DYNAMIC INTERVENTIONS: OPPORTUNITIES AND CHALLENGES

Linda M. Collins, Ph.D.
The Methodology Center
Penn State

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The Methodology Center
advancing methods, improving health

A lot of what I am presenting is drawn from work of

- Danny Almirall (Michigan)
- Susan Murphy (Michigan)
- Inbal (Billie) Nahum-Shani (Michigan)
- Daniel Rivera (Arizona State)

What is a dynamic intervention?

- Idea:
  - —Tailoring variable is measured on each individual periodically
  - —Treatment may be adjusted (increased, decreased, or switched) depending on value
- These go by a lot of different names
  - —Time-varying adaptive interventions
  - —Dynamic treatment regimes
  - —Stepped care
  - —Just-in-time adaptive interventions (JITAI's)
  - —Others

Anatomy of a dynamic intervention

1. Decision points

   Times at which treatment options should be considered based on patient information

2. Tailoring variable:

   Patient information used to make treatment decisions

3. Intervention options

   Type/dose of treatment

4. Decision rule

   Links tailoring variables to intervention options. A dynamic intervention includes multiple decision rules.

5. Outcomes

   Proximal and distal

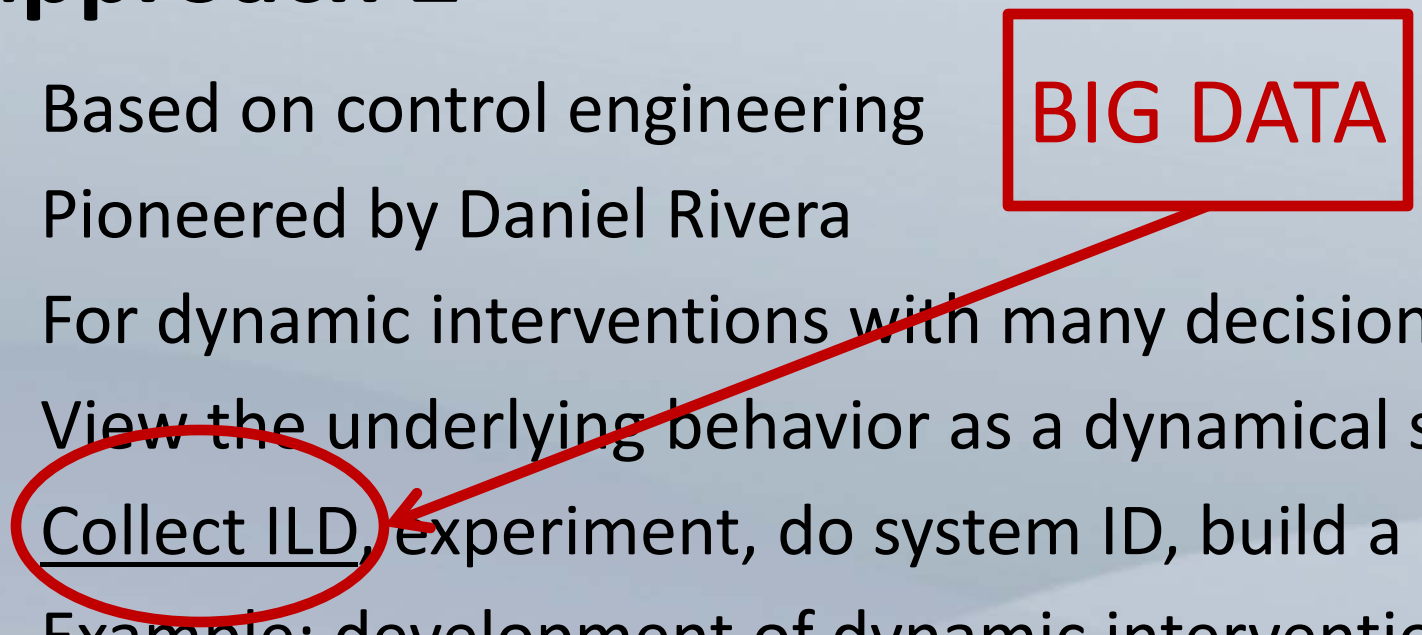
Approaches to development and evaluation of dynamic interventions

- Classical approach
  - —Identify intervention components, assemble treatment package, then evaluate in an RCT
- Multiphase optimization strategy (MOST)
  - —Identify intervention components, **empirically optimize intervention**, assemble **optimized** treatment package, then evaluate in an RCT

Optimizing dynamic interventions, approach 1

- Sequential Multiple Assignment Randomized Trial (SMART)
- Pioneered by Susan Murphy, Daniel Almirall, Inbal (Billie) Nahum-Shani
- For dynamic interventions with a limited number of decision points
- Variation on the factorial experiment

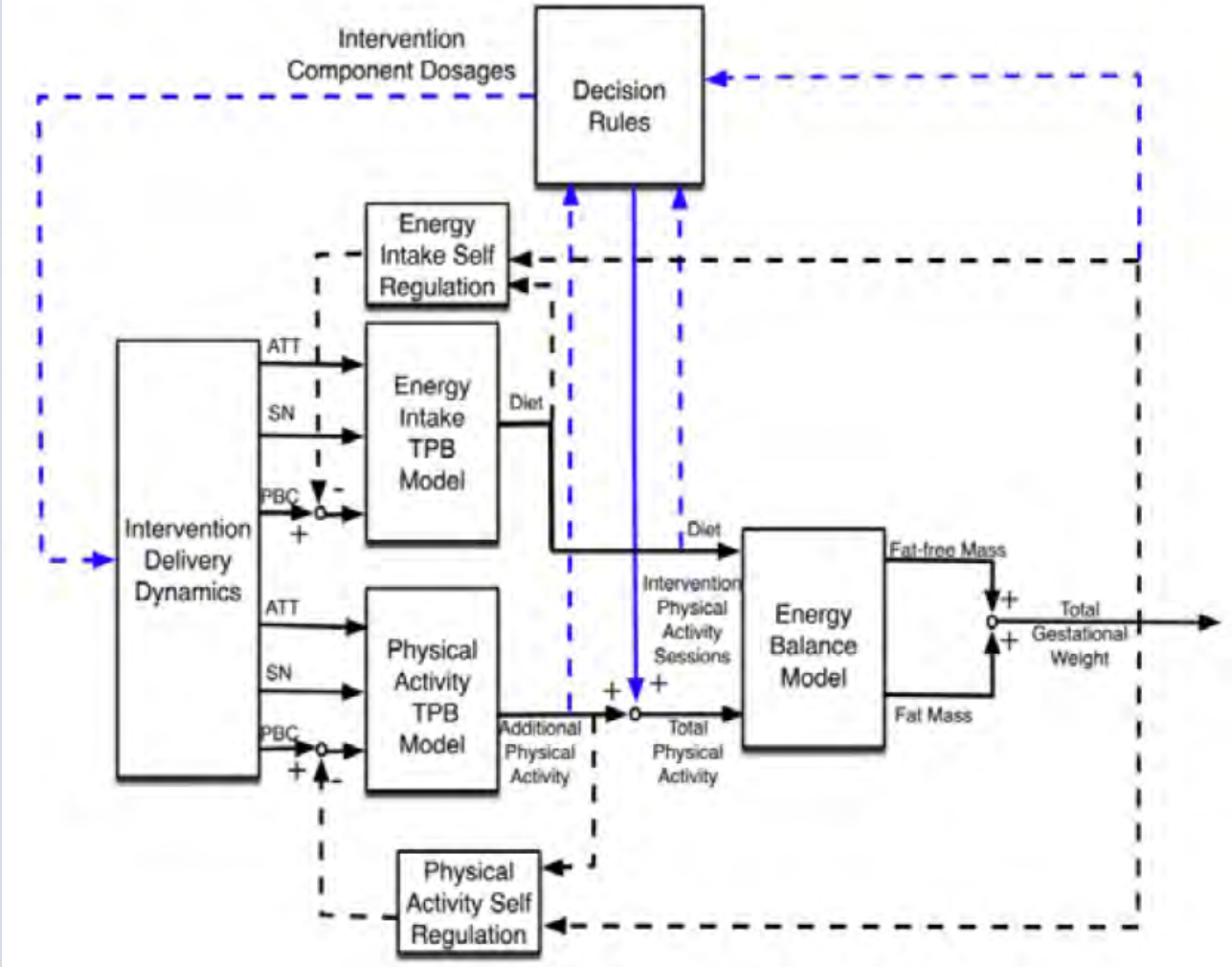
Optimized dynamic interventions, approach 2



- Based on control engineering
- Pioneered by Daniel Rivera
- For dynamic interventions with many decision points
- View the underlying behavior as a dynamical system
- Collect ILD, experiment, do system ID, build a controller
- Example: development of dynamic intervention to help pregnant women regulate gestational weight gain (recently funded by NHLBI; Danielle Downs (PSU), PI)

Fig C.2. Conceptual Simulation Framework for GWG.

Note. TPB = Theory of Planned Behavior, ATT = attitude, SN = subjective norm, PBC = perceived behavioral control.



Optimized dynamic interventions, approach 3

- Comes from computer science
- Pioneered by Susan Murphy and Inbal (Billie) Nahum-Shani
- Just-in-time adaptive interventions (JITAI's)
- Collect very ILD using a smart phone or similar
- Use machine learning principles to develop ("learn") decision rules for each individual

BIG DATA

Challenges

- A lot of methodological work is needed in all three of these areas
- Encouragement for intervention scientists to
  - —Take an optimization perspective
  - —Collaborate on research with a methodological focus