HOW TO APPLY THE MULTIPHASE OPTIMIZATION STRATEGY (MOST) IN YOUR INTERVENTION DEVELOPMENT RESEARCH

Module 6

Completing the optimization phase and identifying your next steps

Lesson 3: An example of making decisions based on the results of a factorial optimization trial

NYU SCHOOL OF GLOBAL PUBLIC HEALTH

Intervention Optimization Initiative

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In the previous lesson you learned how to:

- Understand what are current best practices for empirically identifying an optimized intervention

In this lesson you will learn how to:

- Implement current practices in an example
- Relate the decision-priority perspective to identification of the optimized intervention

Developing an intervention aimed at reducing viral load among HIV+ individuals who drink heavily

- Components:
- Motivational interviewing (no [not included], yes [included])
- Peer mentoring (no, yes)
- Text message support (no, yes)
- Mindfulness meditation (no, yes)
- Behavioral skills training (low intensity, high intensity)

We need to identify an optimization objective

- Best expected outcome obtainable for < $500

Suppose you conducted an optimization trial using this 2^5 factorial design

Experimental condition	*MI*	*PEER*	*TEXT*	*MIND*	*SKILLS*
1	No	No	No	No	Low
2	No	No	No	No	High
3	No	No	No	Yes	Low
4	No	No	No	Yes	High
5	No	No	Yes	No	Low
6	No	No	Yes	No	High
7	No	No	Yes	Yes	Low
8	No	No	Yes	Yes	High
9	No	Yes	No	No	Low
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14	No	Yes	Yes	No	High
15	No	Yes	Yes	Yes	Low
16	No	Yes	Yes	Yes	High
17	Yes	No	No	No	Low
18	Yes	No	No	No	High
19	Yes	No	No	Yes	Low
20	Yes	No	No	Yes	High
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25	Yes	Yes	No	No	Low
26	Yes	Yes	No	No	High
27	Yes	Yes	No	Yes	Low
28	Yes	Yes	No	Yes	High
29	Yes	Yes	Yes	No	Low
30	Yes	Yes	Yes	No	High
31	Yes	Yes	Yes	Yes	Low
32	Yes	Yes	Yes	Yes	High

Suppose these are the factorial ANOVA results of the optimization trial. (*This is artificial data.*)

(Table from Collins (2018), p. 238)

Table 7.2 Results of analysis of variance on data from 2^5 factorial experiment[a]

		b-weight	*t*	*p*
	Intercept	5.033	105.655	<.001
Main effects				
	MI	0.167	3.510	<.001
	PEER	0.217	4.556	<.001
	TEXT	0.030	0.623	0.534
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Interactions				
	MI × *PEER*	−0.119	−2.504	0.013
	MI × *TEXT*	0.134	2.804	0.005
	MI × *MIND*	−0.013	−0.272	0.786
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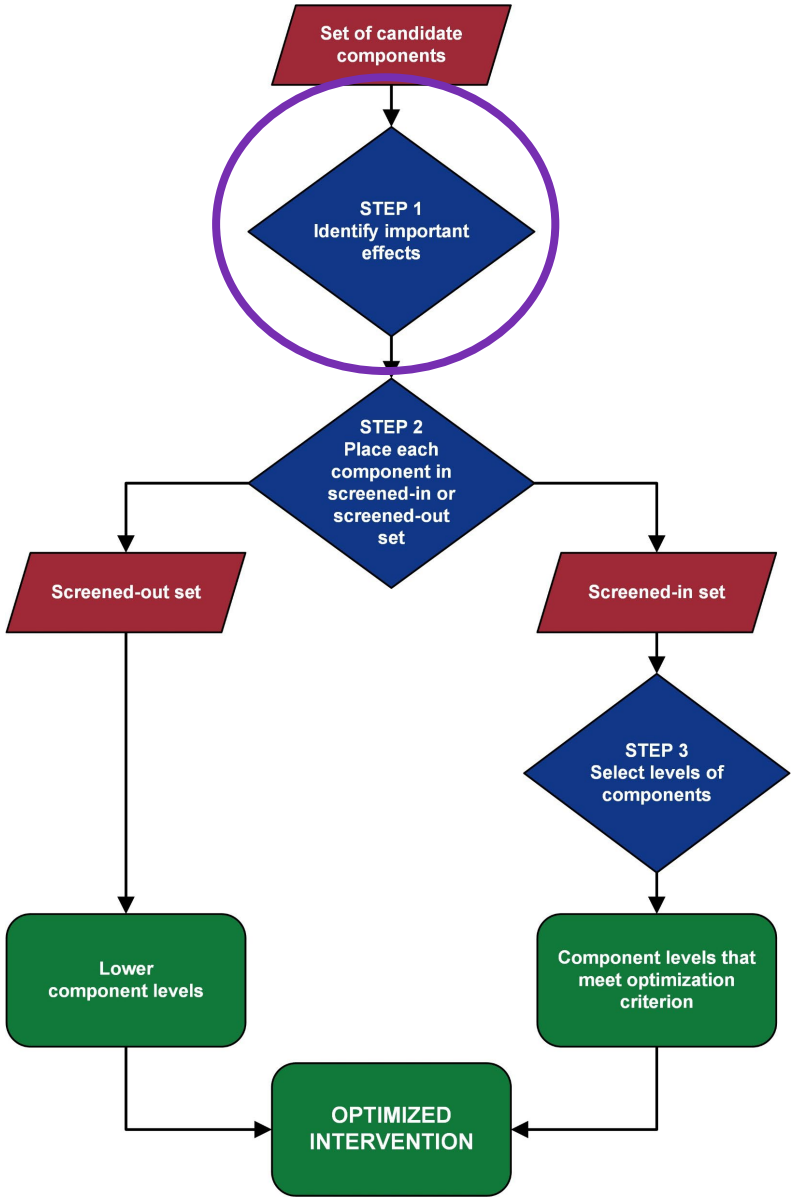
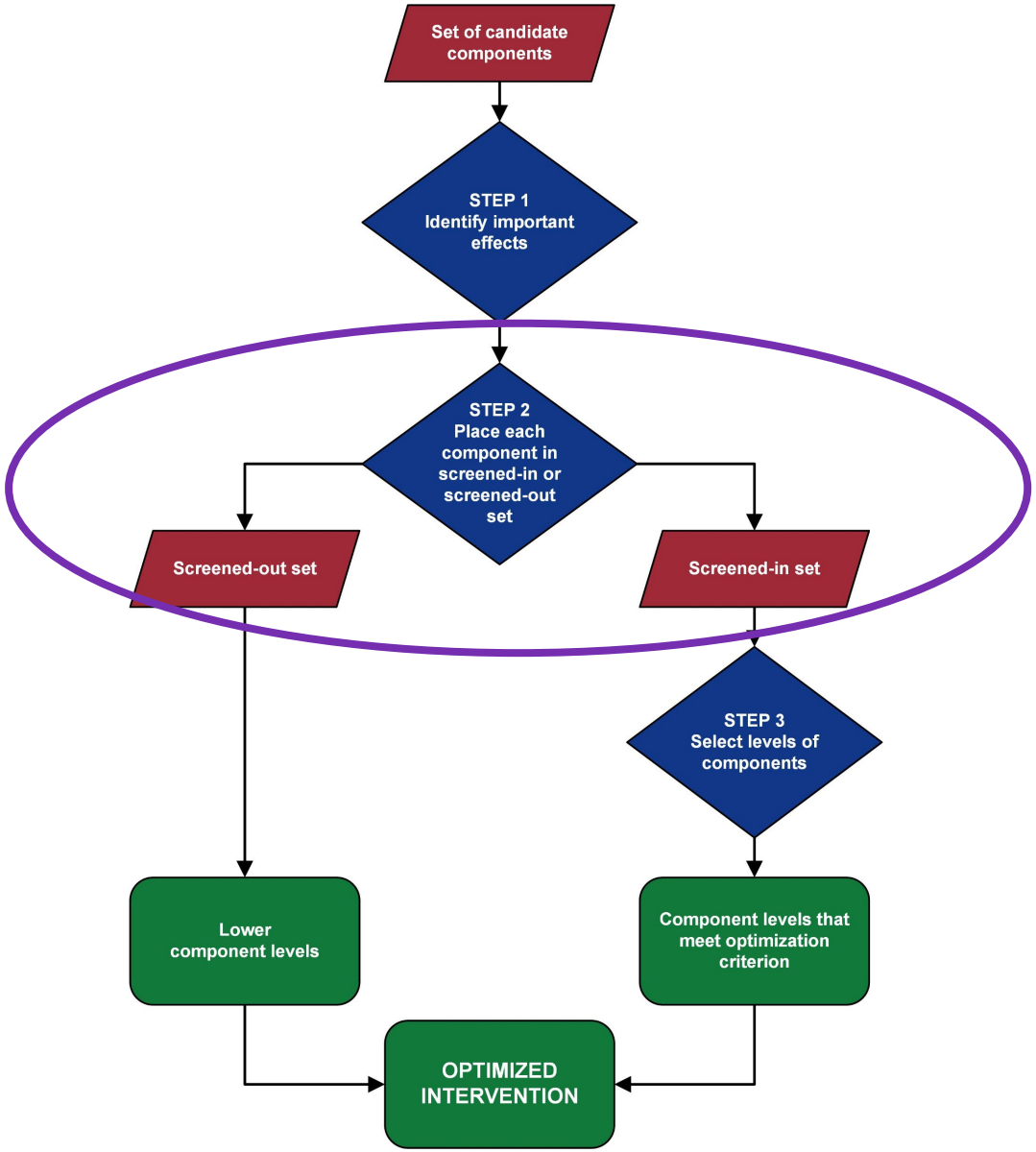
	PEER × *TEXT* × *MIND* × *SKILLS*	−0.012	−0.250	0.803
	MI × *PEER* × *TEXT* × *MIND* × *SKILLS*	0.008	0.160	0.873

[a]$N = 512$. Standard error (all effects) = .048. Results are based on artificial data. Shading indicates that the effect meets the main effect or interaction criterion. In this example both criteria are $p < .15$

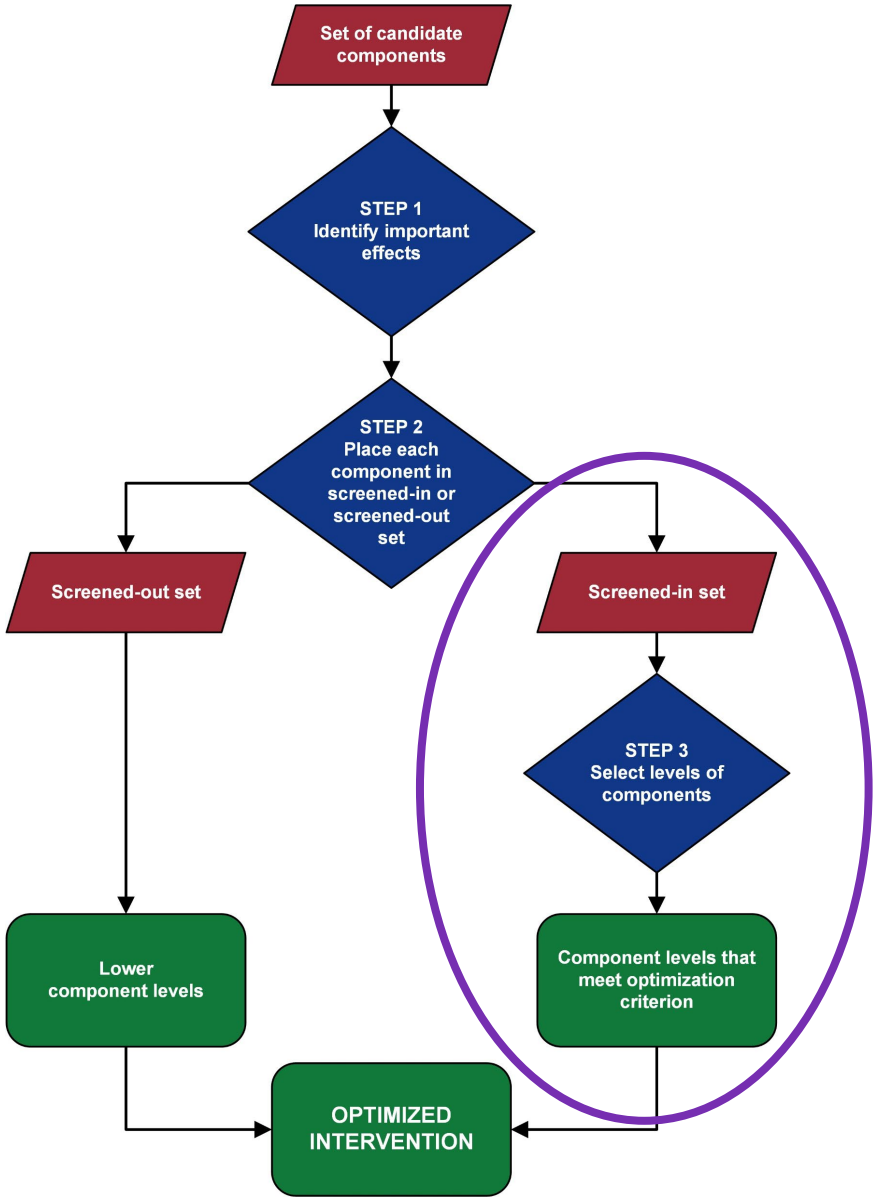
Step 1: Identify important effects



Step 2: Place each component in the screened-in or screened-out set



Step 3:
Select, from the screened-in set, components/ component levels that best meet the optimization objective



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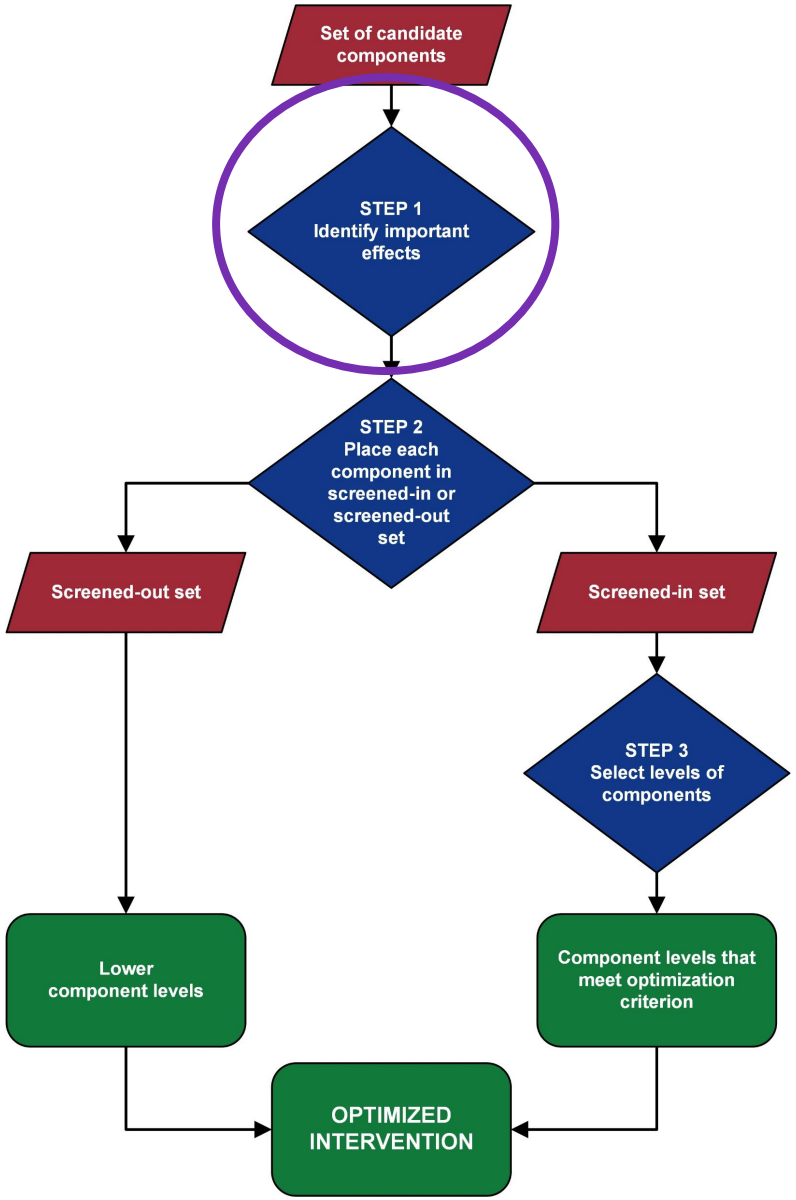

We need to establish cut-offs to define important effects

- In this example, suppose you have selected $p \leq .15$
- We will use the same cut-off for main effects and interactions (although they can be different)
- Note that a main effect in the undesired direction that exceeds the cut-off is still considered important

Identifying important effects from a decision-priority perspective

- Rationale for using $p \leq .15$ as a cut-off:
  - We are in the optimization phase of MOST
  - So, working from a decision-priority perspective
  - By using a larger α we increase statistical power, i.e. increase probability of identifying the effective components
- In evaluation phase, optimized intervention will be evaluated using $\alpha = .05$

Identifying important effects from a decision-priority perspective

- Rationale for not using a correction for multiple hypothesis tests
  - Again, working from a decision-priority perspective
  - We need to use any information we have as a basis for dividing components into the screened-in and screened-out sets
  - Using a particular α as a cut-off is the same as selecting all effects above a particular effect size

Suppose these are the factorial ANOVA results of the optimization trial. (*This is artificial data.*)

Important effects (according to our cut-off of $p \leq .15$) are highlighted in yellow.

Three main effects are important. Four 2-way interactions are important.

(Table from Collins (2018), p. 238)

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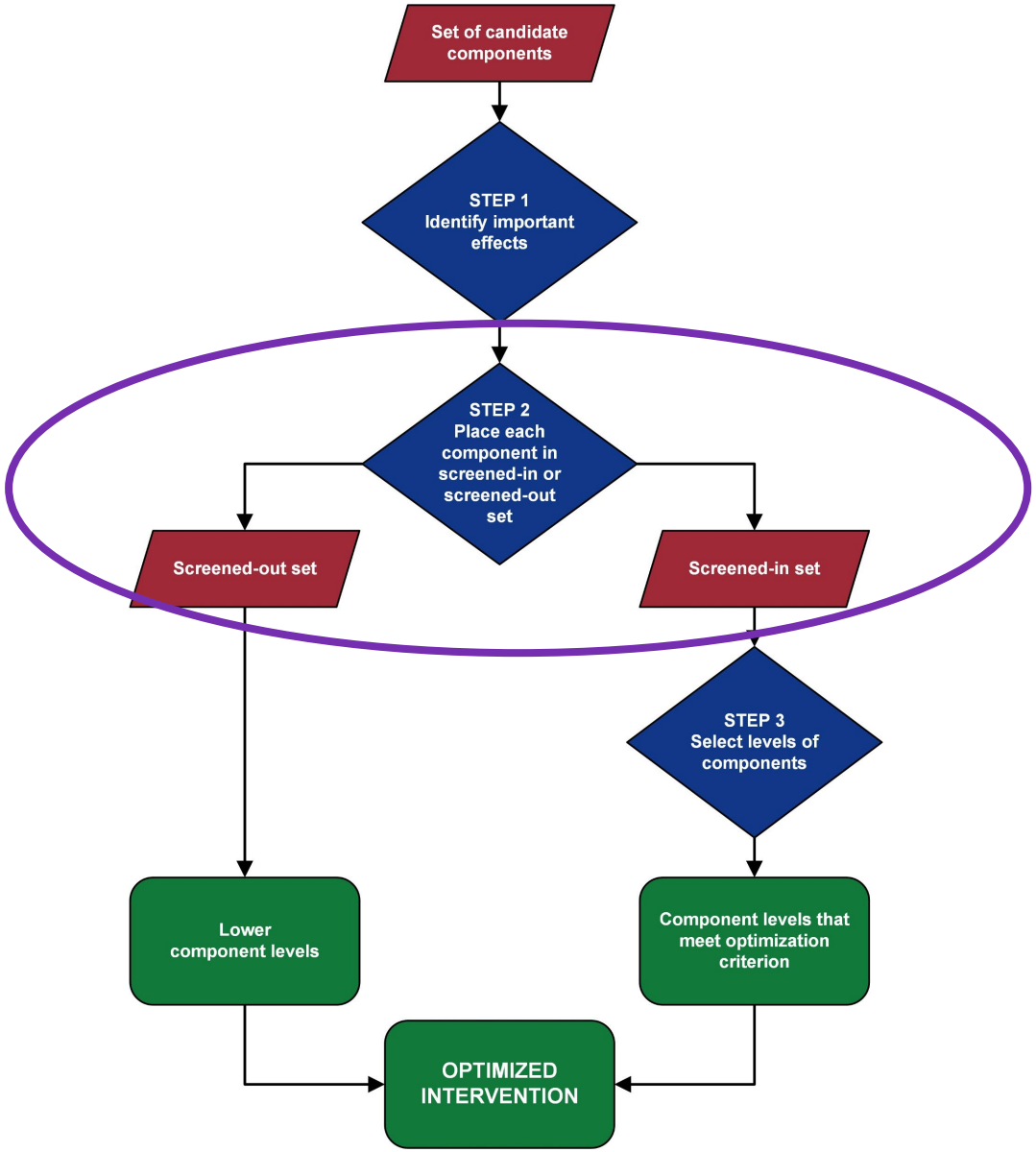
[a]$N = 512$. Standard error (all effects) = .048. Results are based on artificial data. Shading indicates that the effect meets the main effect or interaction criterion. In this example both criteria are $p < .15$

Step 2: Place each component in the screened-in or screened-out set



How to decide on the screened-in and screened-out sets

First, preliminarily select all components corresponding to factors with important main effects (according to the cut-off you identified) **in the desired direction** into the screened-in set of components

Then, reconsider these selections in light of any important interactions

How to decide on the screened-in and screened-out sets

First, preliminarily select all components corresponding to factors with important main effects (according to the cut-off you identified) in the desired direction into the screened-in set of components

Preliminary selection: motivational interviewing, peer mentoring, and behavioral skills training are selected into the screened-in set

This is based solely on important main effects

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[a]$N = 512$. Standard error (all effects) = .048. Results are based on artificial data. Shading indicates that the effect meets the main effect or interaction criterion. In this example both criteria are $p < .15$

- Preliminary screened-in set: motivational interviewing, peer mentoring, and behavioral skills training
- Preliminary screened-out set: text messaging and mindfulness meditation

How to decide on the screened-in and screened-out sets

Then, reconsider these selections in light of any important interactions

Now the preliminary selections must be reconsidered in the light of the following interactions, which have been identified as important:

MI × PEER
MI × TEXT
MI × SKILLS
PEER × SKILLS

(Table from Collins (2018), p. 238)

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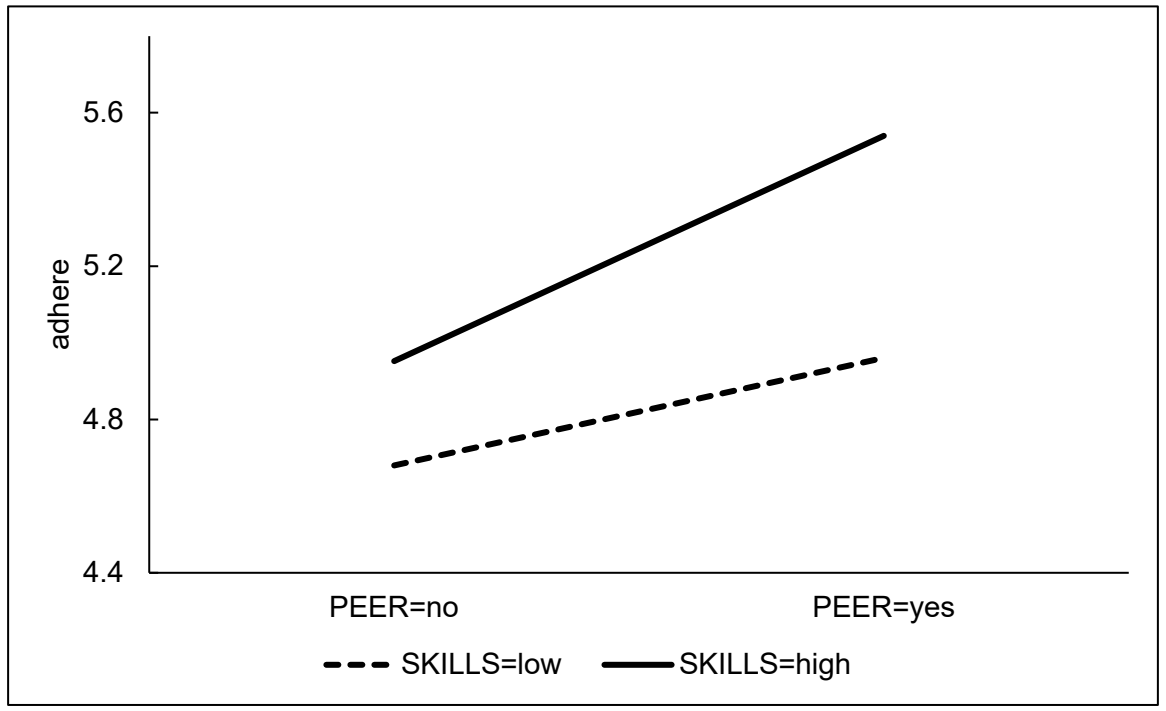


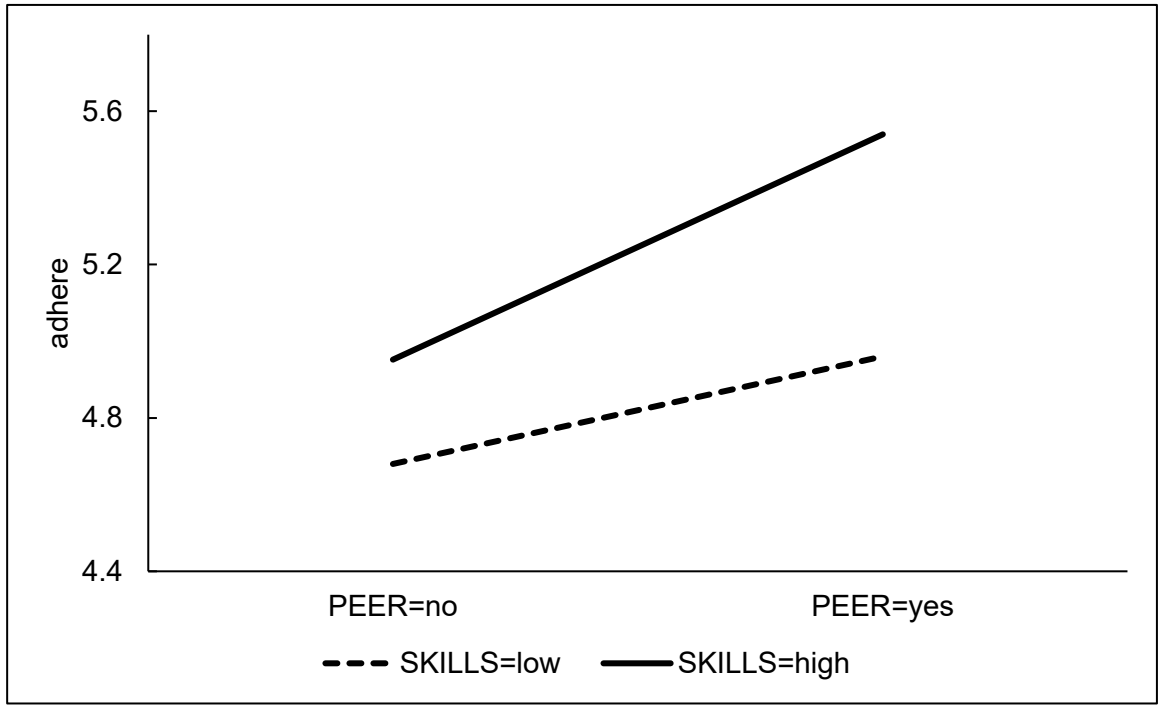
Example: To get this plot of the PEER × SKILLS interaction…

(Figure from Collins (2018), p. 243)

	PEER	
SKILLS	Yes	No
Yes	$\hat{Y}$	$\hat{Y}$
No	$\hat{Y}$	$\hat{Y}$

…it is necessary to compute this table of marginal means. These means are collapsed across all levels of all the other factors.

PEER × SKILLS interaction



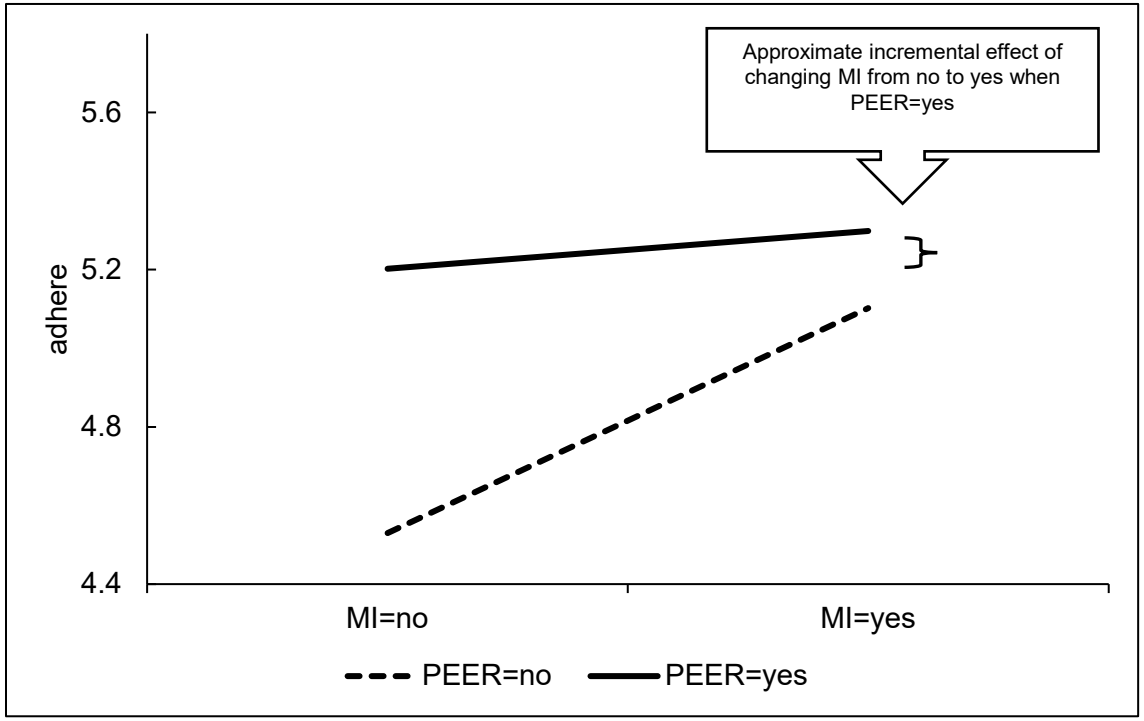
Preliminary decision: Peer mentoring and behavioral skills training selected into the screened-in set.

Reasoning: This is a synergistic interaction; including both peer mentoring and the high-intensity level of behavioral skills training produces a highly favorable outcome.

Conclusion: Do not change preliminary decision.

(Figure from Collins (2018), p. 243)

MI × PEER interaction



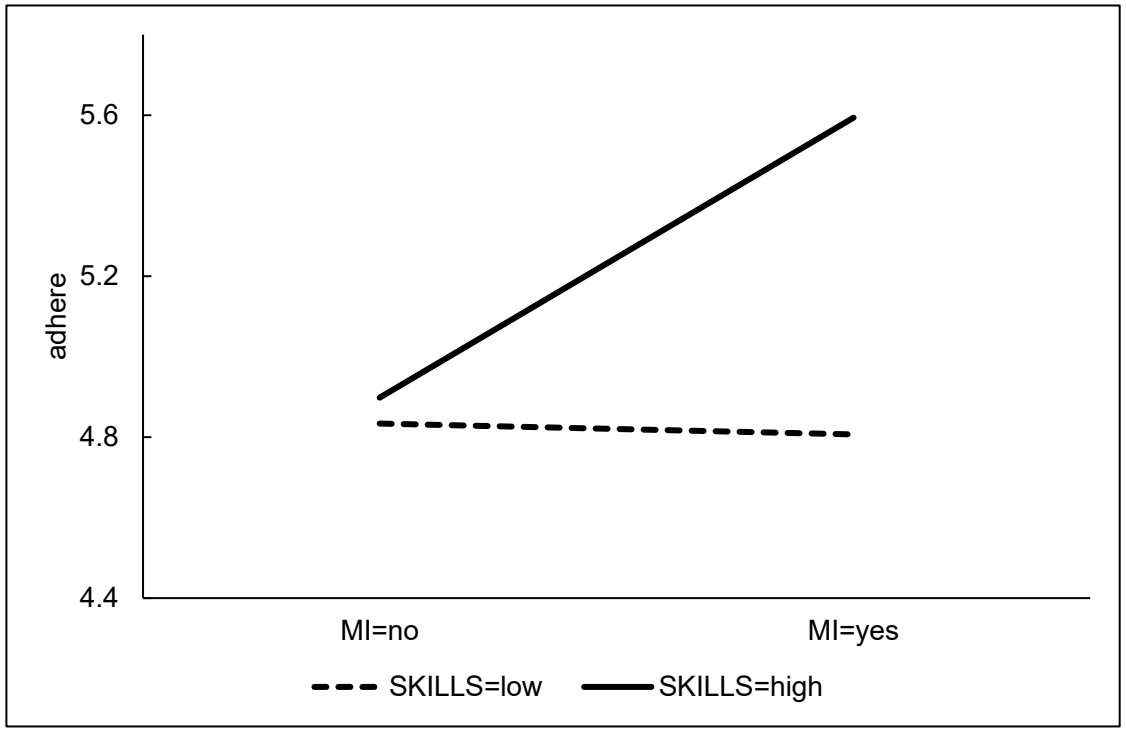
Preliminary decision: Motivational interviewing and peer mentoring selected into the screened-in set.

Reasoning: This is an antagonistic interaction, so the combination of these two components is not as favorable as would be expected based solely on the main effects. However, there is still a small net gain associated with including motivational interviewing along with peer mentoring.

Conclusion: Do not change preliminary decision.

(Figure from Collins (2018), p. 243)

MI × SKILLS interaction



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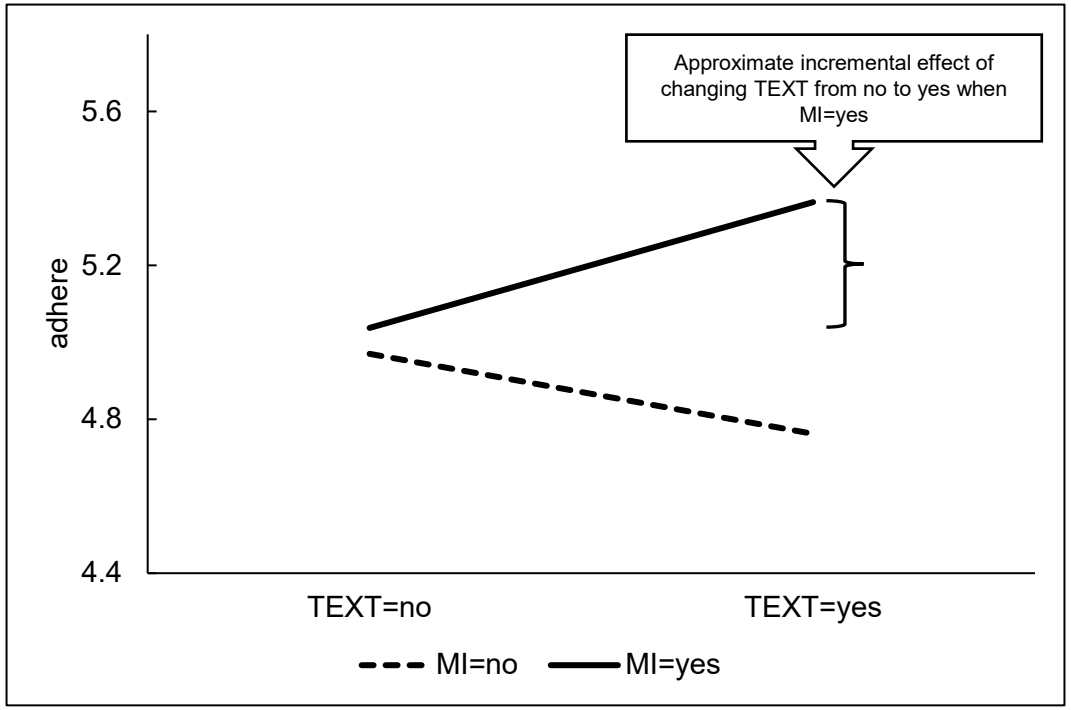
Reasoning: This is a synergistic interaction; including both motivational interviewing and the high-intensity level of behavioral skills training produces a highly favorable outcome.

Conclusion: Do not change preliminary decision.

(Figure from Collins (2018), p. 245)

MI × TEXT interaction



Preliminary decision: Motivational interviewing is in the screened-in set; text messaging is in the screened-out set.

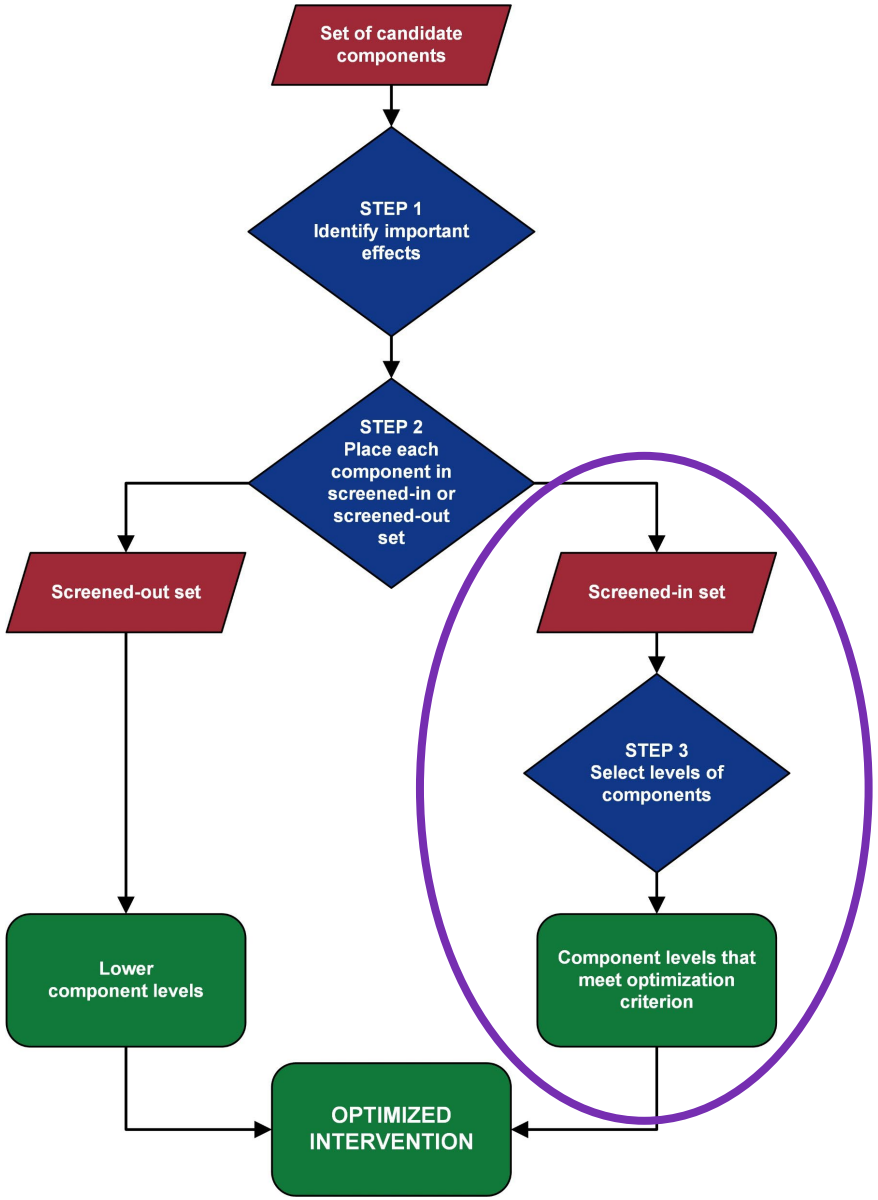
Reasoning: This is a synergistic interaction. There appears to be a substantial incremental gain associated with adding test messaging, even though there is no main effect of text messaging.

Conclusion: Move text messaging into the screened-in set.

(Figure from Collins (2018), p. 246)

- Final screened-in set: motivational interviewing, peer mentoring, text messaging, and behavioral skills training are selected into the screened-in set
- Final screened-out set: Mindfulness meditation

Step 3:
Select, from the screened-in set, components/ component levels that best meet the optimization objective



Step 3: Select components/component levels to make up the optimized intervention

- If the optimization objective is “all active components” the intervention consistsof the components in the screened-in set, all at the higher level
- If a different optimization objective, there is more work to do!

Step 3: Select components/component levels to make up the optimized intervention

- Recall the optimization objective: Best expected outcome obtainable for < $500

1. Identify all the combinations of components/component levels that can be made from the screened-in set
2. Eliminate combinations that exceed $500
3. Of remaining, select combination that produces best expected outcome

Data on cost

- Suppose the costs are as follows (in $US):
  - Motivational interviewing: $300
  - Peer mentoring: $150
  - Text messaging: $50
  - Behavioral skills training
    - Low intensity: $25
    - High intensity: $225

Combinations that are greyed are ruled out because they are too expensive (>$500)

Of those remaining, Combination 6 shows the best expected outcome (largest $\hat{Y}$)

(Table from Collins (2018), p. 252)

Table 7.5 Combinations of factor levels corresponding to components in screened-in set in order of cost in $US

Combination number	*MI*	*PEER*	*TEXT*	*MIND*	*SKILLS*	$\hat{Y}$ (parsimonious model)	Cost (US$)
1	No[a]	No	No	No	Low	4.708	25
3	No	No	Yes	No	Low	4.441	75
5	No	Yes	No	No	Low	5.227	175
2	No	No	No	No	High	4.618	225
7	No	Yes	Yes	No	Low	4.960	225
4	No	No	Yes	No	High	4.351	275
9	Yes	No	No	No	Low	4.652	325
6	No	Yes	No	No	High	5.445	375
11	Yes	No	Yes	No	Low	4.919	375
8	No	Yes	Yes	No	High	5.178	425
13	Yes	Yes	No	No	Low	4.694	475
10	Yes	No	No	No	High	5.286	525
15	Yes	Yes	Yes	No	low	4.961	525
12	Yes	No	Yes	No	High	5.553	575
14	Yes	Yes	No	No	High	5.635	675
16	Yes	Yes	Yes	No	High	5.902	725

[a]No means not included in intervention; yes means included in intervention

- With the selected optimization objective, the intervention includes ONLY peer mentoring and the high-intensity level of behavioral skills training (combination 6)

Optimized ≠ best

- The optimized intervention (according to our selected optimization objective) is combination 6
- Is this the option that delivers the best $\hat{Y}$? NO
- But it is the best we can afford
- To stay within $500 we must omit motivational interviewing and text messaging

Back to the classical approach for a thought experiment

- Suppose you had used the classical treatment package approach
- Put all the components together at the higher level, evaluated in an RCT, found a significant effect
- And only then considered the < $500 budget

Back to the classical approach for a thought experiment

- What would you do?
- You would probably have to eliminate some components – but which ones?
- Suppose you decided to
  - Eliminate text message support, mindfulness mediation, behavioral skills training
  - Keep motivational interviewing and peer mentoring
- This would cost $475 and be less effective than combination 6

Combinations that are greyed are ruled out because they are too expensive (>$500)

Of those remaining, Combination 6 shows the best expected outcome (largest $\hat{Y}$)

(Table from Collins (2018), p. 252)

Table 7.5 Combinations of factor levels corresponding to components in screened-in set in order of cost in $US

Combination number	*MI*	*PEER*	*TEXT*	*MIND*	*SKILLS*	$\hat{Y}$ (parsimonious model)	Cost (US$)
1	No[a]	No	No	No	Low	4.708	25
3	No	No	Yes	No	Low	4.441	75
5	No	Yes	No	No	Low	5.227	175
2	No	No	No	No	High	4.618	225
7	No	Yes	Yes	No	Low	4.960	225
4	No	No	Yes	No	High	4.351	275
9	Yes	No	No	No	Low	4.652	325
6	No	Yes	No	No	High	5.445	375
11	Yes	No	Yes	No	Low	4.919	375
8	No	Yes	Yes	No	High	5.178	425
13	Yes	Yes	No	No	Low	4.694	475
10	Yes	No	No	No	High	5.286	525
15	Yes	Yes	Yes	No	low	4.961	525
12	Yes	No	Yes	No	High	5.553	575
14	Yes	Yes	No	No	High	5.635	675
16	Yes	Yes	Yes	No	High	5.902	725

[a]No means not included in intervention; yes means included in intervention

Back to the classical approach for a thought experiment

- The reality is, resource limitations make difficult choices necessary
- You may not have the resources to implement all the effective components
- Then you are forced to choose which ones to implement
- You can make these choices blindly, or based on empirical evidence

In this lesson you learned how to:

- Implement current practices in an example
- Relate the decision-priority perspective to identification of the optimized intervention

In the next lesson you will learn how to:

- Understand the alternative possibilities for next steps
- Relate the resource management and continual optimization principles to the decisions about next steps