Comparing MCI Patients to Healthy Controls using Three ERP Paradigms

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BACKGROUND

- Data comes from clinical intervention pilot study – impact of cognitive training on patients with MCI
- Neuropsychological, behavioural and ERP outcomes
- ERP correlates of working memory, executive functioning (attention) and semantic processing
- Three paradigms:
  - N-back
  - Go-NoGo
  - Verbal Recognition

OBJECTIVE

Compare baseline cognitive performance and ERP results of participants with MCI to Healthy Controls (HC) using 3 paradigms: N-back, Go-NoGo, Verbal Recognition

METHODS: TESTING & Assignment

- Data for the participants was collected in two separate 2 hour sessions: one for Neuro-psych and one for EEG testing
- Cognition was tested using the MoCA, RBANS subtests, and Trails A & B
- Appropriateness for diagnostic group was confirmed by an inter-disciplinary committee based on NP test results

METHODS: PARTICIPANTS

- MCI Group: 15 patients Bruyère Memory Program (Ottawa Canada)
  - RBANS Memory < 10th percentile
  - And up to one other domain < 10th percentile

- Healthy Older Adults: 17 were recruited from the general population

RESULTS: DEMOGR, NP

	HC (n=17)	MCI (n = 15)	P
Female	11 (65%)	8 (53%)	
Age	72.4	75.7	.13
Education	15.6	14.7	.38

Test	HC (n=17)	MCI (n=15)	P
MoCA	27.7	22.6	<.001
RBANS Total	114.3	79.8	<.001
Immediate Mem	107.2	71.9	<.001
Delayed Mem	108.1	61.1	<.001
Visuospatial	125.3	107.8	<.001
Language	99.9	89.5	.01
Attention	108.2	93.1	<.001
Trails A (seconds)	37.2	55.0	.02
Trails B (seconds)	81.3	164.4	<.001

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RESULTS: N-BACK BEHAV

	HC	MCI
0-Back R Time (ms)	433.7 (57.8)	479.18 (64.5)*
1-back R Time (ms)	464. 2 (49.7)	560.42 (78.0)*
2-back R Time (ms)	548.3 (59.6)	629.62 (71.4) *
0-back Accuracy (%)	97.1 (2.4)	97.3 (2.3)
1-back Accuracy (%)	95.1 (2.9)	91.2 (5.9) *
2-back Accuracy (%)	75.3 (8.5)	57.2 (13.7) *

*Main Effect of Task condition confirmed in both groups.
Reaction Time: Main effect of Group, $p<.001$
Accuracy: Interaction between Group and Task Condition. HCs performed better than MCIs at 1-back ($p=.03$) and 2-back ($p<.001$)

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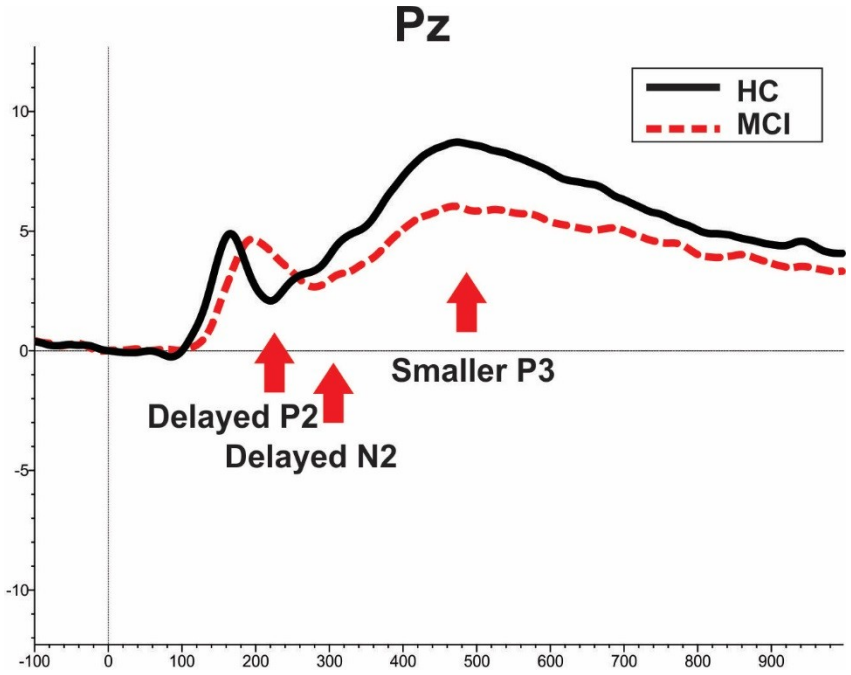
RESULTS: N-BACK ERP



	HC	MCI
P2 lat	172.3 (22.7)	196.6 (18.6)
N2 lat	237.6 (30.6)	274.3 (48.3)
P3 ampl	7.78 (3.25)	5.30 (4.23)

P2 Latency: Interaction between Group and Site. MCIs had delayed latencies relative to HCs at CPz (p=.01) and Pz (p=.003).
N2 Latency: Main effect of Group, p=.04.
P3 Amplitude: Main effect of Group, p=.04.

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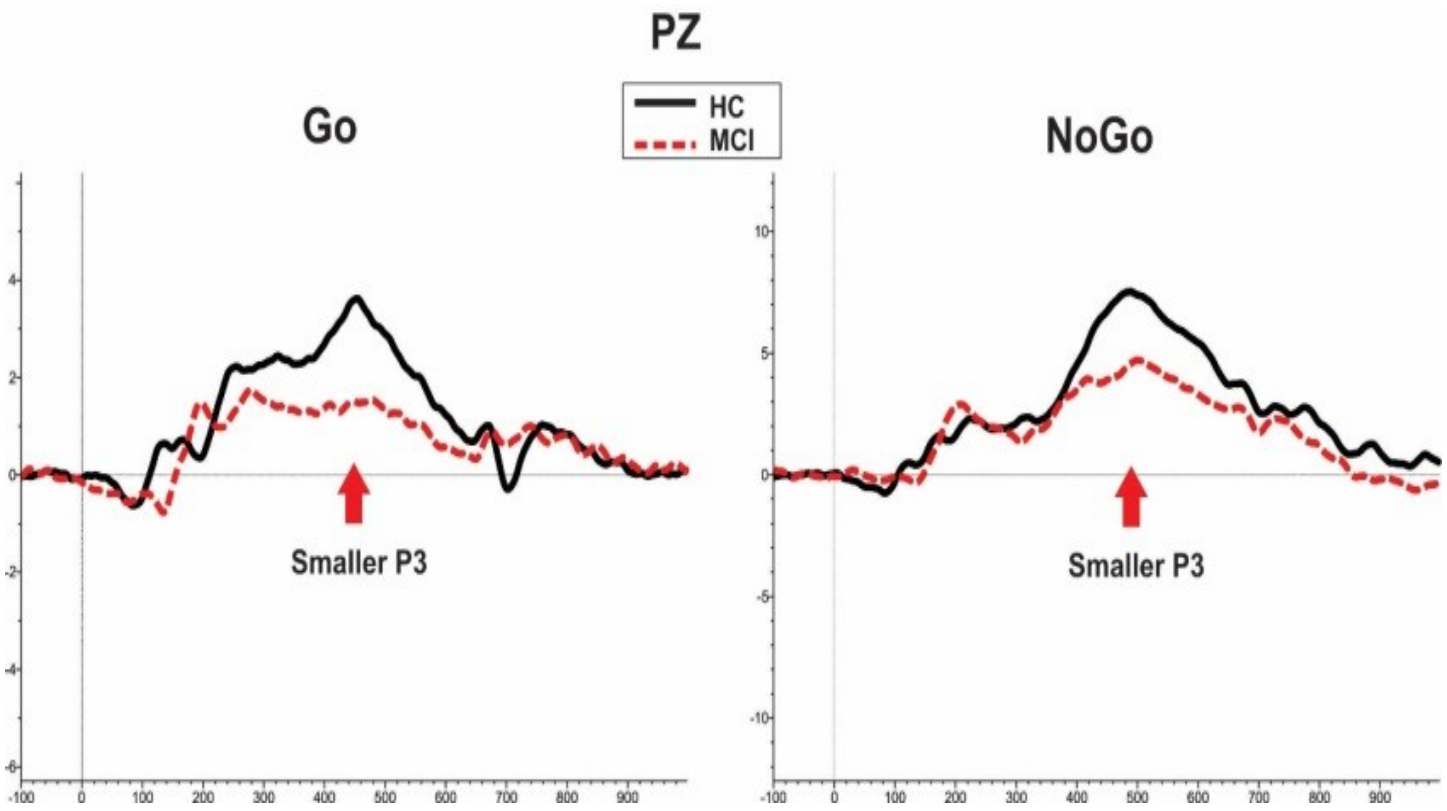
RESULTS: Go-NoGo BEHAV

Task Condition	Group	
	HC	MCI
Go Accuracy (%)	86.7 (14.7)	74.0 (15.8)
No-Go Accuracy (%)	90.7 (6.7)	79.5 (14.0)
Go RT (ms)	363.7 (48.8)	356.6 (31.4)

Accuracy: Main effect to Group, $p<.001$

RT: no significant differences, $p=.67$.

RESULTS: Go-NoGo ERP



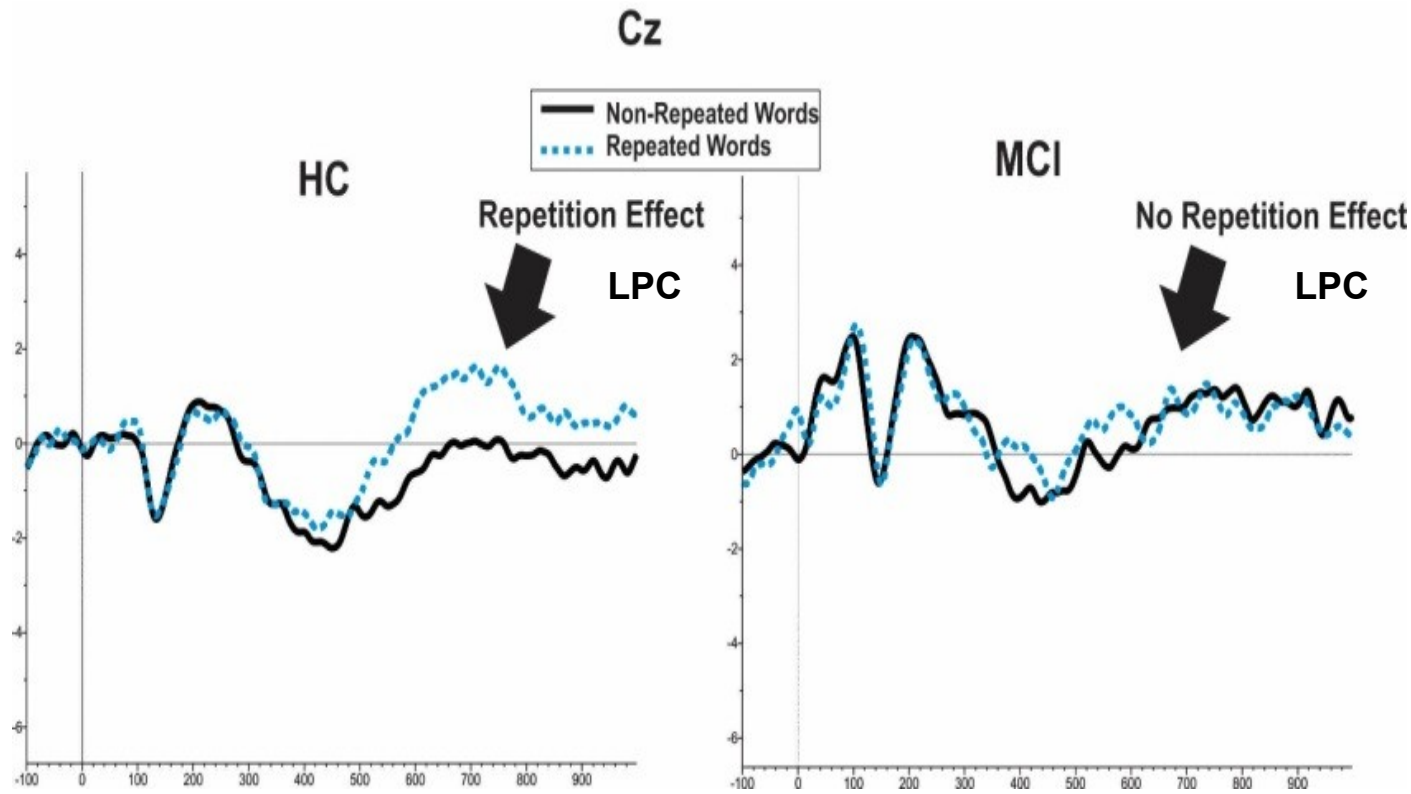
P3 Mean Amplitude: Main effect of Group, p=.03

RESULTS: VERB RECOG BEHAV

Task Condition	Group	
	HC	MCI
Repeated Acc (%)	71.2 (12.5)	60.28 (12.8)
Non-Repeated Acc (%)	94.5 (1.72)	88.06 (11.6)
Repeated RT (ms)	919.8 (114.8)	1238.2 (239.7)
Non-Repeated RT (ms)	917.2 (144.7)	1323.0 (144.7)

Accuracy: Main effect of Group, $p<.001$
RT: Main effect of Group, $p<.001$

RESULTS: VERB RECOG ERP



HC Group: Main Effect of Task Condition, p=03

MCI Group, Main effect of Task is non-significant, p=.47

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DISCUSSION

- Significant differences in all NP test results (HC vs. MCI)
- HC group had more correct responses in all three paradigms
- HC responded more quickly in all N-back conditions & all verbal recognition conditions
- Go-NoGo and Verbal Recognition paradigms showed expected ERP differences (HC vs. MCI)
- N-back paradigm showed significant differences in P2 and N2 latencies, and P3 amplitude (HC vs. MCI)

FUTURE WORK

- Compare sensitivities and specificities of 3 paradigms
- Analyses of clinical intervention
- Longitudinal trial to see which paradigm(s) is/are best biomarker(s) for MCI diagnosis and identification of transition risk.

Acknowledgements

- Participants
- Members of Dr. Taler's lab who performed the tests
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Questions?

"We had to remove your brain for a couple of days, so just try to relax."

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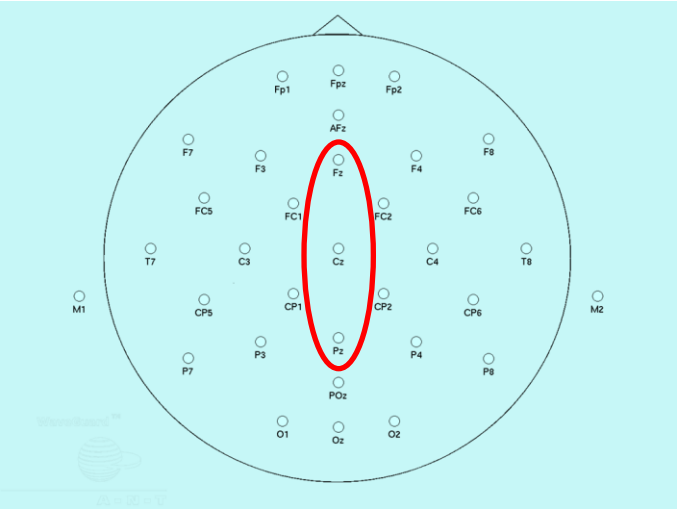
BACKGROUND

- 16.8% older adults have Mild Cognitive Impairment (MCI)
- Approximately 15% of MCI patients transition to dementia each year
- Electroencephalography (EEG) may have a role in assessing cognition, because it measures current changes to the level of milli-seconds
- ERP data is sensitive to early brain changes and may be a useful biomarker for clinical interventions

METHODS: ERP

- ERP signal components:
- P200
- N200
- P300
- N400
- Late positive complex (LPC)

Electrodes



- EEGs were measured using NeuroScan NuAmps 4.3 and analyzed using Brain Analyzer 2.1

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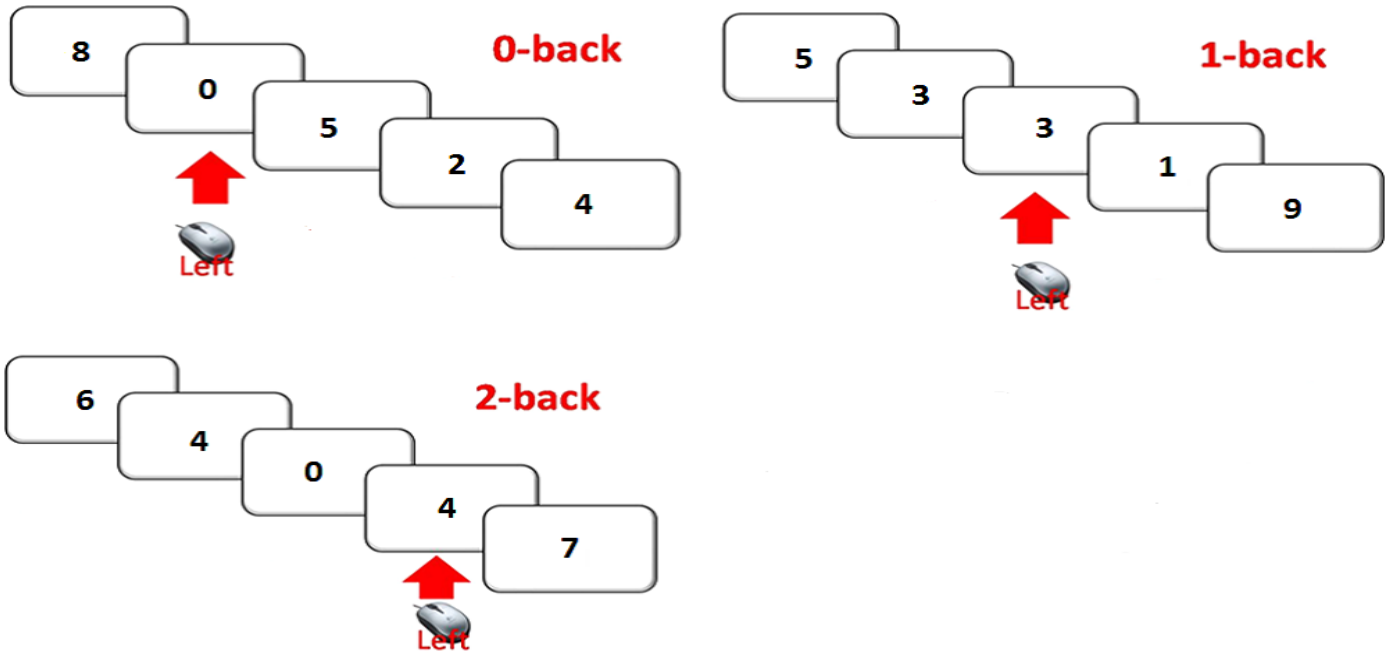
METHODS: PARADIGMS

N-Back Task



METHODS: PARADIGMS

Go-NoGo Task

- The stimuli consists of the letters "S" and "O".
- "S" = press key and "O" do not press key
  - or vice versa
  - Task is counterbalanced
  - Frequency 80 - 20

METHODS: PARADIGMS

Verbal Recognition Task

- Words are presented on the screen
- Participants press one of two keys: new or repeat
- Half of words are repeat, half are new
- Stimuli words controlled for critical psycholinguistics variables such as frequency and familiarity