UNPACKING THE BLACK BOX: ENGINEERING MORE POTENT BEHAVIORAL INTERVENTIONS USING THE MULTIPHASE OPTIMIZATION STRATEGY (MOST)

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advancing methods, improving health

It is feasible to examine the effectiveness of individual intervention components.

This will enable us to unpack the black box…

…and develop more effective, efficient, and scalable behavioral interventions.

Outline

- Developing behavioral interventions: Business as usual
- The Multiphase Optimization Strategy (MOST)
- A brief example

Definition: behavioral intervention

- A program aimed at modifying behavior for the purpose of treating or preventing disease, promoting health, and/or enhancing well-being.
- Examples:
  - —Clinic-based smoking cessation
  - —Weight loss/management program
  - —School-based drug abuse prevention



- Note that according to this definition, most behavioral interventions are treatment packages made up of multiple components.

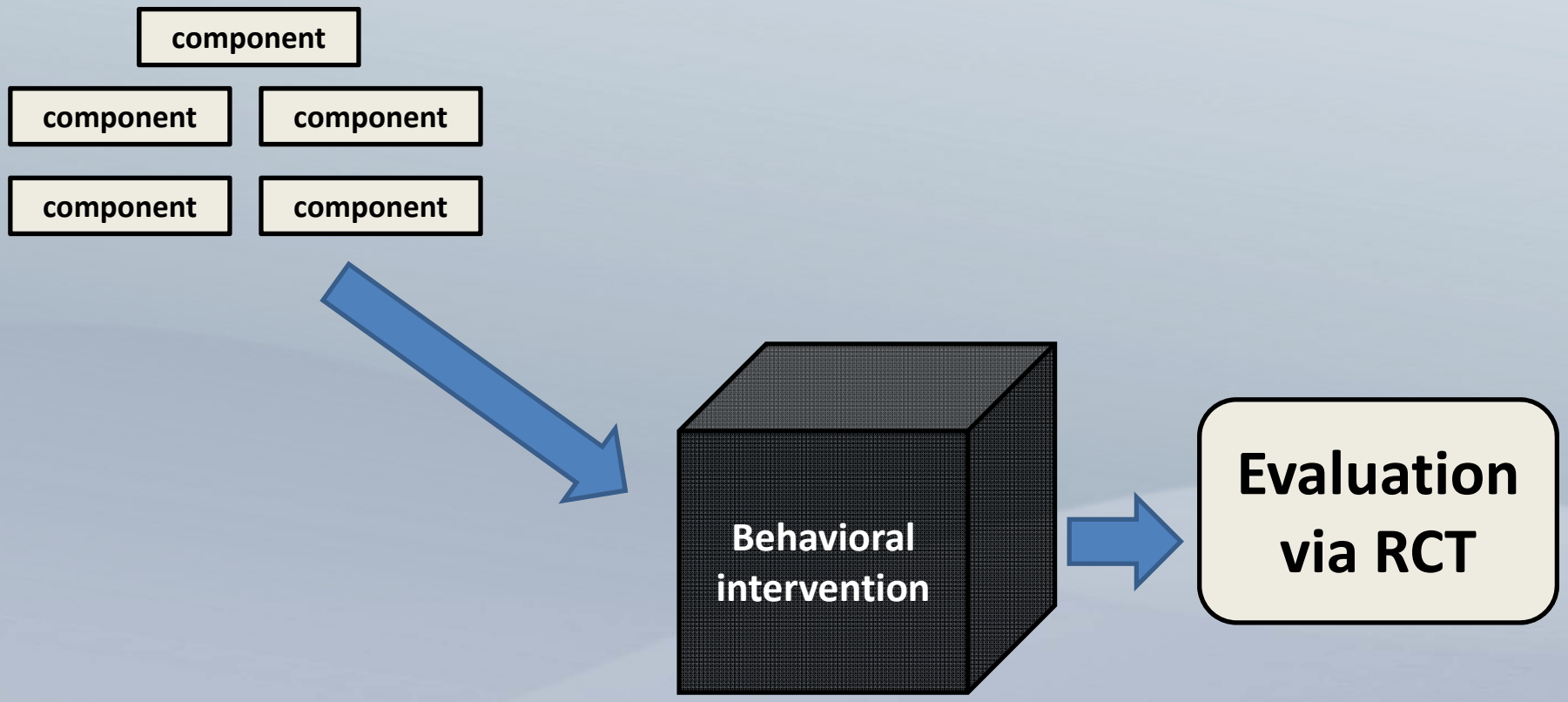
Definition: Intervention component

- *Any aspect of an intervention that can be separated out for study*
  - —Parts of intervention content
    - e.g.: segments in the curriculum of a school-based drug abuse prevention program
  - —Features that promote compliance/adherence
    - e.g.: use of encouraging text messages
  - —Features aimed at improving fidelity
    - e.g.: 800 number for program delivery staff to call with questions

How behavioral inventions are typically developed

- Intervention components are chosen based on scientific theory, clinical experience, etc.
- Combined into a treatment package
- Package is evaluated via a randomized controlled trial (RCT)
- The *treatment package approach*

Treatment package approach



What's wrong with evaluating a treatment package via an RCT?

Absolutely nothing!

The RCT is designed to tell us

- Whether a treatment package performs better than a control or comparison
- Whether one treatment package performs better than another

The RCT does not tell us

An RCT that finds a significant effect DOES NOT tell us

- Which components are making positive contributions to overall effect
- Whether a component's contribution offsets its cost
- Whether all the components are really needed
- How to make the intervention more effective, efficient, scalable, and sustainable

What the RCT does not tell us

An RCT that finds a <u>non-significant</u> effect DOES NOT tell us

- Whether any components are worth retaining
- Whether one component had a negative effect that offset the positive effect of others
- Specifically what went wrong and how to do it better the next time

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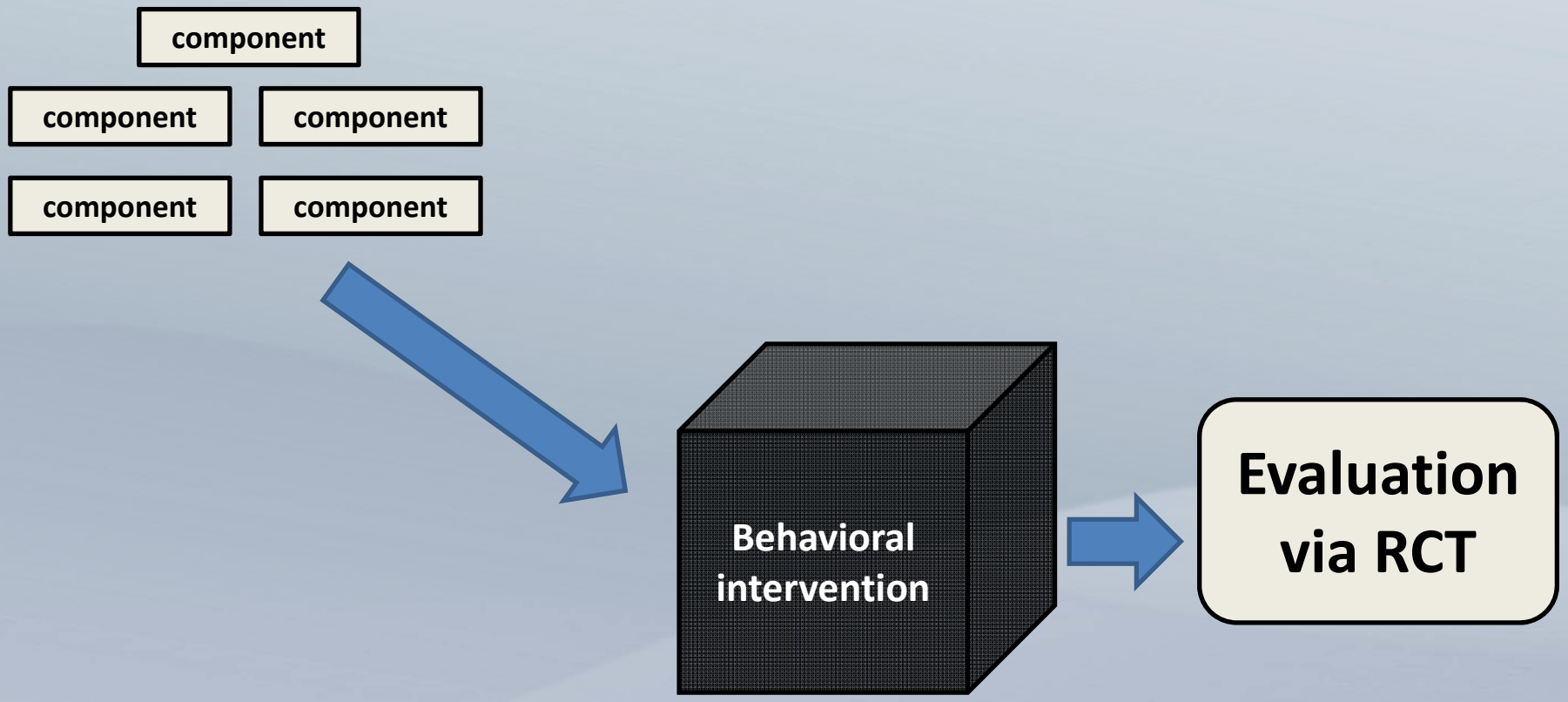
The Multiphase Optimization Strategy (MOST)

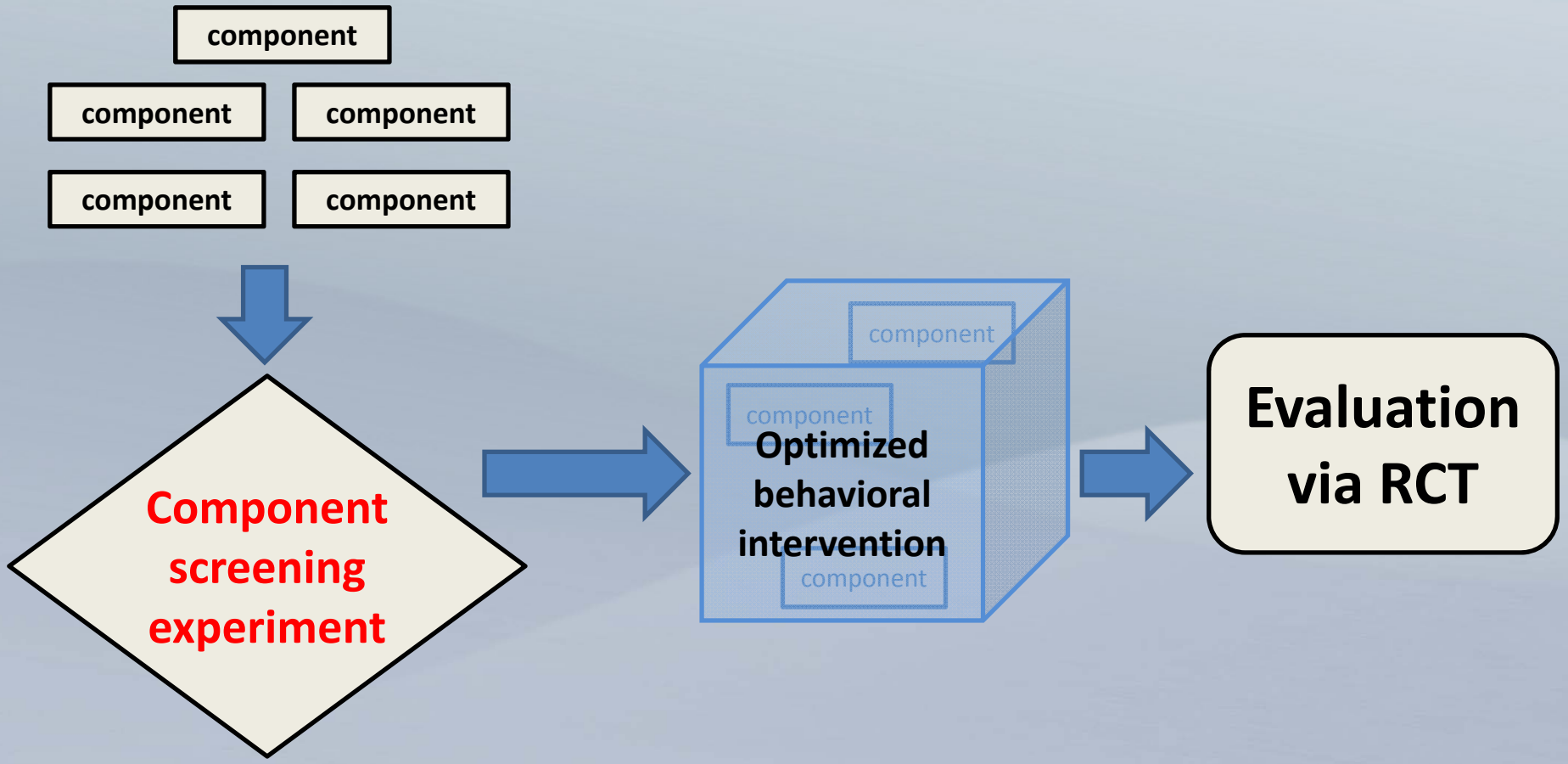
- An engineering-inspired framework for development, optimization, and evaluation of behavioral interventions
- Using MOST it is possible to engineer a behavioral intervention to meet a specific optimization criterion

Collins, Murphy, Nair, & Strecher, 2005; Collins, Murphy, & Strecher, 2007; Collins, Baker, Mermelstein, Piper, Jorenby, Smith, Schlam, Cook, & Fiore, 2011

Treatment package approach



Multiphase Optimization Strategy (MOST)



The component screening experiment

- Highly efficient experiment examining
  - —individual component effects
  - —Interactions between components
- Called a screening experiment because it is used to screen out poorly performing components

Uses of component screening experiments

- Selection of components to include in a highly effective/efficient treatment package
- Understanding which components are working as desired
- Assessment of magnitude of each component's effect
- Sophisticated mediation analyses to investigate which components are mediated by which variables
  - —Theory testing

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Example of MOST: "Opt-in" weight reduction intervention study

Objective: Develop a highly effective weight reduction intervention aimed at adults

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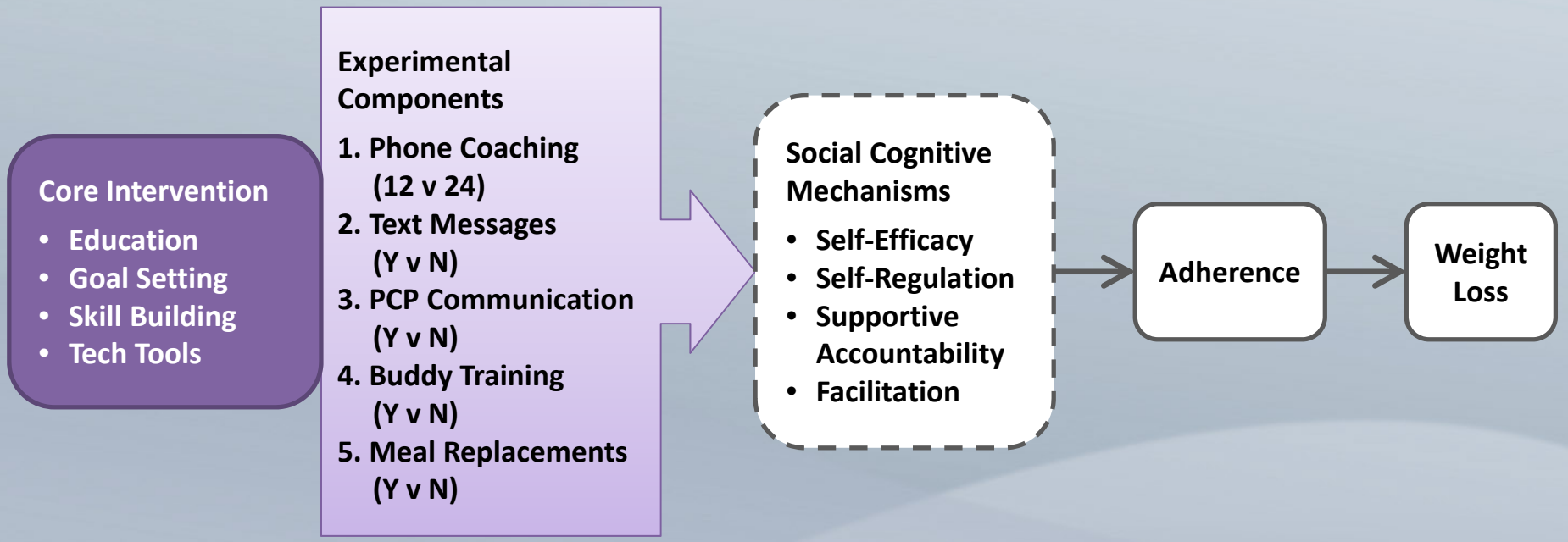
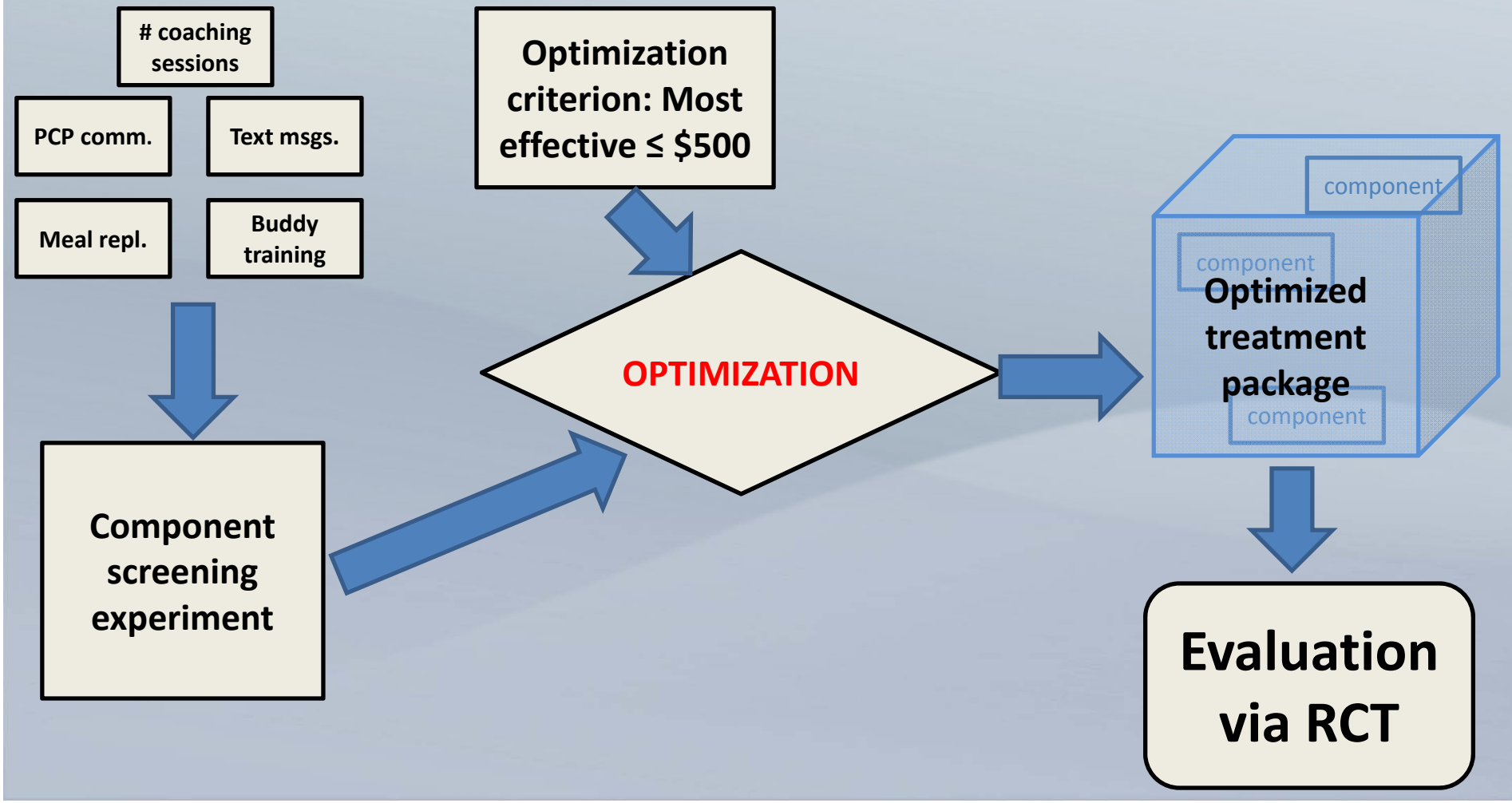
Funded by the US National Institute of Diabetes and Digestive and Kidney Disease (part of the National Institutes of Health)

Opt-in theoretical model



MOST as implemented in opt-in



Comparison of four experimental design options for Opt-In

Design	*N* to achieve power ≥ .8	Number of experimental conditions	Can interactions be examined?
Option 1: Five individual experiments	2,800	10	No
Option 2: Comparative treatment	1,680	6	No
Option 3: Factorial experiment	560	32	Yes, all
Option 4: Fractional factorial experiment	560	16	Yes, but only selected

Surprised that a factorial experiment is so efficient? See Collins, Dziak, & Li (2009).

Using data from the experiment to optimize

- Conduct an analysis of variance, obtain estimates of effects of each of the components
- Use this information to select components to include in the intervention
  - —Discard components that do not perform adequately
  - —Use size of effects in combination with other data (e.g. cost) to select components that will make up optimized intervention

After we have optimized and evaluated this intervention

- Our work will establish which components work…
- …and what is the best combination under $500 pp
- Future work (by us or others) can build on this to develop
  - —equally effective for less money
  - —OR more effective for $500
  - —OR “Here is a more meaningful optimization criterion:____”

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There is a lot more to MOST. For additional information:

http://methodology.psu.edu/ra/most

This web site has

- —suggested reading
- —FAQ
- —Advice for people writing grant proposals involving MOST

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Some recent publications

Caldwell, L.L., Smith, E.A., Collins, L.M., Graham, J.W., Lai, M., Wegner, L., Vergnani, T., Matthews, C., & Jacobs, J. (2012). Translational research in South Africa: Evaluating implementation quality using a factorial design. *Child and Youth Care Forum, 41,* 119-136.

Chakraborty, B., Collins, L.M., Strecher, V., and Murphy, S.A. (2009). Developing multicomponent interventions using fractional factorial designs. *Statistics in Medicine, 28,* 2687-2708.

Collins, L.M., Baker, T.B., Mermelstein, R.J., Piper, M.E., Jorenby, D.E., Smith, S.S., Schlam, T.R., Cook, J.W., & Fiore, M.C. (2011). The Multiphase Optimization Strategy for engineering effective tobacco use interventions. *Annals of Behavioral Medicine, 41,* 208-226.

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Dziak, J.D., Nahum-Shani, I., & Collins, L.M. (2012). Multilevel factorial experiments for developing behavioral interventions. *Psychological Methods, 17,* 153-175.