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

## Module 5

## Rigorous and responsible conduct of intervention optimization research

## Lesson 1: Ensuring that all factors can be manipulated independently

NYU SCHOOL OF GLOBAL PUBLIC HEALTH

Intervention Optimization Initiative

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# In this lesson you will learn how to:

- Recognize the critical importance of selecting experimental factors that can be manipulated independently

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

Suppose there are 4 candidate components:

- Motivational interviewing  (no, yes)
- Peer mentoring (no, yes)
- Text message support (no, yes)
- Mindfulness meditation (no, yes)

# The factorial design

- $2^4$ factorial experiment
- This will have 16 experimental conditions
- We will use abbreviations for the independent variable names

Experimental conditions in a factorial experiment with four factors:

*MI*, *PEER*, *TEXT*, and *MIND*

| Experimental condition | *MI* | *PEER* | *TEXT* | *MIND* | *Outcome* |
|---|---|---|---|---|---|
| **1** | No | No | No | No | $\overline{Y}_1$ |
| **2** | No | No | No | Yes | $\overline{Y}_2$ |
| **3** | No | No | Yes | No | $\overline{Y}_3$ |
| **4** | No | No | Yes | Yes | $\overline{Y}_4$ |
| **5** | No | Yes | No | No | $\overline{Y}_5$ |
| **6** | No | Yes | No | Yes | $\overline{Y}_6$ |
| **7** | No | Yes | Yes | No | $\overline{Y}_7$ |
| **8** | No | Yes | Yes | Yes | $\overline{Y}_8$ |
| **9** | Yes | No | No | No | $\overline{Y}_9$ |
| **10** | Yes | No | No | Yes | $\overline{Y}_{10}$ |
| **11** | Yes | No | Yes | No | $\overline{Y}_{11}$ |
| **12** | Yes | No | Yes | Yes | $\overline{Y}_{12}$ |
| **13** | Yes | Yes | No | No | $\overline{Y}_{13}$ |
| **14** | Yes | Yes | No | Yes | $\overline{Y}_{14}$ |
| **15** | Yes | Yes | Yes | No | $\overline{Y}_{15}$ |
| **16** | Yes | Yes | Yes | Yes | $\overline{Y}_{16}$ |

# A necessary assumption

- All the factors can be manipulated independently
- This implies:
  1. All combinations of factor levels make sense
  2. Consistent implementation of each level of each factor: Each level of each factor can be implemented in the same manner irrespective of which other levels of other factors it is combined with

# 1. All combinations of factor levels make sense

- When considering a factorial experiment, it’s a good idea to review all the experimental conditions to make sure they make sense.
- Example: Suppose the text messages are to come from the peer mentor.

**If the peer mentor is to send the text messages, how will it be possible to implement these conditions?**

| Experimental condition | *MI* | *PEER* | *TEXT* | *MIND* | *Outcome* |
|---|---|---|---|---|---|
| **1** | No | No | No | No | $\overline{Y}_1$ |
| **2** | No | No | No | Yes | $\overline{Y}_2$ |
| **3** | No | No | Yes | No | $\overline{Y}_3$ |
| **4** | No | No | Yes | Yes | $\overline{Y}_4$ |
| **5** | No | Yes | No | No | $\overline{Y}_5$ |
| **6** | No | Yes | No | Yes | $\overline{Y}_6$ |
| **7** | No | Yes | Yes | No | $\overline{Y}_7$ |
| **8** | No | Yes | Yes | Yes | $\overline{Y}_8$ |
| **9** | Yes | No | No | No | $\overline{Y}_9$ |
| **10** | Yes | No | No | Yes | $\overline{Y}_{10}$ |
| **11** | Yes | No | Yes | No | $\overline{Y}_{11}$ |
| **12** | Yes | No | Yes | Yes | $\overline{Y}_{12}$ |
| **13** | Yes | Yes | No | No | $\overline{Y}_{13}$ |
| **14** | Yes | Yes | No | Yes | $\overline{Y}_{14}$ |
| **15** | Yes | Yes | Yes | No | $\overline{Y}_{15}$ |
| **16** | Yes | Yes | Yes | Yes | $\overline{Y}_{16}$ |

# 1. All combinations of factor levels make sense

- Another example: The investigators would like to test whether a booster session to be delivered 6 months later is effective.
- They are considering adding a $5^{th}$ factor: Booster with levels no and yes
- Would the condition in which all the factors except Booster are set to no make sense?

# 1. All combinations of factor levels make sense

- What happens if this assumption is violated?
- Usually you cannot conduct the experiment!
- It is not possible simply to leave out any experimental conditions that do not make sense or cannot be implemented

# 1. All combinations of factor levels make sense

- Why should you not simply eliminate combinations of factor levels (i.e. experimental conditions) that do not make sense?
- This will destroy the balance property and you will no longer have a factorial experiment (Modules 3 and 4)

# 1. All combinations of factor levels make sense

- So, it is a REALLY good idea to make sure all combinations make sense before going very far
- Take the time to “walk” through all combinations of factor levels

# 2. Consistent implementation of each level of each factor

- How a level of a factor is implemented should be exactly the same across experimental conditions
- This means how a component is implemented should not vary depending on which other components/component levels are combined with it in an experimental condition

# 2. Consistent implementation of each level of each factor

- Suppose the same staff member is to deliver motivational interviewing and the training in mindfulness meditation
- Some experimental conditions call for **only motivational interviewing** and not mindfulness meditation

Suppose the same staff member is delivering *MI* and *MIND*

| Experimental condition | *MI* | *PEER* | *TEXT* | *MIND* | *Outcome* |
|---|---|---|---|---|---|
| **1** | No | No | No | No | $\overline{Y}_1$ |
| **2** | No | No | No | Yes | $\overline{Y}_2$ |
| **3** | No | No | Yes | No | $\overline{Y}_3$ |
| **4** | No | No | Yes | Yes | $\overline{Y}_4$ |
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| **8** | No | Yes | Yes | Yes | $\overline{Y}_8$ |
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| **10** | Yes | No | No | Yes | $\overline{Y}_{10}$ |
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| **12** | Yes | No | Yes | Yes | $\overline{Y}_{12}$ |
| **13** | Yes | Yes | No | No | $\overline{Y}_{13}$ |
| **14** | Yes | Yes | No | Yes | $\overline{Y}_{14}$ |
| **15** | Yes | Yes | Yes | No | $\overline{Y}_{15}$ |
| **16** | Yes | Yes | Yes | Yes | $\overline{Y}_{16}$ |

# 2. Consistent implementation of each level of each factor

- Suppose the same staff member is to deliver motivational interviewing and the training in mindfulness meditation
- Some experimental conditions call for **only mindfulness meditation** and not motivational interviewing

Suppose the same staff member is delivering *MI* and *MIND*

| Experimental condition | *MI* | *PEER* | *TEXT* | *MIND* | *Outcome* |
|---|---|---|---|---|---|
| **1** | No | No | No | No | $\overline{Y}_1$ |
| **2** | No | No | No | Yes | $\overline{Y}_2$ |
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| **13** | Yes | Yes | No | No | $\overline{Y}_{13}$ |
| **14** | Yes | Yes | No | Yes | $\overline{Y}_{14}$ |
| **15** | Yes | Yes | Yes | No | $\overline{Y}_{15}$ |
| **16** | Yes | Yes | Yes | Yes | $\overline{Y}_{16}$ |

# 2. Consistent implementation of each level of each factor

- Suppose the same staff member is to deliver motivational interviewing and the training in mindfulness meditation
- Some experimental conditions call for **both** motivational interviewing and mindfulness meditation

Suppose the same staff member is delivering *MI* and *MIND*

| Experimental condition | *MI* | *PEER* | *TEXT* | *MIND* | *Outcome* |
|---|---|---|---|---|---|
| **1** | No | No | No | No | $\overline{Y}_1$ |
| **2** | No | No | No | Yes | $\overline{Y}_2$ |
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| **14** | Yes | Yes | No | Yes | $\overline{Y}_{14}$ |
| **15** | Yes | Yes | Yes | No | $\overline{Y}_{15}$ |
| **16** | Yes | Yes | Yes | Yes | $\overline{Y}_{16}$ |

# 2. Consistent implementation of each level of each factor

- The same staff member will, ideally, deliver motivational interviewing and the training in mindfulness meditation in **the same manner** in all of these experimental conditions
- This means NOT e.g. combining them into one briefer treatment to save time in Conditions 10, 12, 14, and 16

# What happens if this assumption is violated?

- Violation of this assumption can produce an interaction between factors (where otherwise there would be no interaction)

# What happens if this assumption is violated?

- In practice, this assumption is sometimes violated to some extent
- Some redundancy between components may be inevitable, and it may make sense to streamline when they are presented together
- Try to keep this to a minimum

# In this lesson you learned how to:

- Recognize the critical importance of selecting experimental factors that can be manipulated independently

# In the next lesson you will learn how to:

- Ensure that all participants are provided at least the standard of care by including a constant component in a factorial experiment