Methods for implementing CAR.

# Introduction

[Replication is ever more important, but rare and tricky for longitudinal designs]

Replicability of research findings in psychology recently came under increasing scrutiny (e.g. Maxwell et al, 2015, ADD). Multiple research findings failed to replicate (e.g. power pose, mindfulness meditation, etc, ADD). Calls for and attempts at systematic replication became more frequent (Open Science Collaboration, 2015). However, most of recent replication attempts involve **cross-sectional** designs and involve repeated data collection based on the original research protocols. Replications based on **longitudinal** designs (e.g. Brown et al, 2012; Piccinin et al, 2013, etc) are rare due to methodological and technical challenges and almost never involve collection of new data, instead relying on coordinating analyses across existing longitudinal studies.

[There are many proposed operationalizations to replication for longitudinal designs.]

A number of approaches for replicating findings from longitudinal studies have been proposed. *Sequential independent replication* (e.g. Vand Dijk et al, 2008) examines published findings and evaluates other independent longitudinal studies for supporting evidence to the original claim. *Meta-analysis* (e.g. Sutton & Higgins, 2008) combines standardized effects from a set of published findings and estimates the general effect. Another class of approaches combines individual-level data from multiple studies (e.g. data pooling, integrative data analysis, mega-analysis, pooled data meta-analysis, etc). One needs to make a lot of decisions to operationalize what “replication” means in longitudinal setting, hence the variety of proposed solutions.

Hofer and Piccinin (2009) introduced the concept of *coordinated analysis with replication*, an approach to maximize the value of data in individual longitudinal studies.

# Portland workshop

In February of 2015 IALSA conducted a collaborative workshop in Portland, OR, bringing together the data from nine longitudinal studies[\*1]. Each of the study asked its data the same question: *is decline in physical abilities related to the decline in cognitive abilities as people age in later life*? The identical statistical operationalization of this question tested the data from each study: the bivariate growth curve model. While sharing no person-level data, each study submitted the results of model estimation (namely, Mplus output files) to the collective. The model pool, hosted in a public cloud location for transparency and accountability, counted over 1000 outputs, pairing 3 physical measures (pulmonary function, gait speed, and grip strength) with more than 50 different cognitive tests (e.g. mmse, block design, line orientation, etc.). This paper describes the coordinated analysis with replication (CAR) approach: a vehicle for organizing and implementing a large-scale replication of longitudinal analyses across multiple studies.

The CAR method aims to gather corroborating evidence for a broad hypothesis from multiple data sources. For example, the hypothesis "decline in pulmonary function is associated with decline in perceptual speed" may be tested by observing a statistical relationship between the trajectories of peak expiratory flow (pef) and performance on the symbol substitution task (symbol) in the data from Einstein Aging Study (EAS). The conclusion, however, even though supported  by statistical significance, would be limited to these specific measures and this specific sample. [ discuss limitation of pooled and meta analysis and transition to CAR’s response to the same challenges]

# Infrastructure

## Maelstrom

## Face-to-face

## Follow-up

## GitHub

# Research Process

## 1. Research Proposal

## 2. Protocol Development

## 3. Analysis Plan

## 4. Statistical Analysis

## 5. Comparison of Results

## 6. Dissemination of Results

# References

[1] Maxwell, S. E., Lau, M. Y., & Howard, G. S. (2015). Is psychology suffering from a replication crisis? What does “failure to replicate” really mean?. *American Psychologist*, *70*(6), 487.

[2] Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, *349*(6251), aac4716.

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