TESTING PROGRAM COMPONENTS USING THE MULTIPHASE OPTIMIZATION STRATEGY (MOST)

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The Methodology Center
advancing methods, improving health

OUTLINE

- What's wrong with business as usual?

- What is MOST? What is optimization?

- Selecting an approach to examine individual components

- Take-home messages

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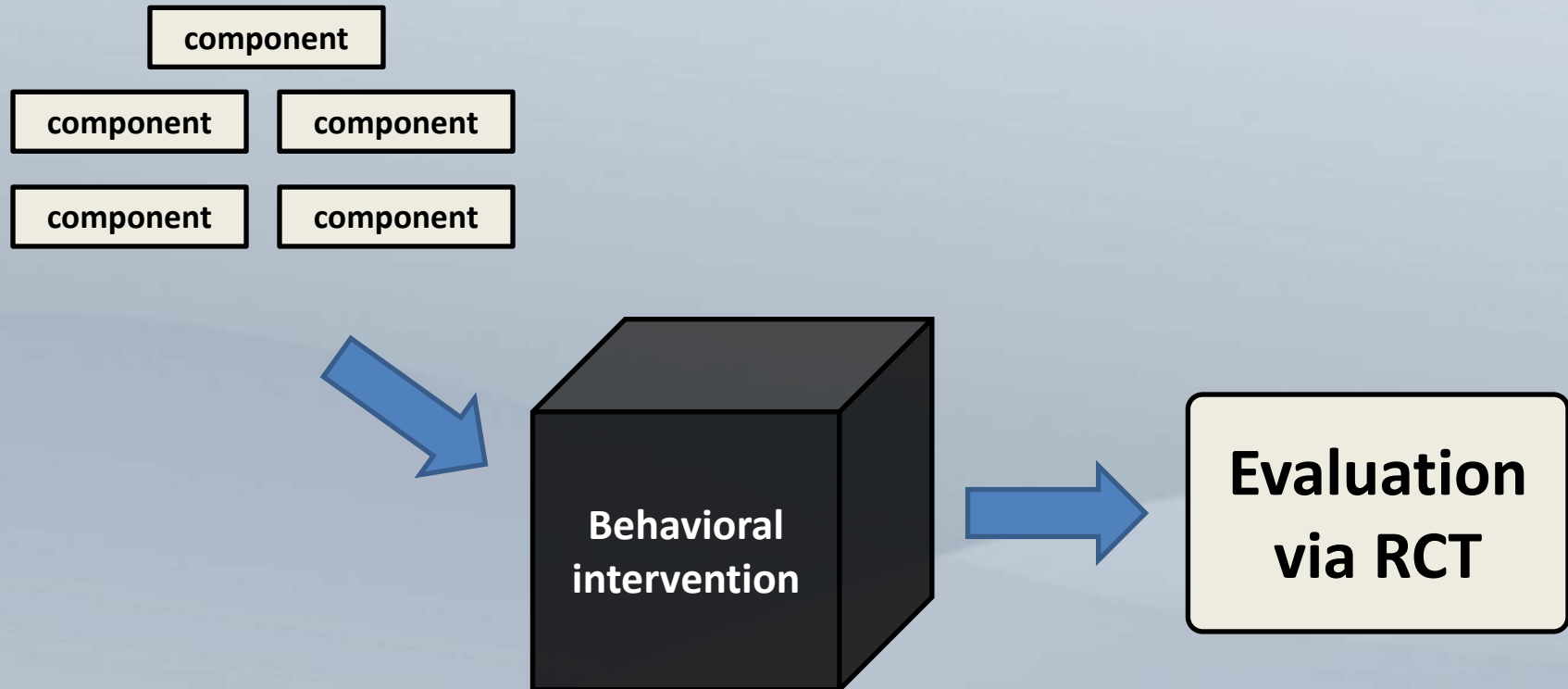
What's wrong with evaluating a treatment package via an RCT?

Absolutely nothing!

THE RCT IS BEST SUITED FOR

- Determining whether a treatment package performs better than

  - A control or comparison group

  - An alternative intervention

TREATMENT PACKAGE APPROACH

component

component   component

component   component

Behavioral intervention

Evaluation via RCT
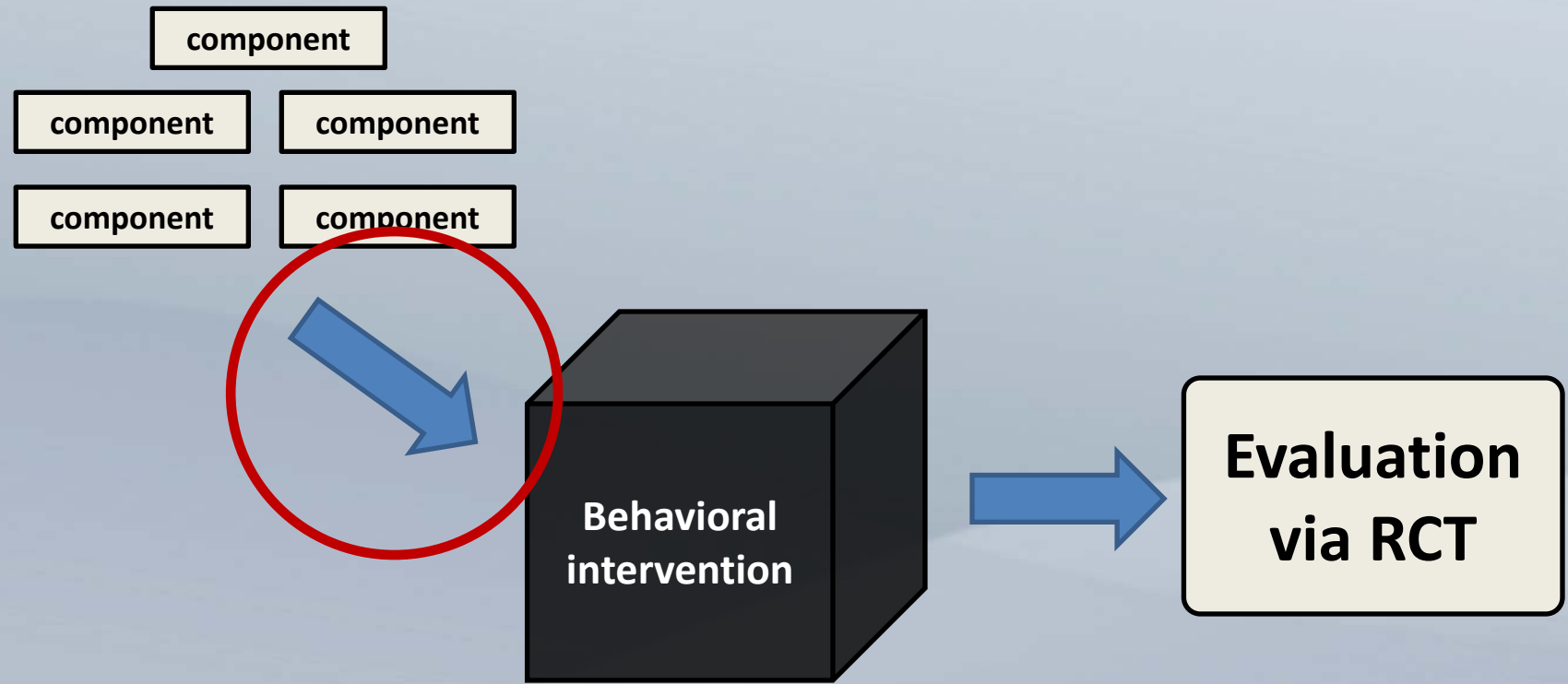
WHAT THE RCT CANNOT NOT TELL US

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

- Which components are making positive contributions to overall effect

- Whether the inclusion of one component has an impact on the effect of another

- Whether a component's contribution offsets its cost

- Whether all the components are really needed

- How to make the intervention more effective, efficient, and scalable

WHAT THE RCT CANNOT 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

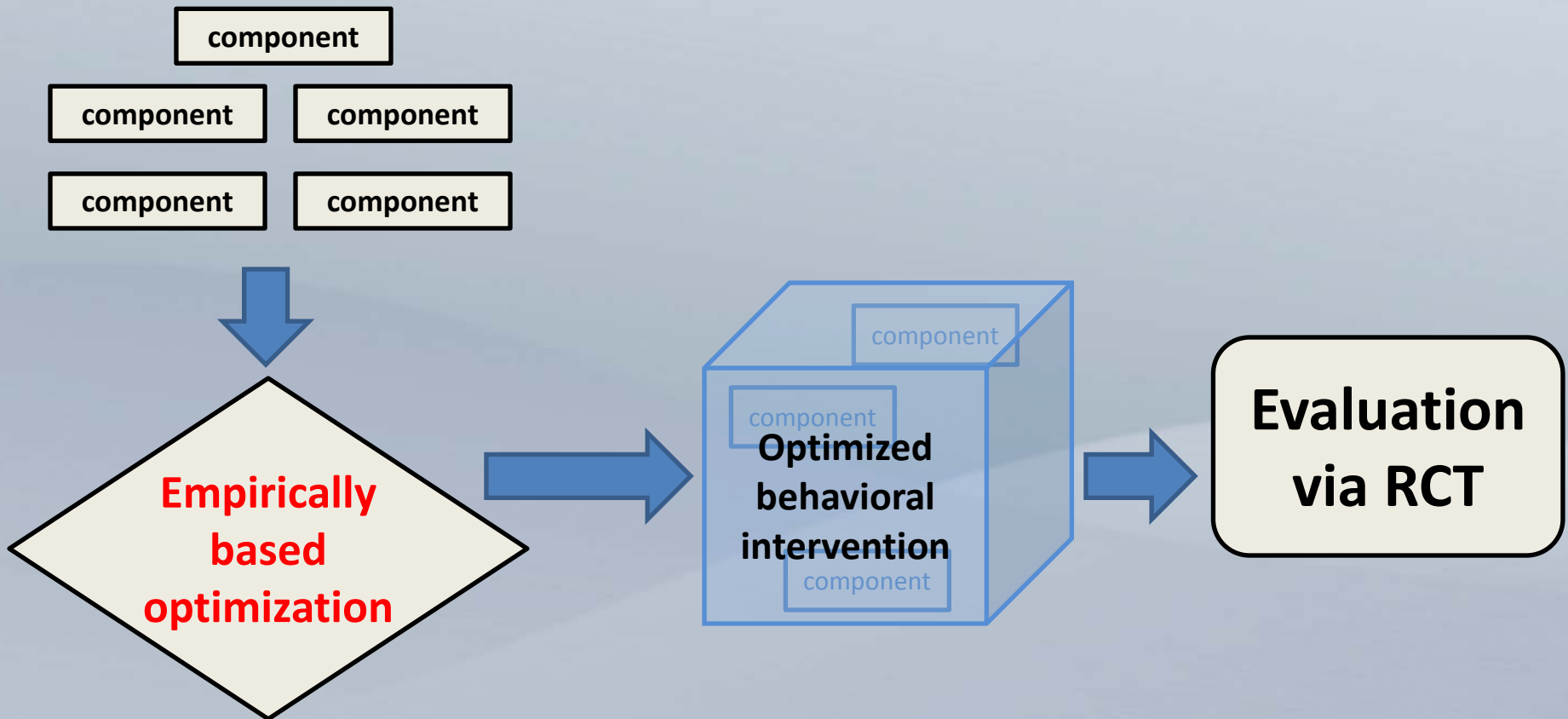**What is the alternative to <u>sole reliance</u> on the RCT?**

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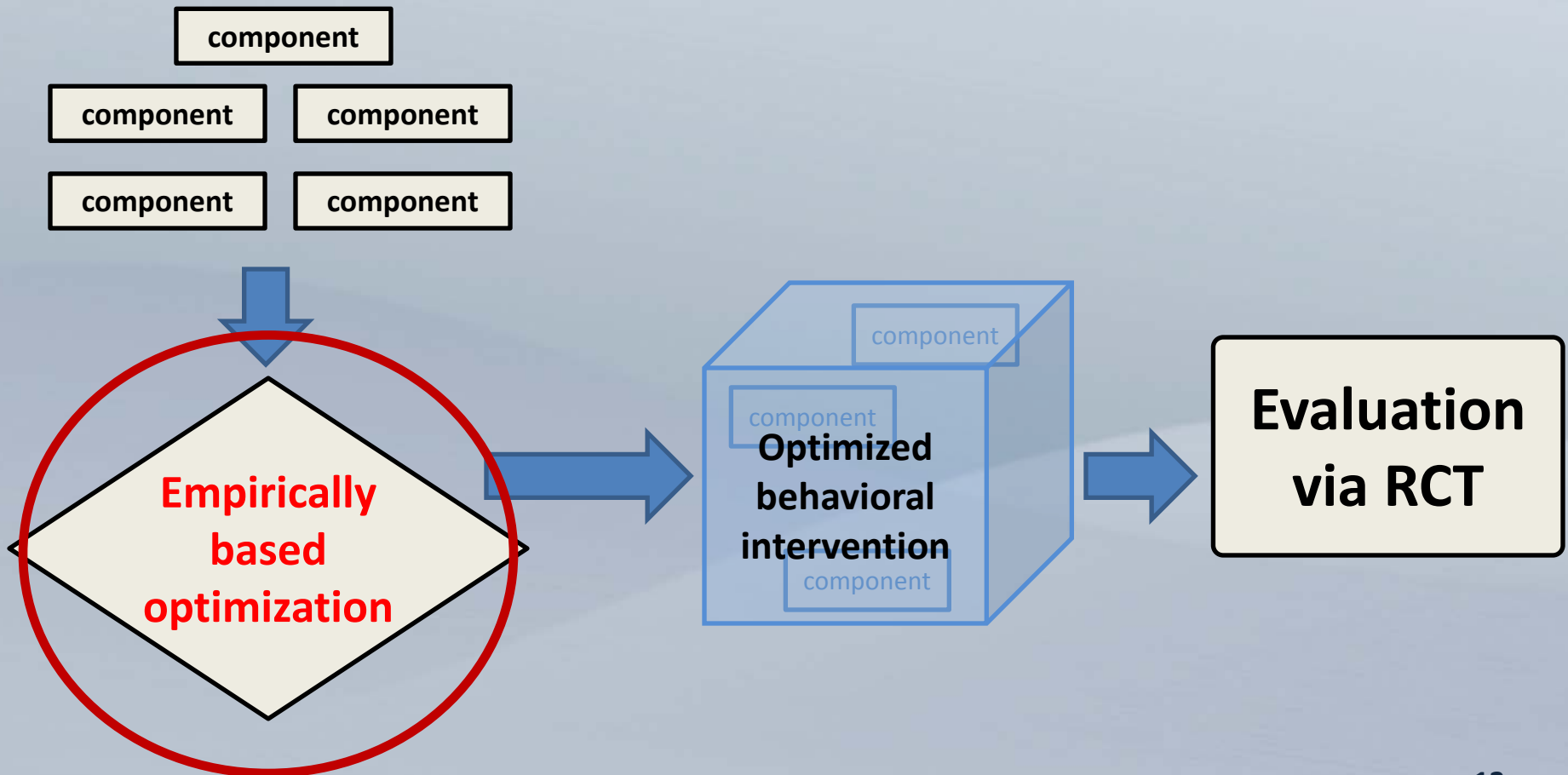- Take-home messages

AN ALTERNATIVE: THE MULTIPHASE OPTIMIZATION STRATEGY (MOST)

- An integration of ideas from engineering and the behavioral sciences

- A framework for development, optimization, and evaluation of behavioral interventions

- MOST INCLUDES THE RCT along with other types of experimentation

- Using MOST it is possible to engineer an intervention to meet a specific criterion

MULTIPHASE OPTIMIZATION STRATEGY (MOST)

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component

component   component

component   component

Empirically based optimization

Optimized behavioral intervention

component

component

component

Evaluation via RCT

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component

component   component

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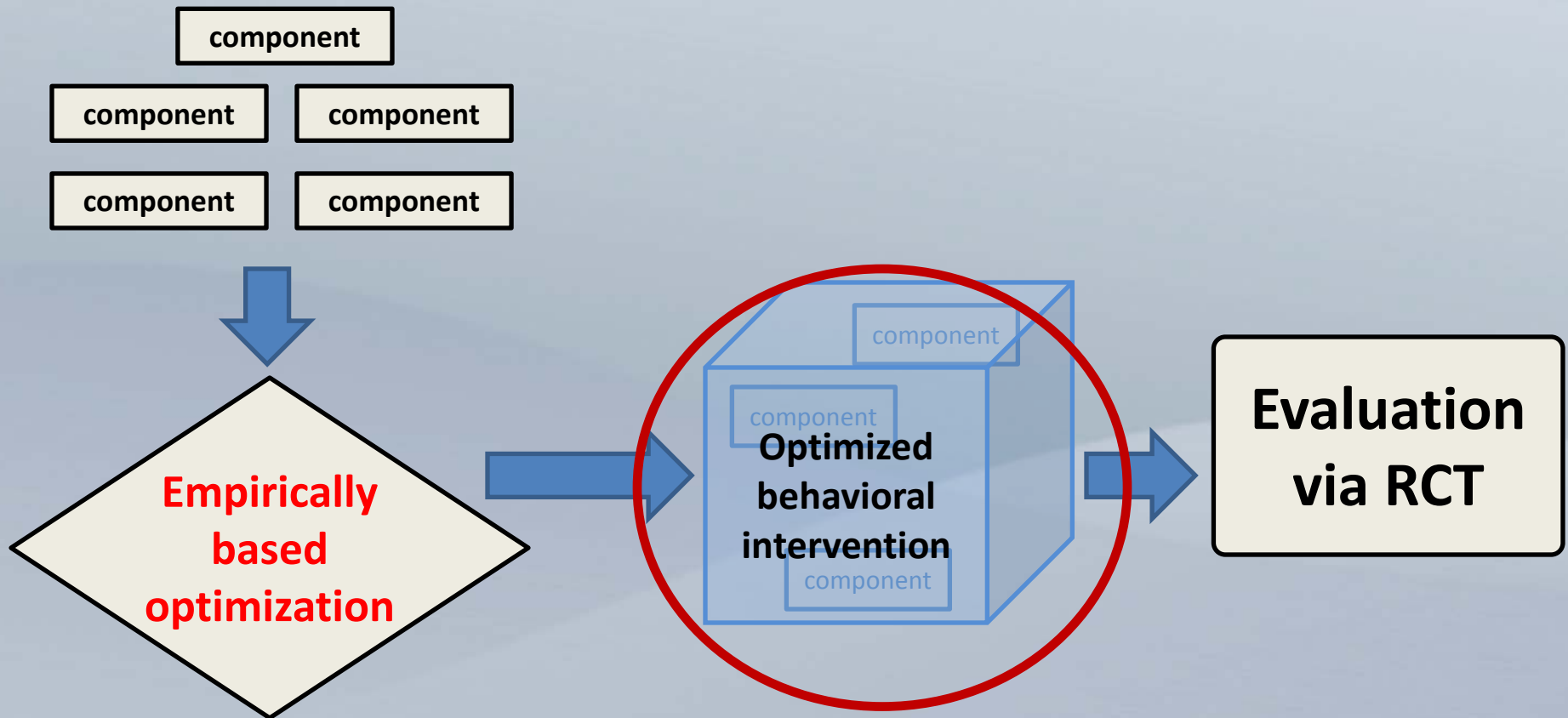
MULTIPHASE OPTIMIZATION STRATEGY (MOST)

Evaluation and optimization: Both important; not the same thing.	Evaluation: Is the intervention's effect *statistically significant*?	
Optimization: Is the intervention the *best possible, given constraints*?	No	Yes
No	May wish to optimize to improve effect size	Intervention can probably be improved
Yes	Different intervention strategy needed	What we should be aiming for

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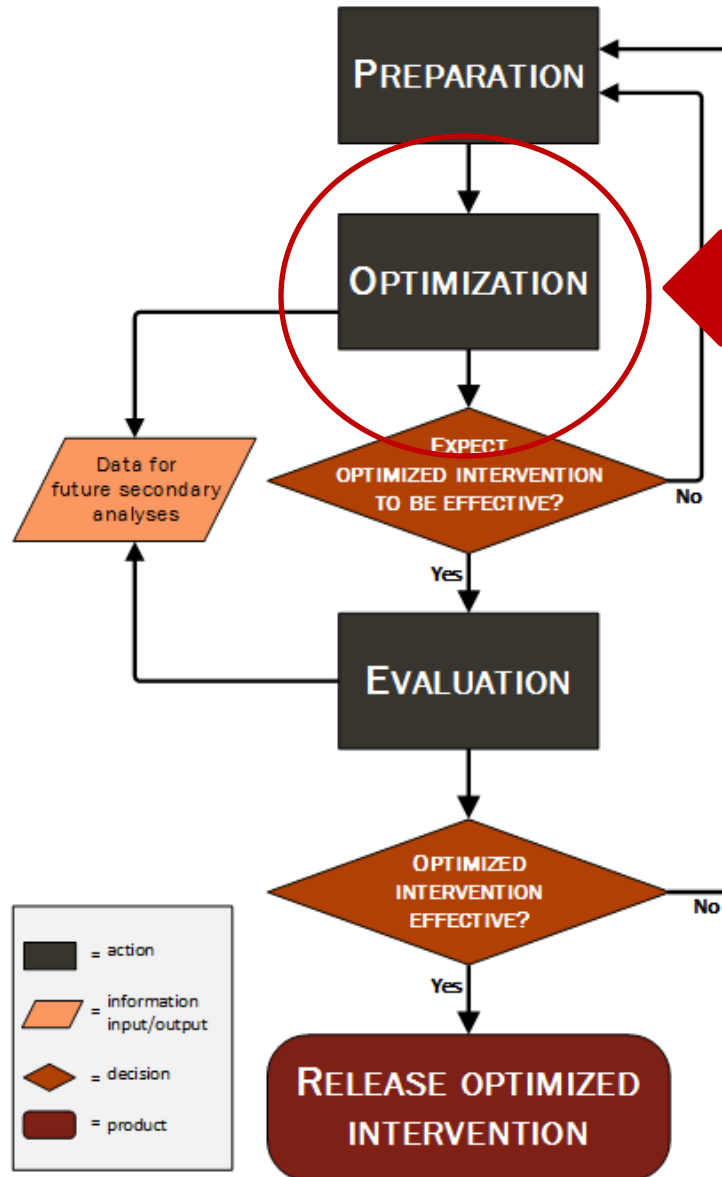
PREPARATION

OPTIMIZATION

EXPECT OPTIMIZED INTERVENTION TO BE EFFECTIVE?

Data for future secondary analyses

No

Yes

EVALUATION

OPTIMIZED INTERVENTION EFFECTIVE?

No

Yes

RELEASE OPTIMIZED INTERVENTION

= action

= information input/output

= decision

= product

COMPONENTS

- Enhanced teacher training
  - Standard training (one and one-half days) vs. enhanced (three days + two additional days four months later)

- Structure, support, and supervision
  - No additional vs. additional (e.g., weekly text messages; monthly visits from support staff; option to call support staff with questions as needed)

- Enhanced school climate
  - No climate enhancement vs. climate enhancement (e.g., form committee of parents and teachers to promote HealthWise; develop visuals; issue newsletter)

SELECTING AN EXPERIMENTAL APPROACH FOR THE OPTIMIZATION PHASE OF MOST

- We decided to conduct a factorial experiment. Why?

- Enables examination of individual component effects AND

- Statistical power achieved with **smaller** sample sizes than alternative designs

- BUT they also usually require more experimental conditions than we may be accustomed to

- Experiment uses all 56 schools in district

SELECTING AN EXPERIMENTAL APPROACH FOR THE OPTIMIZATION PHASE OF MOST

- NOTE: ANY experimental design is a possibility

- The SMART, a special case of the factorial experiment, can be used

- Or other experimental designs besides factorial designs

- Or other approaches such as dynamical systems ID or machine learning

COMPARISON OF RESOURCE REQUIREMENTS FOR POWER ≥ .8, MEDIUM EFFECT SIZE

DESIGN	N	# experimental conditions
3 individual experiments	168	6
Comparative treatment experiment	112	4
Factorial experiment	56	8

HealthWise component selection experiment in South African school district. 56 schools in all; 7 schools assigned to each experimental condition

Experimental condition	N of schools	HealthWise program	Training	Structure, support, & supervision	Enhanced school climate
1	7	✓			
2	7	✓			✓
3	7	✓		✓	
4	7	✓		✓	✓
5	7	✓	✓		
6	7	✓	✓		✓
7	7	✓	✓	✓	
8	7	✓	✓	✓	✓

HOW CAN 7 SCHOOLS PER EXPERIMENTAL CONDITION BE ENOUGH?

- In a factorial experiment you DO NOT compare individual conditions

- Each main effect estimate is based on ALL schools

- Power driven by OVERALL N, NOT per-condition n

Main effect of Training is mean of (5,6,7,8) vs. mean of (1,2,3,4).

Note that all 56 schools are used in estimating the main effect.

Experi-mental condition	N of schools	HealthWise program	Training	Structure, support, & supervision	Enhanced school climate
1	7	✓			
2	7	✓			✓
3	7	✓		✓	
4	7	✓		✓	✓
5	7	✓	✓		
6	7	✓	✓		✓
7	7	✓	✓	✓	
8	7	✓	✓	✓	✓

Main effect of Structure, support, & supervision is mean of (3,4,7,8) vs. mean of (1,2,5,6).

Note that all 56 schools are used in estimating the main effect.

Experi-mental condition	N of schools	HealthWise program	Training	Structure, support, & supervision	Enhanced school climate
1	7	✓			
2	7	✓			✓
3	7	✓		✓	
4	7	✓		✓	✓
5	7	✓	✓		
6	7	✓	✓		✓
7	7	✓	✓	✓	
8	7	✓	✓	✓	✓

Main effect of Enhanced school climate is mean of (2.4.6.8) vs. mean of (1,3,5,7).

Note that all 56 schools are used in estimating the main effect.

Experi-mental condition	N of schools	HealthWise program	Training	Structure, support, & supervision	Enhanced school climate
1	7	✓			
2	7	✓			✓
3	7	✓		✓	
4	7	✓		✓	✓
5	7	✓	✓		
6	7	✓	✓		✓
7	7	✓	✓	✓	
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TAKE-HOME MESSAGES

- It is possible and feasible to conduct experimentation to examine individual intervention components

- Possible even when cluster randomization is necessary

- Factorial experiments can be really efficient when properly applied and analyzed

FOR MORE INFORMATION:

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

This website has

– Suggested reading

– FAQ

– Advice for people writing grant proposals involving MOST

For a brief conceptual introduction, go to YouTube and see my 12-min TED talk: *Reducing smoking deaths: Is it rocket science?*

A FEW ARTICLES

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.

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., Dziak, J.J., Kugler, K.C., & Trail, J.B. (In press). Factorial experiments: Efficient tools for evaluation of intervention components. *American Journal of Preventive Medicine*.

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.

Collins, L. M., Nahum-Shani, I., & Almirall, D. (2014). Optimization of behavioral dynamic treatment regimens based on the sequential, multiple assignment, randomized trial (SMART). *Clinical Trials, 11,* 426-434.

Collins, L.M., Trail, J.B., Kugler, K.C., Baker, T.B., Piper, M.E., & Mermelstein, R.J. (2014). Evaluating individual intervention components: Making decisions based on the results of a factorial component screening experiment. *Translational Behavioral Medicine.* doi: 10.1007/s13142-013-0239-7.

Dziak, J.D., Nahum-Shani, I., & Collins, L.M. (2012). Multilevel factorial experiments for developing behavioral interventions. *Psychological Methods, 17*(2)*,* 153-175.