

Dissociation of Measures of Topographical and Nontopographical Cognitive Ability in Older Adults

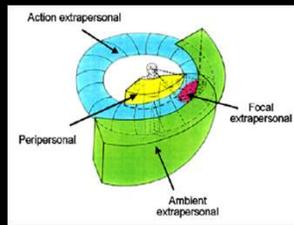
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*1st International Conference of Applied Neuroscience
Sydney, Australia
22 May 2019*

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The Topographical Neural System

- The topographical neural system – also termed “topokinetic”, “action-extraperisonal”, and “navigational”—is one of four systems interacting with 3D space
- It supports topographical orientation, navigational capability, and scene memory (“presence”)

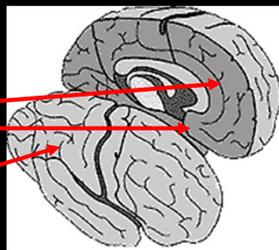


From Previc, 1998

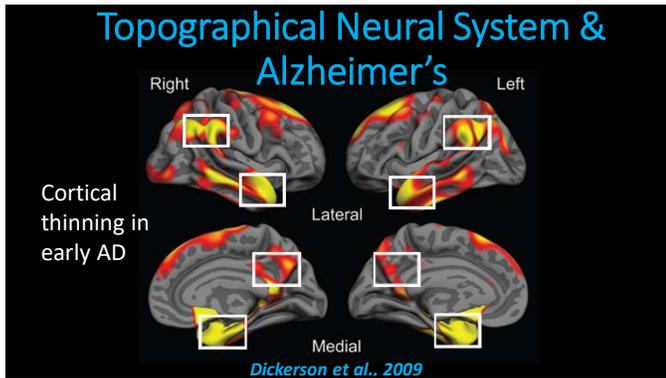
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The Topographical Neural System

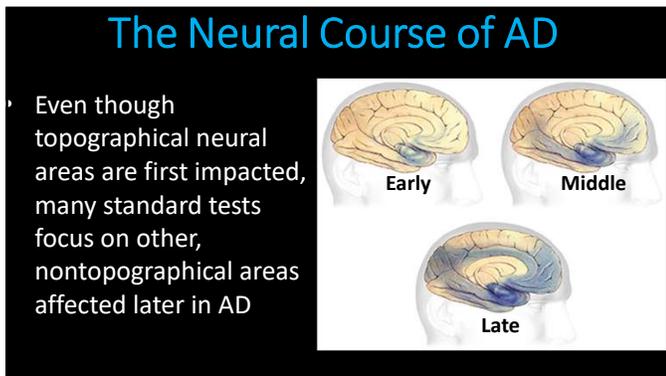
- The topographical neural network primarily includes the:
 - posterior cingulate cortex
 - medial temporal cortex and hippocampus
 - parietal-temporal cortex
- It is anchored to head movements (vestibular inputs)
- It is first system impacted in Alzheimer’s Disease



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Purpose of Study

- **Question 1:** How similar are the results of tests of topographical and nontopographical abilities in older adults?
- **Question 2:** What topographical test is best for assessment?
- This was part of a larger study that also examined the relationship between vestibular and topographical measures in older adults

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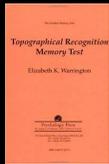
Methods

- Participants: 25 older adults (70-85 yrs, 16 F) screened for “normal” overall cognitive ability (19 or more on MoCA)
- Single 1.5 h testing session
- Three topographical tests
 - Camden Topographical Recognition Memory Test (CTRMT)
 - Virtual Pond Maze (VPM, analogous to “Morris Water Maze”)
 - Topographical Mental Rotation Test (TMRT) (like “3 Mountains”)
- Three nontopographical tests
 - Montreal Cognitive Assessment (MoCA)—also used for screening
 - Trail-Making Test Part B (TMT-B)
 - Visual Short-Term Memory Test (VSMT)

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Camden Topographical Memory

- 30 scenes presented during viewing
- Three alternatives presented during testing (two differing in distance and angle)
- Test norms provided



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Virtual Pond Maze

- Six starting points around virtual pond
- Every third trial platform was visible
- 18 trials overall to reach platform (12 with hidden platform)
- Time to reach platform using L-R cursors measured (60-s cutoff)



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Topographical Mental Rotation

- 15 trials in which participant's imagined view rotated either 90°L, 90°R, or 180° from start
- Three-alternative forced-choice testing

Original Practice Phase

What would this scene look like if you were rotated 90° around it to the left?

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Montreal Cognitive Assessment

- Widely used test of general cognitive ability
- Consists of simple recognition, memory, spatial, cognitive flexibility, general knowledge and general orientation
- 30 pts maximum

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Trail-Making Test

- Participant alternated between letters and numbers in order (1-A-2-B, etc.)
- Time to complete sequence measured

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Visual Short-Term Memory Test

- 15 trials with similar scenes as in rotation test but with four objects
- Nontarget scenes defined color or shape change in one object (no change of location)
- 3-alternative forced-choice matching-to-sample test

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Results

- Results were analyzed by means of:
 - descriptive statistics
 - bivariate correlations (Spearman) (VPM and TMT-B scores inverted because higher times reflected poorer performance)
 - correlations with topographical composite based on average percentile for CTRMT, VPM, & TMRT
 - exploratory factor analysis

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Descriptive Statistics

Variable	<i>M</i>	<i>SD</i>
CTMRT	24.04	4.23
VPM	34.2	11.8
TMRT	9.52*	3.74
MoCA	24.88	2.42
TMT-B	86.44	28.99
VSMT	9.08	2.18

* >50% gender difference: *M*=12.44; *F*=7.88

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Bivariate Correlational Matrix

Variable	CTMRT	VPM	TMRT	MoCA	TMT-B	VSTMT	TOPO (Comp)
CTMRT	-	.33	.32	.22	.32	.05	.73
VPM		-	.29	.22	.22	-.06	.78
TMRT			-	.19	.48*	-.08	.69
MoCA				-	.26	.08	.29
TMT-B					-	-.17	.41
VSTMT						-	-.04
TOPO (Comp)							

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Factor Loadings

Variable	Factor 1	Factor 2
CTMRT	.69	.17
VPM	.62	.03
TMRT	.71	-.23
MoCA	.55	.35
TMT-B	.70	-.34
VSTMT	-.03	.89

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Dissociations in Individuals

MoCA	CTRMT	VPM	TMRT	Topo Comp %
27	14	44.4	7	16
20	24	24.7	8	65

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Conclusions

- Topographical abilities differ from nontopographical ones (e.g., short-term memory), especially for individuals
- Standard tests such as MoCA and TMT-B tap into topographical as well as nontopographical abilities
- More specific topographical assessment may be needed for early Alzheimer's diagnosis
- Camden TRMT may be best choice
 - easy to administer & complete; includes norms
 - no gender difference

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Future Directions

- Larger sample size with older adults
- Comparison to younger population
- Prediction of conversion to Alzheimer's
- Assessment of treatment (e.g., vestibular) efficacy

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Research Support

This research was supported by the National Center for Advancing Translational Research (NCATS); the National Institute on Aging (NIA); and the National Heart, Lung and Blood Institute (NHLBI) under Award #TR000645-01. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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