate at task switching
- ***Dancers*** process biological motion stimuli faster than Non-dancers

Greater familiarity with certain types of biological motion leads to differences in neural processing

- ***Dancers*** with early and maintained training show the ***opposite*** neural tissue recruitment pattern from Non-dancers in brain areas involved in processing Dance

CONCLUSIONS

- Extensive training in the Arts may afford long-term advantages to other higher cognitive abilities
- Extensive training in the Arts also may alter neural processing
- These findings of cognitive benefits from extensive training in the Arts have implications for designers of educational curricula

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