

# IMPROVING INTERVENTION DESIGN AND DEVELOPMENT:

## THE MULTIPHASE OPTIMIZATION STRATEGY (MOST)

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The Methodology Center  
Penn State

**Physical Activity and Disease Prevention: Identifying Research Priorities**

Office of Disease Prevention

National Institutes of Health

Bethesda, MD

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PENNSSTATE



**The Methodology Center**  
advancing methods, improving health

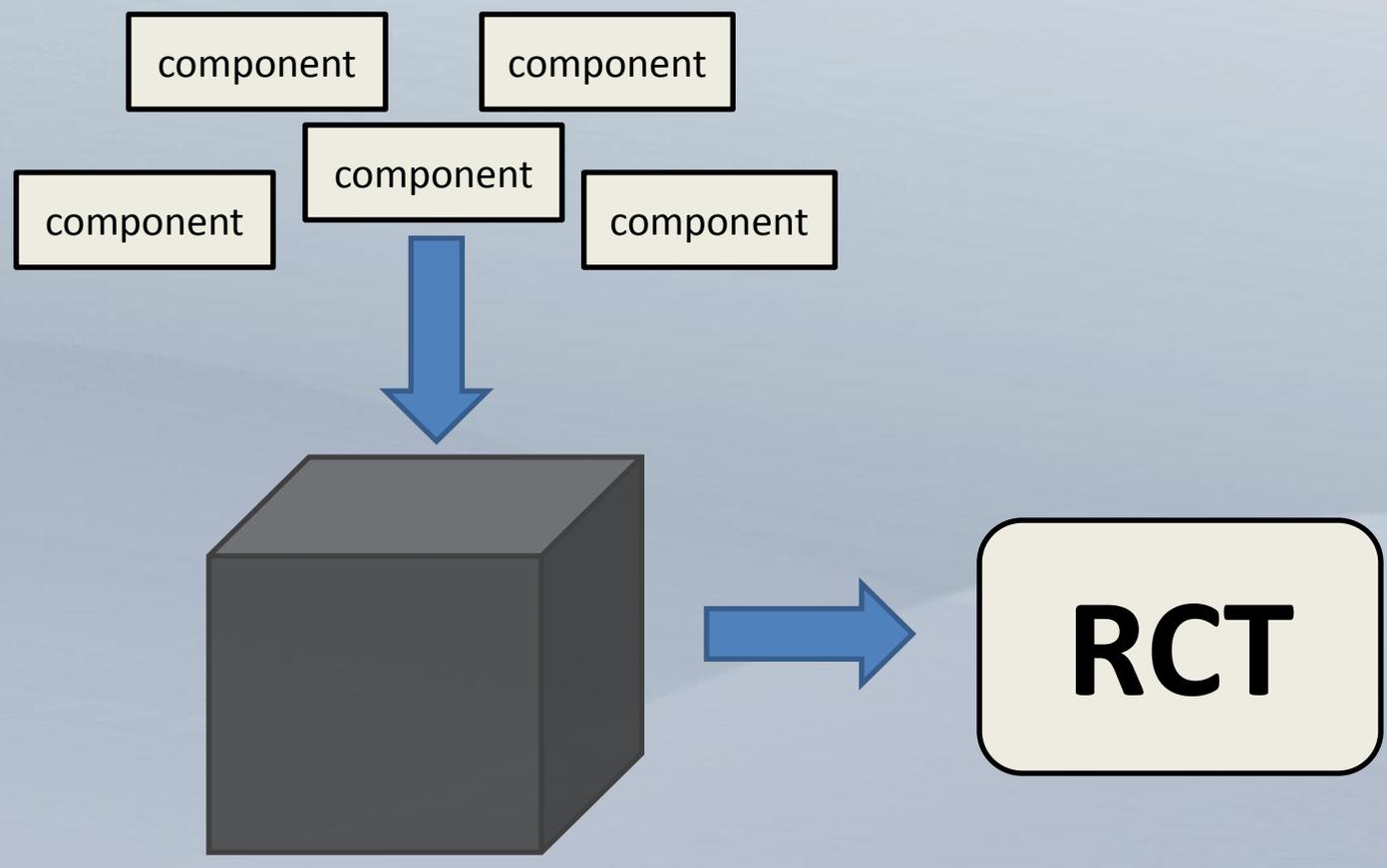
# I HOPE TO CONVINCING YOU THAT:

- We will make more progress in figuring out what works if we take an engineering-inspired approach
- This is feasible, even given current resource limitations

# HOW BEHAVIORAL INVENTIONS ARE TYPICALLY DEVELOPED AND EVALUATED

- Intervention components are chosen based on scientific theory, clinical experience, etc.
- Combined into a package
- Package is evaluated via a randomized controlled trial (RCT)
- Let's call this the treatment package approach

# TREATMENT PACKAGE APPROACH



# WHY UNPACK THE BLACK BOX?

If RCT finds a significant effect, it is UNKNOWN

- Which components are making positive contribution to overall effect
- How to make the intervention more effective, efficient, cost-effective

# WHY UNPACK THE BLACK BOX?

If RCT finds a non-significant effect, it is UNKNOWN

- Whether any components in the box are worth retaining
- Specifically what went wrong and how to do it better the next time

# WHY UNPACK THE BLACK BOX?

The treatment package approach

- Encourages stuffing the black box with as many components as possible to get a significant effect
- Downplays considerations such as efficiency, cost-effectiveness, time-effectiveness

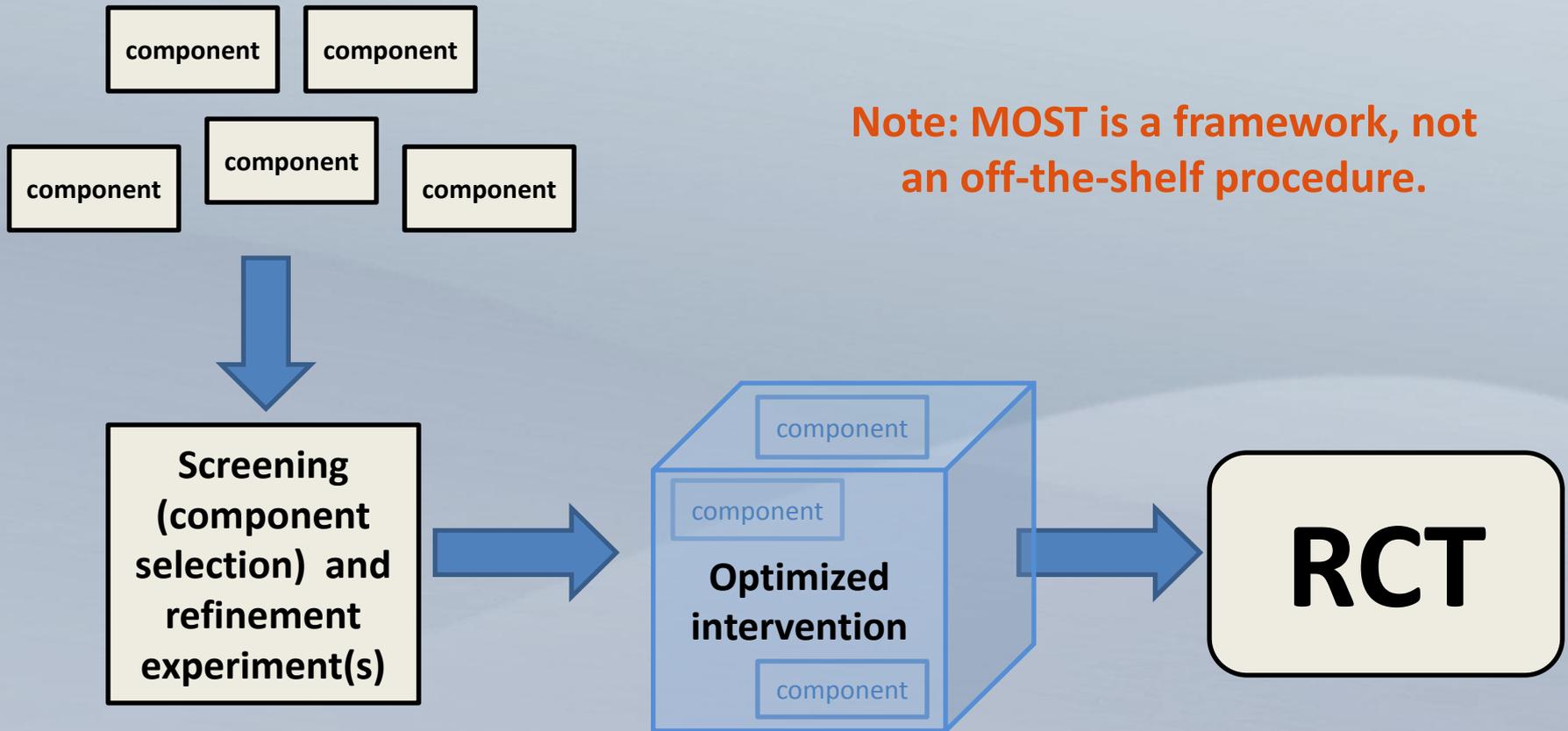
# THE MULTIPHASE OPTIMIZATION STRATEGY (MOST)

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

# DEFINITION OF OPTIMIZATION

- “The process of finding the best possible solution... subject to given constraints” (The Concise Oxford Dictionary of Mathematics)
  - Optimized does not mean best in an absolute or ideal sense
  - Instead, realistic because it includes constraints
- Example: Most effective intervention that can be delivered for  $\leq \$500$ 
  - Best possible: Most effective
  - Constraint: Must cost  $\leq \$500$

# THE MULTIPHASE OPTIMIZATION STRATEGY (MOST)



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# EXAMPLE: OPT-IN: WEIGHT REDUCTION INTERVENTION



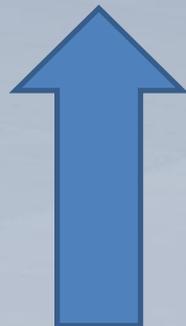
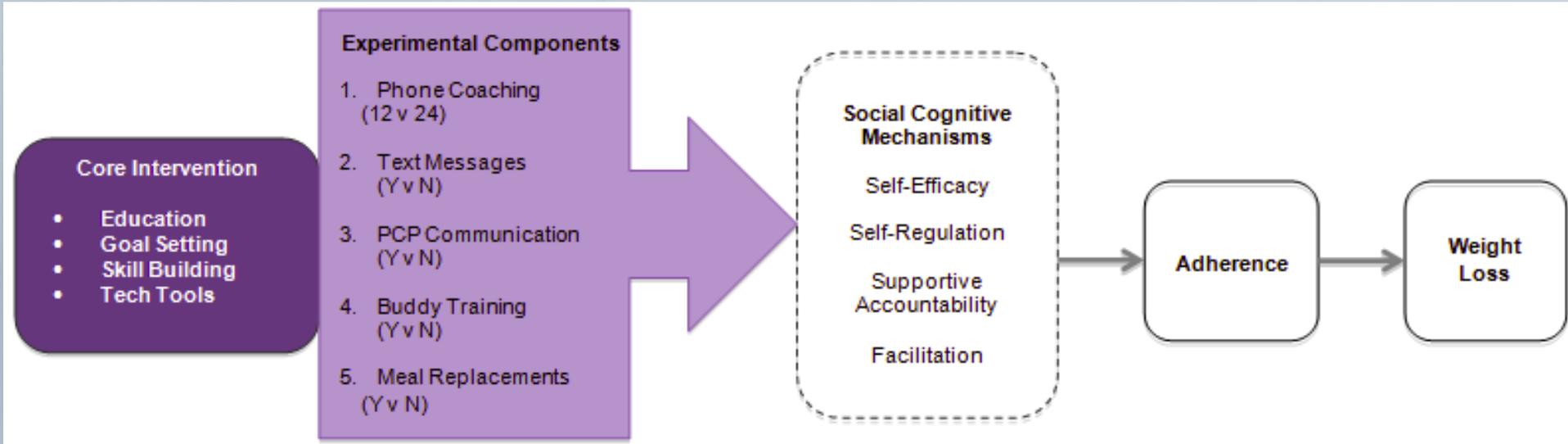
Bonnie Spring

Northwestern University

Project funded by NIDDK grant R01DK097364

**Objective: Select intervention components that will provide the most effective weight reduction intervention that can be implemented for  $\leq$ \$500**

# OPT-IN THEORETICAL MODEL



# EXPERIMENTAL DESIGN FOR EXAMINING PERFORMANCE OF INDIVIDUAL COMPONENTS

- Selected using Resource Management Principle
- Most efficient for us: special type of factorial experiment (fractional factorial)
- Factorial experiments can be VERY economical

## Design for Opt-In Component Selection Experiment

<b>Experimental Condition</b>	<b>Core Intervention</b>	<b># Phone Coaching Sessions</b>	<b>PCP Communication</b>	<b>Text Messages</b>	<b>Meal Replacements</b>	<b>Buddy Training</b>
<b>1</b>	Yes	12	Yes	No	No	No
<b>2</b>	Yes	12	Yes	No	Yes	Yes
<b>3</b>	Yes	12	Yes	Yes	No	Yes
<b>4</b>	Yes	12	Yes	Yes	Yes	No
<b>5</b>	Yes	12	No	No	No	Yes
<b>6</b>	Yes	12	No	No	Yes	No
<b>7</b>	Yes	12	No	Yes	No	No
<b>8</b>	Yes	12	No	Yes	Yes	Yes
<b>9</b>	Yes	24	Yes	No	No	No
<b>10</b>	Yes	24	Yes	No	Yes	Yes
<b>11</b>	Yes	24	Yes	Yes	No	Yes
<b>12</b>	Yes	24	Yes	Yes	Yes	No
<b>13</b>	Yes	24	No	No	No	Yes
<b>14</b>	Yes	24	No	No	Yes	No
<b>15</b>	Yes	24	No	Yes	No	No
<b>16</b>	Yes	24	No	Yes	Yes	Yes

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10	Yes	24	Yes	No	Yes	Yes
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## Resource Requirements of Different Experimental Designs to Investigate Five Intervention Components in OPT\_IN Study

Design	<i>N</i> required to achieve power $\geq .8$	Number of experimental conditions	Total Costs
Five individual experiments	2800	10	$2800 * 100 + 10 * 1000 = \$290,000$
Comparative	1680	6	$1680 * 100 + 6 * 1000 = \$174,000$
Dismantling	1680	6	Same as comparative
Constructive	1680	6	Same as comparative
Full factorial	560	32	$560 * 100 + 32 * 1000 = \$88,000$
Fractional factorial	560	16	$560 * 100 + 16 * 1000 = \$72,000$

# Other studies (that I know of) have been funded by

- NIDA
  - School-based drug abuse and HIV prevention program
  - Substance use prevention aimed at NCAA athletes
- NCI
  - Clinic-based smoking cessation
  - Internet-delivered smoking cessation

# FOR MORE INFORMATION ABOUT MOST:

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

This web site has

- List of relevant publications
- FAQ
- Advice for people writing grant proposals involving MOST

[LMCOLLINS@PSU.EDU](mailto:LMCOLLINS@PSU.EDU)

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# 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.
- Collins, L.M., Chakraborty, B., Murphy, S.A., & Strecher, V. (2009). Comparison of a phased experimental approach and a single randomized clinical trial for developing multicomponent behavioral interventions. *Clinical Trials, 6*, 5-15.
- Collins, L.M., Dziak, J.R., & Li, R. (2009). Design of experiments with multiple independent variables: A resource management perspective on complete and reduced factorial designs. *Psychological Methods, 14*, 202-224.
- Dziak, J.D., Nahum-Shani, I., & Collins, L.M. (2012). Multilevel factorial experiments for developing behavioral interventions. *Psychological Methods, 17*, 153-175.