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Measuring Chemobrain

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Background

***Chemobrain*: Cognitive deficits experienced by patients after undergoing cancer treatment, specifically chemotherapy.[1]**

- Literature shows ***inconsistent*** results regarding changes in cognitive function post-chemo.[2]
- Studies use a spread of neuropsychological tests to measure cognitive changes, which may ***lack the sensitivity*** needed to assess subtle differences in cognition.[3,4]

We hypothesize that:

1. Experimental cognitive tasks are more sensitive to differences in cognition than neuropsychological tests.
2. BCS participants will show generalized cognitive decline.

Methods

Participants: 20 female BCS and 20 healthy controls (HC) between the ages of 30 and 75.

We administered 4 blocks of 40 trials each (160 total) of the **Dot Pattern Expectancy (DPX) task** to all participants.

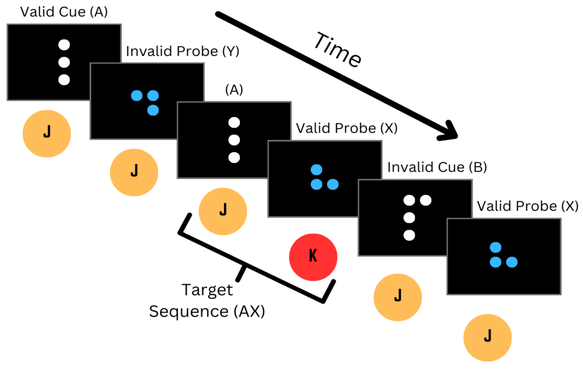

Figure 1. Dot Pattern Expectancy Task Paradigm.

Table 1. Summary of Cognitive Domains Assessed and Task Measures Compared

Cognitive Domain	*DPX Measure*	*Neuropsychological Test*
Processing Speed (Motor Function)	AX Trials Reaction Times	D-KEFS Trail Making Test-A *Number Sequencing*
Working Memory	BX Trials Reaction Times & Accuracy	D-KEFS Trail Making Test-r $\frac{TMT-B}{TMT-A}$
Sustained & Selective Attention	All Trials (Accuracy)	d2 Test of Sustained & Selective Attention
Response Inhibition	AY Trials Reaction Times & Accuracy	D-KEFS Trail Making Test-B *Number-Letter Sequencing*
		D-KEFS Color-Word Incongruency Test *Incongruent Condition*

Experimental cognitive tasks may be ***more sensitive*** to changes in cognitive function than neuropsychological tests

Results

Table 2. Sample Performance on DPX and Neuropsychological Tasks

Measure	BCS	HC	p-value (t_{stat})	Effect Size (d)
Processing Speed				
DPX AX RTs	0.434	0.423	0.4927 (0.693)	**Small (0.219)**
TMT-A	31.80	30.74††	0.7975 (0.259)	Negligible (0.0825)
Working Memory				
DPX BX RTs	0.439	0.393	**0.0482* (2.04)**	**Medium (0.646)**
DPX BX Acc	0.870	0.898	0.4488 (-0.765)	**Small (-0.242)**
TMT-r	2.426	2.374††	0.8604 (0.177)	Negligible (0.0568)
Sustained & Selective Attention				
DPX AX Acc	0.947	0.941	0.6491 (0.459)	**Negligible (0.145)**
DPX AY Acc	0.693	0.800†	0.1065 (-1.657)	**Medium (-0.536)**
DPX BX Acc	0.870	0.898	0.4488 (-0.765)	**Small (-0.242)**
DPX BY Acc	0.950	0.898	0.1863 (1.350)	**Small (0.427)**
d2 Test TC	0.944	0.949	0.7513 (-0.319)	Negligible (-0.101)
Response Inhibition				
DPX AY RTs	0.570	0.522	**0.0557 (1.983)**	**Medium (0.627)**
DPX AY Acc	0.693	0.800†	0.1065 (-1.657)	**Medium (-0.536)**
TMT-B	70.05	66.32††	0.6138 (0.509)	Negligible (0.162)
CWIT IC	49.75	50.94	0.7581 (-0.311)	Negligible (-0.101)

Table 2: Mean performance scores of BCS and HC groups on the DPX task and neuropsychological assessments. Cohen's *d* effect sizes were qualified as "Small" at $d = 0.2$, "Medium" at $d = 0.5$, and "Large" at $d = 0.8$, with values in between defaulting to the qualifier of the lower bound, and all values falling below $d = 0.2$ were considered "Negligible." Abbreviations: BCS = Breast Cancer Survivors, HC = Healthy Controls, AX = valid cue/valid probe trials, AY = valid cue/invalid probe trails, BX = invalid cue/valid probe trials, BY = invalid cue/invalid probe trials, TMT-A = Number Sequencing task, TMT-B = Number-Letter Sequencing task, TMT-r = TMT-B/TMT-A, TC = proportion of Total Correct answers, IC = Incongruent Condition.
* $p < 0.05$, Calculations used †N=17 data points or ††N=19 data points

- Consistently observed ***higher effect sizes for DPX*** compared to neuropsychological assessments.
  - DPX may be more sensitive to subtle differences in cognitive performance between BCS and HC subjects.
- Except for reaction times on BX trials, no other differences in task performances were statistically significant.
  - Cognitive decline ***may not be generalized***.
  - ***Working memory*** and ***response inhibition*** may be more vulnerable to effects of cancer treatment than other domains.
- Attention is ***difficult to isolate*** using behavioral measures.

Cognitive decline due to cancer treatment may be ***specific*** to cognitive domains like ***inhibition*** and ***memory***

Discussion

Based on our results:

- Cancer and cognition studies should ***preferentially*** administer cognitive tasks over neuropsychological assessments.
- ***Neuroimaging*** can help elucidate structural and functional changes, especially with respect to ***attention***.
- Future studies should consider ***psychosocial factors*** that may increase vulnerability to effects of cancer treatments.

Future directions: UNC CogMAP Research Study

- ✓ Longitudinal study.
- ✓ Administers cognitive tasks and neuropsychological tests.
- ✓ Uses neuroimaging.
- ✓ Assesses psychosocial factors using surveys.
- ✓ Collects blood samples to measure immune function.

References

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