Voices in Motion: Exploring the Impact of a Lifestyle Intervention on Patterns of Stability vs. Change in Response Time Inconsistency for Persons with Dementia

University of Victoria

Christopher A. Davie & Stuart W. S. MacDonald

VOICES IN MOTION
A multi-generational community choir for adults with memory loss and their caregivers.

Pacific Alzheimer Research Foundation

Alzheimer Society Canada

island health

Background

- Intraindividual variability (IIV) is a behavioral indicator of central nervous system (CNS) integrity (MacDonald et al., 2009), normative aging (Bielak et al., 2014), and pathological aging including incident Dementia (Kochan et al., 2016; Haynes et al., 2017)
- Due to the absence of a cure for any subtype of Dementia, research focus has concurrently evolved to include complementary lifestyle interventions to increase quality of life

Research Questions

1. Can patterns of within-person variability for Persons with Dementia (PwD) be modulated as a function of engaging in a lifestyle intervention?
2. If variability is modifiable, can we predict patterns of individual differences in change by examining markers of psychological or cognitive health?

Methods

- Lifestyle Intervention: Voices in Motion (VIM)
  - Weekly two hour choir sessions
    - Sing positive emotion-evoking music and socialize to counter isolation and stigma common for PwD
  - PwD, caregivers, high school students
- Design
  - Intensive repeated measures design (Stawski, MacDonald, & Sliwinski, 2015)
    - Assessments conducted every 4-6 weeks
    - Data collected for 3 cohorts spanning a 1.5 year period
- Measures
  - Choice reaction time (CRT) task from Cogstate computerized battery (Albin et al., 2011)
    - Trial-to-trial variability parameterized as intraindividual standard deviations (ISD), partialling for confounds (Stawski et al., 2019)
  - Trails Making Test - Part A (Trails A)
    - Processing Speed (Cosentino et al., 2011)
  - Patient Health Questionnaire (PHQ-9)
    - Screening instrument for indexing depressive symptoms and signs (Kroenke, Spitzer, & Williams, 2001)
- Participants (n = 29)
  - Averaged 77.4 (SD = 10.5) years of age
  - 75% female
  - 98.6% Caucasian
  - Median MMSE score of participants on admission was 24 → Indicative of cognitive impairment

Results

Research Question 1

Linear mixed models were employed to examine within-person (Level 1) change and between-person (Level 2) differences in intraindividual variability for CRT as a function of **time in study** (months in intervention)

Level 1:

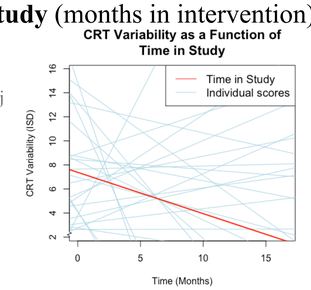
$$CRT\_ISD_{ij} = \beta_{0i} + \beta_{1i}\,(\text{Time in Study}_{ij}) + \varepsilon_{ij}$$

Level 2:

$$\beta_{0i} = \gamma_{00} + \gamma_{01}\,(\text{Age\_c75}) + U_{0i}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}\,(\text{Age\_c75}) + U_{1i}$$

*Age_c75= age at first assessment centered at 75 years



- Independent of age at baseline, significant reductions in CRT variability were observed (γ_{10} = -0.5703, *df* = 17.41, *t* = -2.413, *p* = 0.027)

Research Question 2

Coupled change models were employed to examine within-person associations between CRT variability and select time-varying predictors (processing speed and depressive symptoms). Person-mean centering was employed to parse the effects of the predictors into both within-person (WP: Level 1) and between-person (BP: Level 2) sources.

Level 1

$$CRT\_ISD_{ij} = \beta_{0i} + \beta_{1i}\,(\text{Time in Study}_{ij}) + \beta_{2i}\,(\text{Trails A\_WP}_{ij} - \text{PM\_Trails A}) + \varepsilon_{ij}$$

Level 2

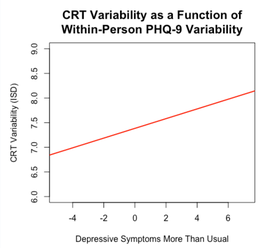
$$\beta_{0i} = \gamma_{00} + \gamma_{01}\,(\text{Age\_c75}) + \gamma_{02}\,(\text{Trails A\_BP}) + u_{0i}$$

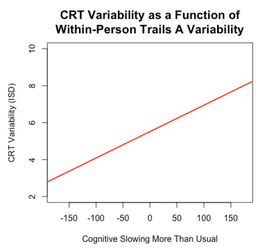
$$\beta_{1i} = \gamma_{10} + u_{1i}$$

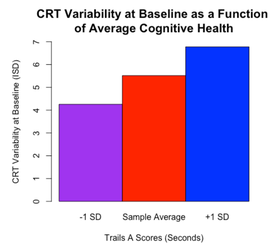
$$\beta_{2i} = \gamma_{20} + u_{2i}$$

**PM= Person-centered mean
**Age_c75= age at first assessment centered at 75 years
**WP = within-person; BP = between-person

- Relative to a given individual's usual level, on occasions when depressive symptoms on the PHQ-9 were increasing, corresponding significant increases in CRT variability were observed (γ_{20} = 0.0515, *df* = 2246, *t* = 2.107, *p* = 0.035)
- Similarly, on occasions when Trails A was slower relative to an individual's usual level, corresponding within-person increases in CRT variability were observed(γ_{20} = 0.0249, *df* = 2594, *t* = 21.351, *p* < 0.001); between-person slowing for Trails A was also linked to increased variability(γ_{02} = 0.0191, *df* = 21.033, *t* = 3.317, *p* = 0.003)







Interpretation

- Time accounted for 25.12% of within-person variability on the CRT
  - Within-person change in psychological &/or cognitive health, relative to a person's own average levels, can help predict variability in cognitive function (a proxy for CNS integrity)
- Significant declines in variability for the CRT task were observed for each month PwD took part in VIM
  - Such reductions in variability suggest that the intervention can modulate levels of variability that have been linked to cognitive decline, neural atrophy, and mortality
- Several significant time-varying moderators of these declines in variability were identified; relative to a given individual's usual levels, slower speed of responding (Trails-A) and increased depressive symptoms (PHQ-9) were linked to greater CRT variability
  - Such patterns suggest that lifestyle interventions may moderate trajectories of cognitive decline by mitigating comorbidities (e.g., depressive affect)

Limitations & Future Research

- Limitations
  - Attrition
  - Small sample size and limited statistical power
  - Fast progressing Dementia
- Future Research
  - Coupled change model examining change in RT variability and other key predictors (e.g., physiological health)
  - Lifestyle interventions aimed to reduce variability, as well as comorbidities that accompany Dementia

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