Presented by

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Just-in-Time Adaptive Interventions

JITAIs

Module 4 🕐 60 min

Outline

Defining Just In Time Adaptive Interventions (JITAIs)

Components of a JITAI

Why use JITAIs

Q&As about JITAIs

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Why use JITAIs

Q&As about JITAIs

What is a JITAI?

- An intervention design, not an experimental design

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- A JITAI is an intervention design that guides <u>rapid</u> <u>adaptation</u>

  - <u>Adaptation</u> refers to the use of dynamic information about a unit of interest (e.g., individual) to make repeated decisions concerning whether or how to intervene

What is a JITAI?

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- A JITAI is an intervention design that guides **adaptation** on a **relatively fast time-scale**

  - **Adaptation** refers to the use of dynamic information about a unit of interest (e.g., individual) to make repeated decisions concerning whether or how to intervene

What is a JITAI?

- An intervention design, not an experimental design

- A JITAI is an intervention design that guides <u>sequential intervention decision-making</u> on a <u>relatively fast time-scale</u>

    —<u>Sequential intervention decision-making</u> refers to the use of dynamic information about a unit of interest (e.g., individual) to make repeated decisions concerning whether or how to intervene

What is a JITAI?

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- Interventions are not designed for use by researchers

What is a JITAI?

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  - Adaptation refers to the use of dynamic information about a unit of interest (e.g., individual) to make repeated decisions concerning whether or how to intervene

- Interventions are not designed for use by researchers

- Protocolized

- Evidence-based (ideally)

What is a JITAI?

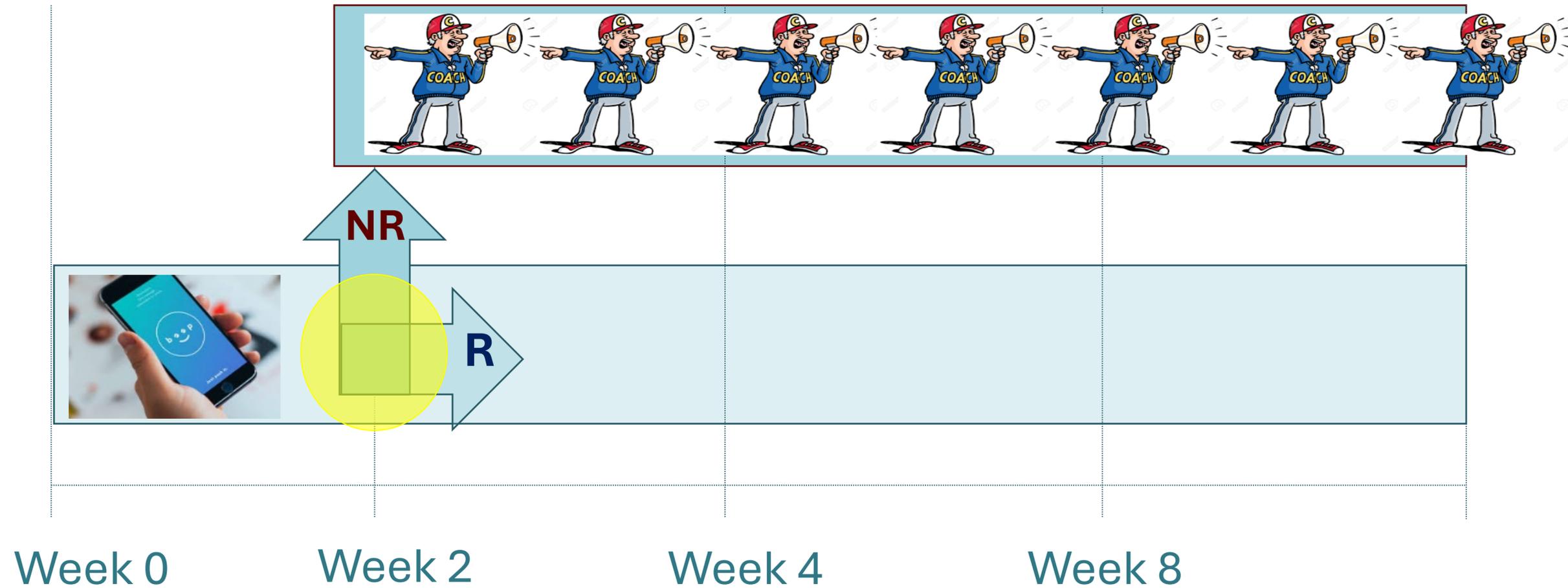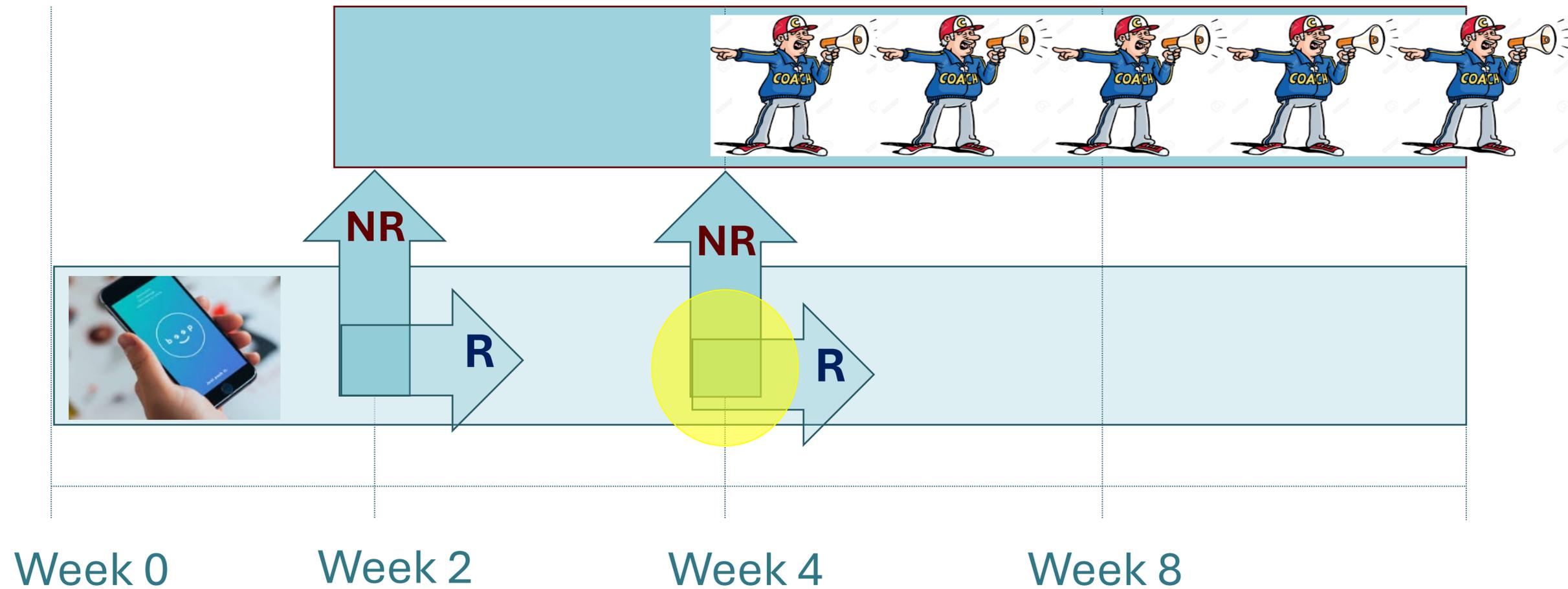|	
Adaptive intervention: *ADI*	Intervention options adapted on a relatively slow timescale (e.g., every few weeks)
Multi-level adaptive implementation strategy: *MAISY*	Implementation strategies adapted at multiple levels (e.g., provider and clinic)
Just-in-time adaptive intervention: *JITAI*	Intervention options adapted on a relatively fast timescale (e.g., every few hours) in daily life. **The decision rules do not vary from individual to individual**.
Personalizing JITAI: *pJITAI*	JITAIs with an RL algorithm that updates the adaptation repeatedly, based on the person's responsivity as they interact with the intervention over time.
Multimodality adaptive intervention: *MADI*	Human- and digitally-delivered components are blended and adapted on different timescales—slow (for human) and fast (for digital).

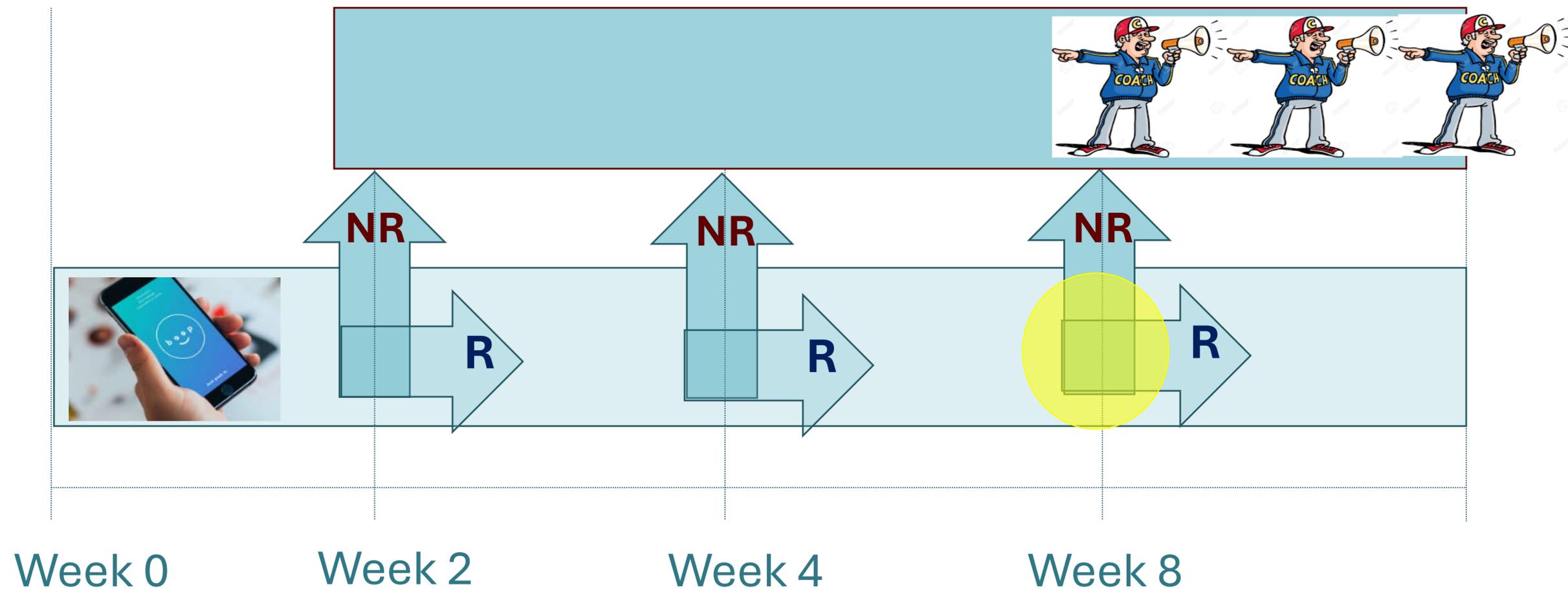# Recall the foundational adaptive intervention

Week 0   Week 2   Week 4   Week 8

Recall the foundational adaptive intervention

Week 0   Week 2   Week 4   Week 8
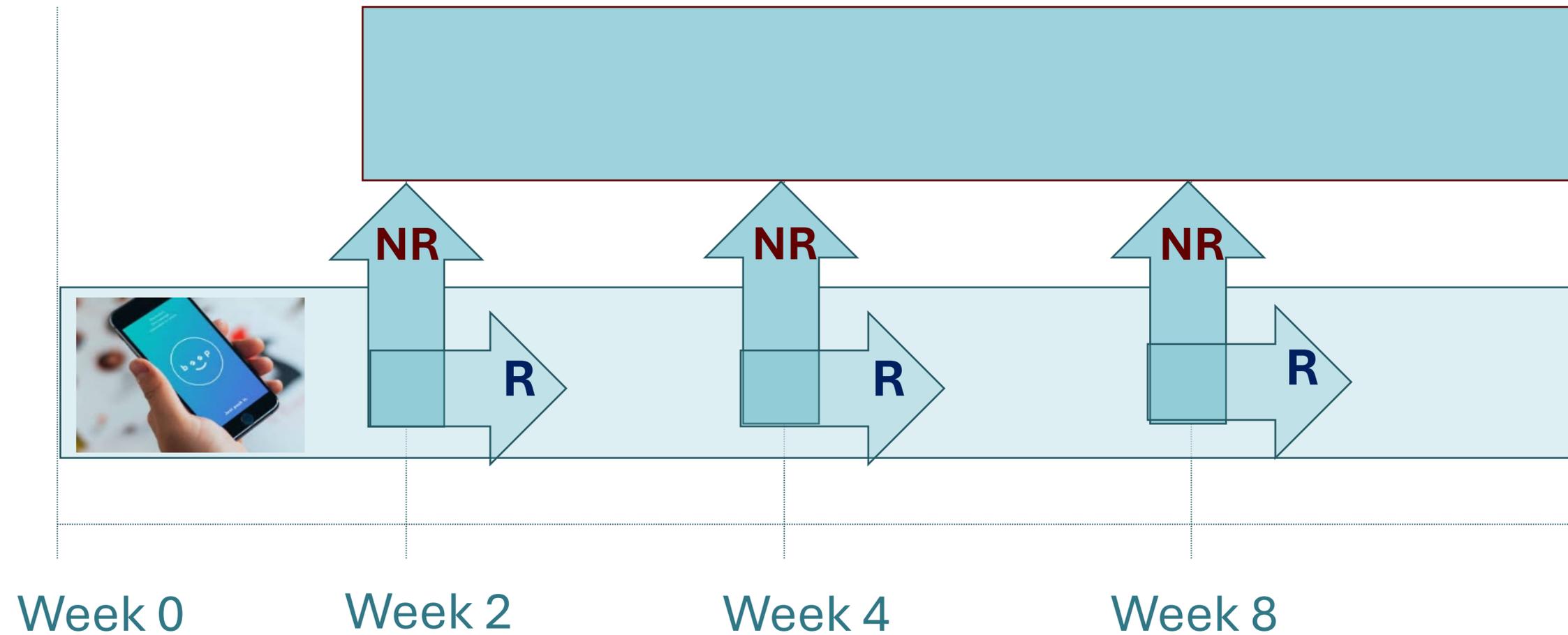
Recall the foundational adaptive intervention

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Recall the foundational adaptive intervention

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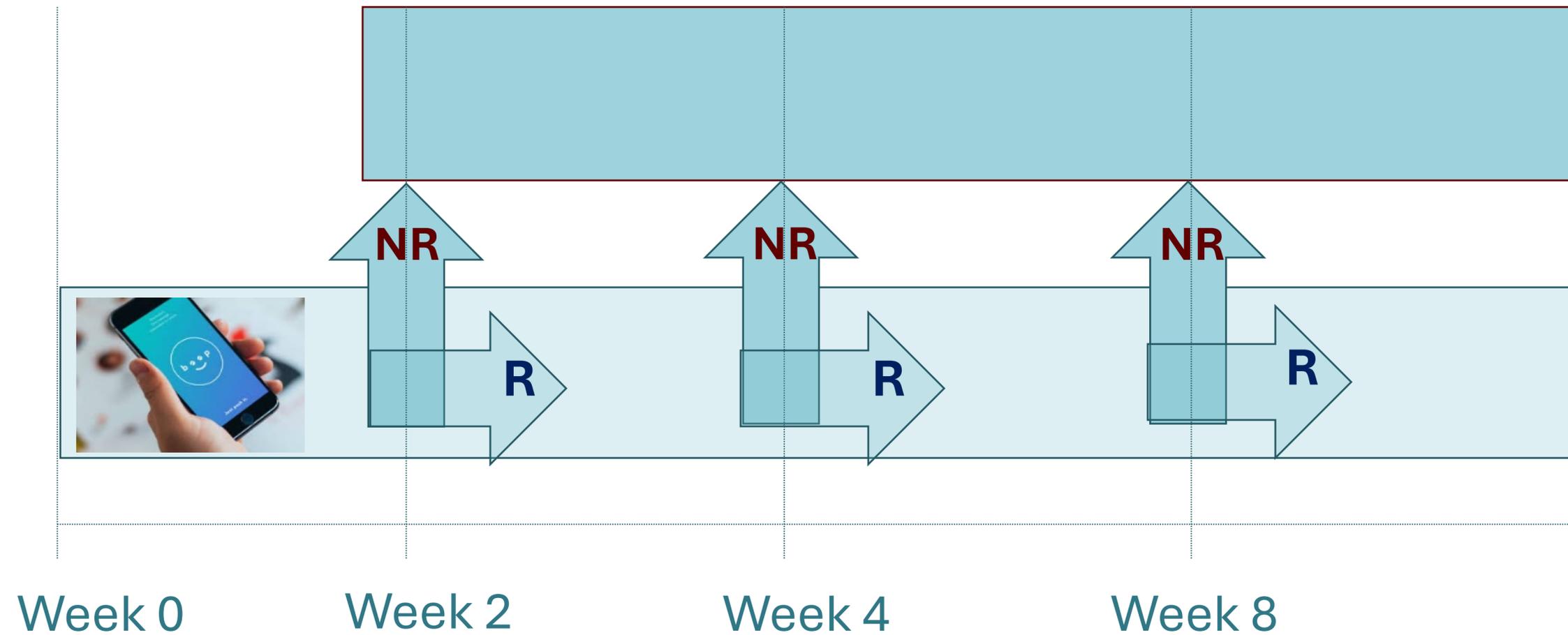
Recall the foundational adaptive intervention

Offer App initially

*Then, at weeks 2, 4 and 8*

    If Response Status = NR

        Then, IO = Add Coaching *& stop assessing response status*

    Else if Response Status = R

        Then, IO = Continue with App & keep assessing response status

Recall the foundational adaptive intervention

Decision Points

Offer App initially

Then, at weeks 2, 4 and 8

    If Response Status = NR

        Then, IO = Add Coaching & *stop assessing response status*

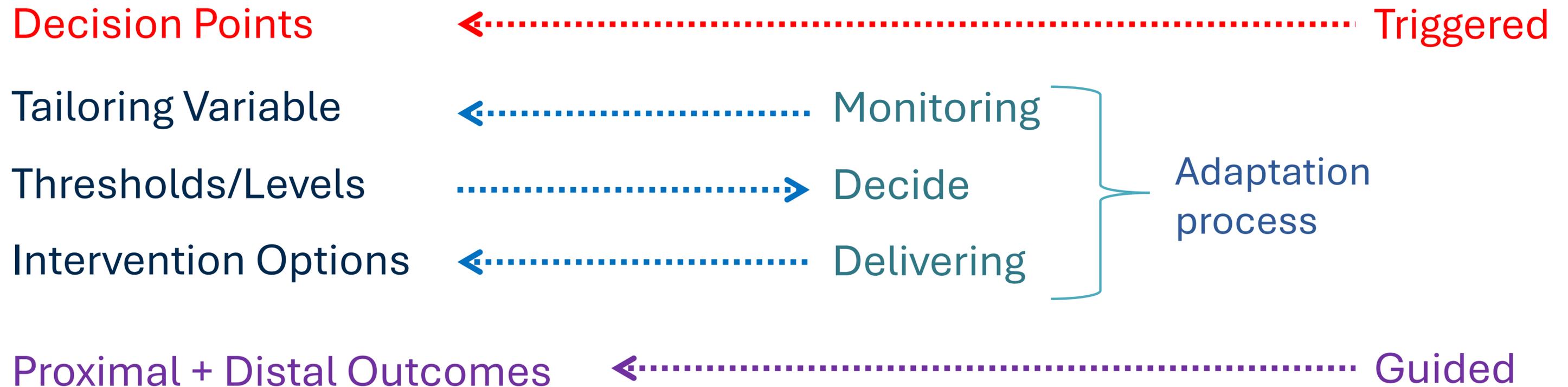   *Else if* Response Status = R

        Then, IO = Continue with App & keep assessing response status
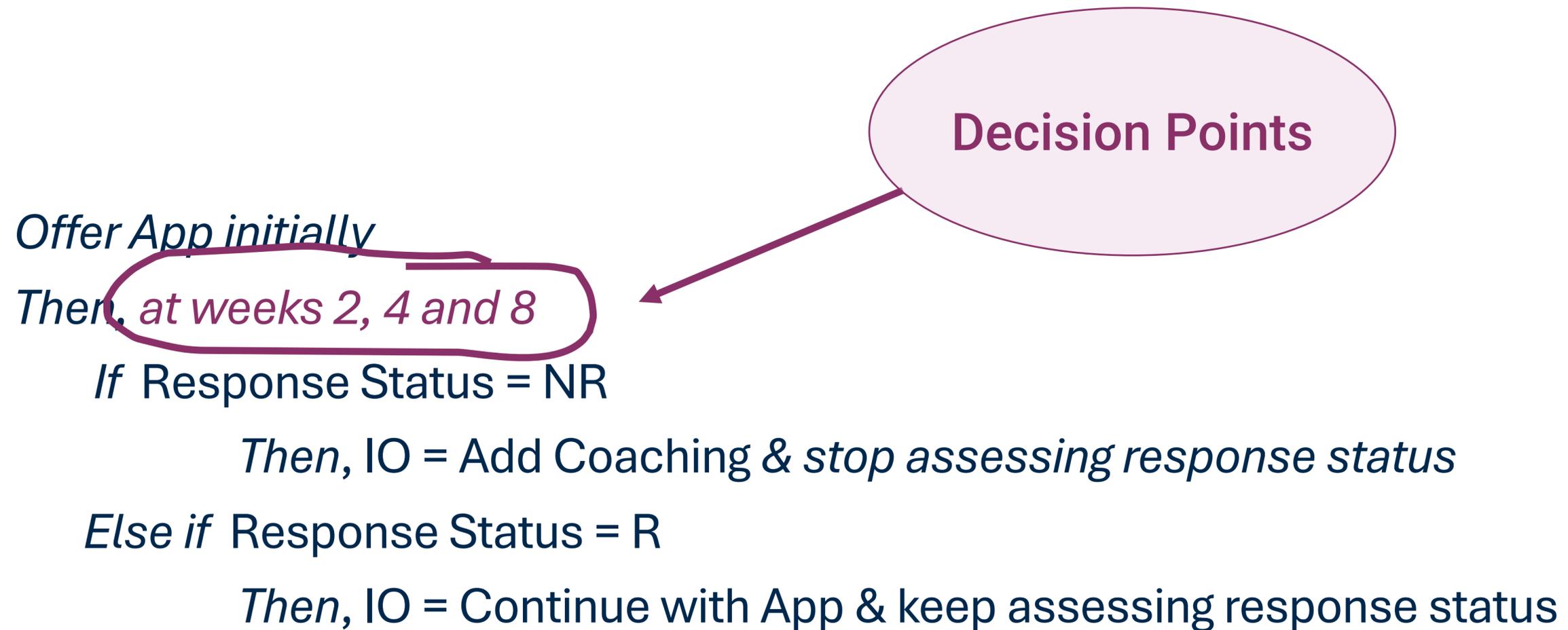
The decision points reflect the <u>time-scale at which we adapt</u>

Recall the foundational adaptive intervention

Decision Points ⟵ ············ Triggered

Tailoring Variable ⟵ ········ Monitoring ⎫
Thresholds/Levels ········⟶ Decide ⎬ Adaptation process
Intervention Options ⟵ ········ Delivering ⎭

Proximal + Distal Outcomes ⟵ ········ Guided

Recall the foundational adaptive intervention

Typically, decisions are made on a relatively slower time-scale.

Decision Points ← --- Triggered

Address conditions that unfold on a relatively **slower time-scale** ← **Adaptation process**
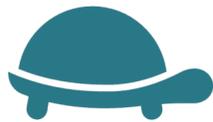
Proximal + Distal Outcomes ← --- Guided

Recall the foundational adaptive intervention

Decisions are made on a relatively faster time-scale.

Decision Points ←--- Triggered

Address conditions that unfold on a relatively **faster time-scale** ← **Adaptation process**

Proximal + Distal Outcomes ←--- Guided

Example JITAI in Smoking Cessation

o Goal: smoking cessation support

o Stress presents risk for lapse (slip)

- State characterized by arousal and displeasure
  (Kristensen, 1996; Posner et al., 2005)

Quit day   1   2   3   4   5   6   7   8   9   Day 10

Example JITAI in Smoking Cessation

If stress is detected, this JITAI intervenes with a stress management strategy
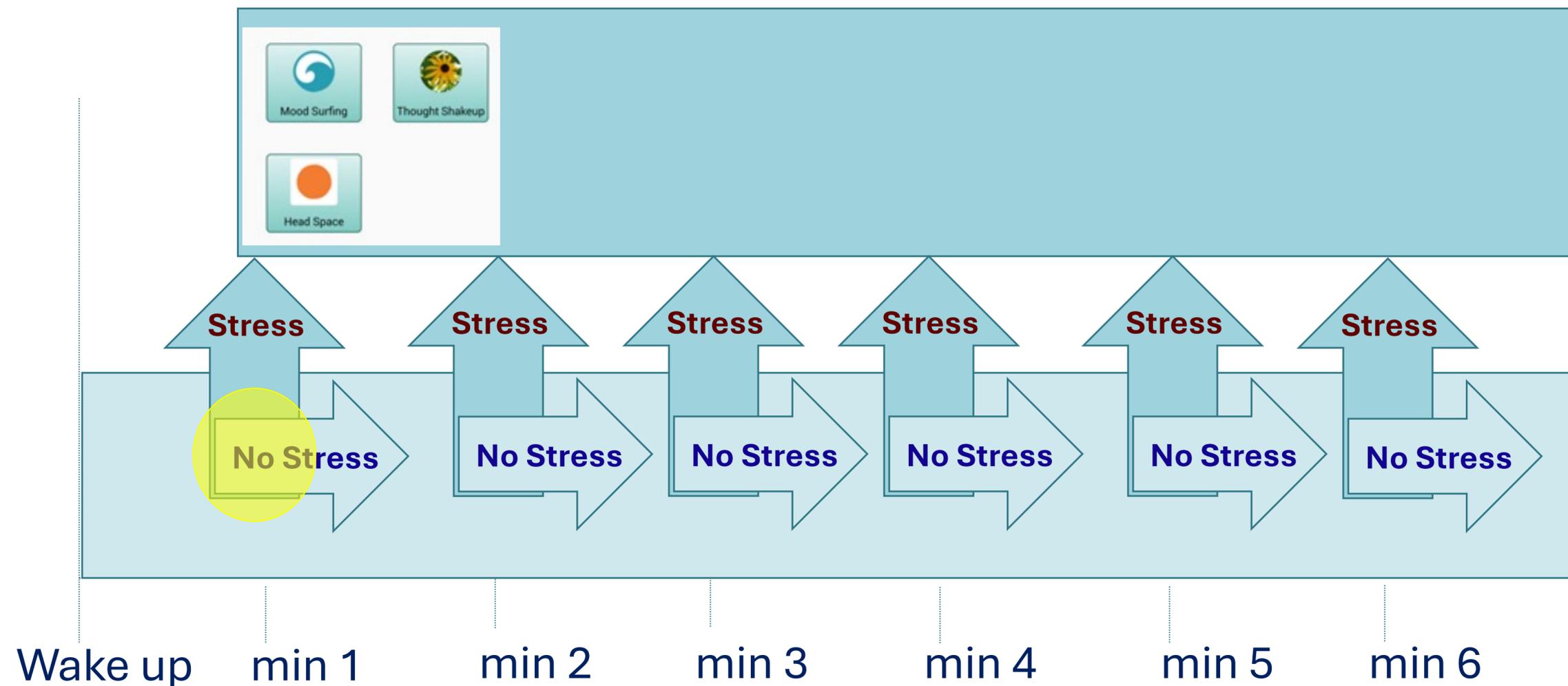
Example JITAI in Smoking Cessation

As with foundational adaptive interventions, we can operationalize JITAIs using if-then decision rules

Every minute

If Stress =Yes

   Then, IO = {Prompt}

Else if Stress ≠ Yes

   Then, IO = {Nothing}

Example JITAI in Smoking Cessation

But, unlike foundational adaptive interventions, this JITAI adapts on a minute-by-minute basis
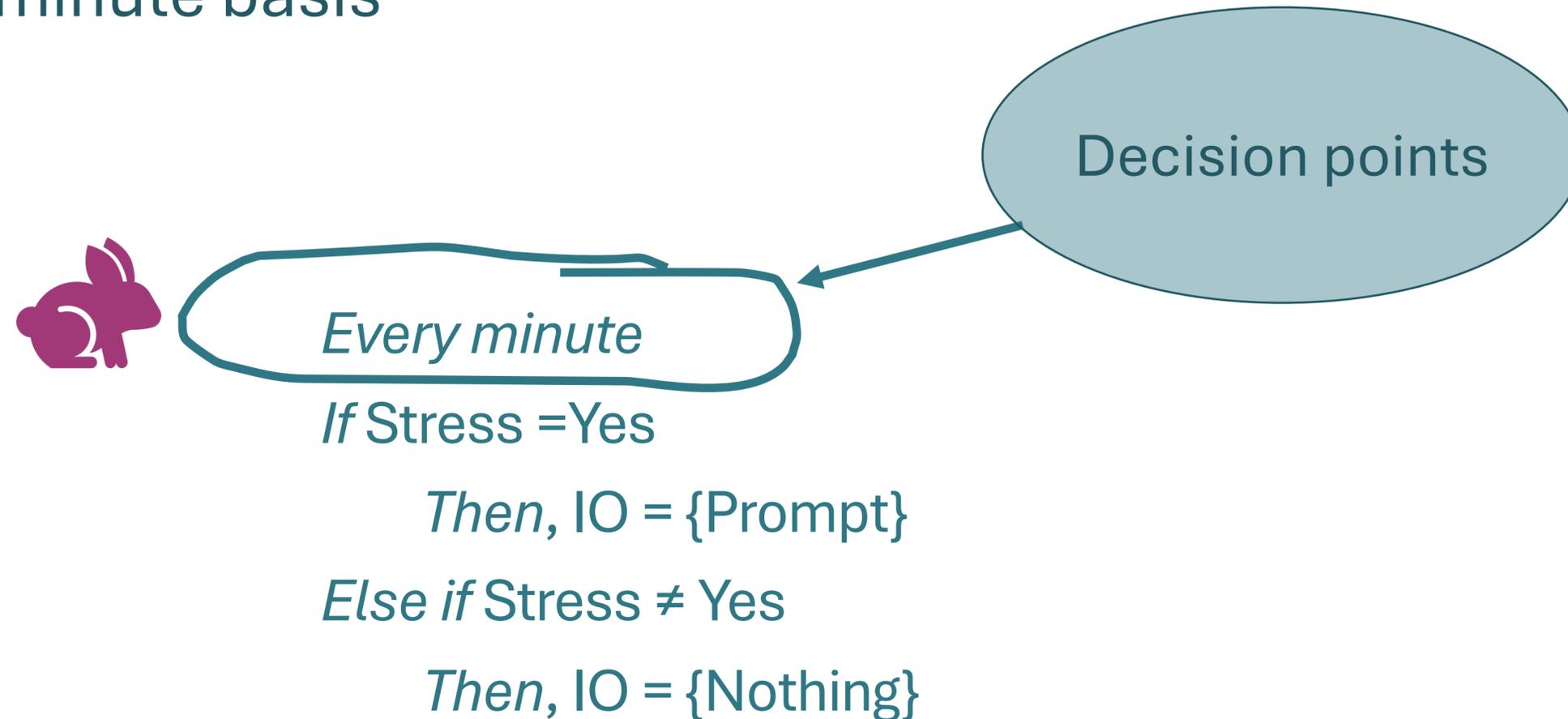
Decision points

Every minute

If Stress =Yes

Then, IO = {Prompt}

Else if Stress ≠ Yes

Then, IO = {Nothing}

Outline

Defining Just In Time Adaptive Interventions (JITAIs)

Components of a JITAI

Why use JITAIs

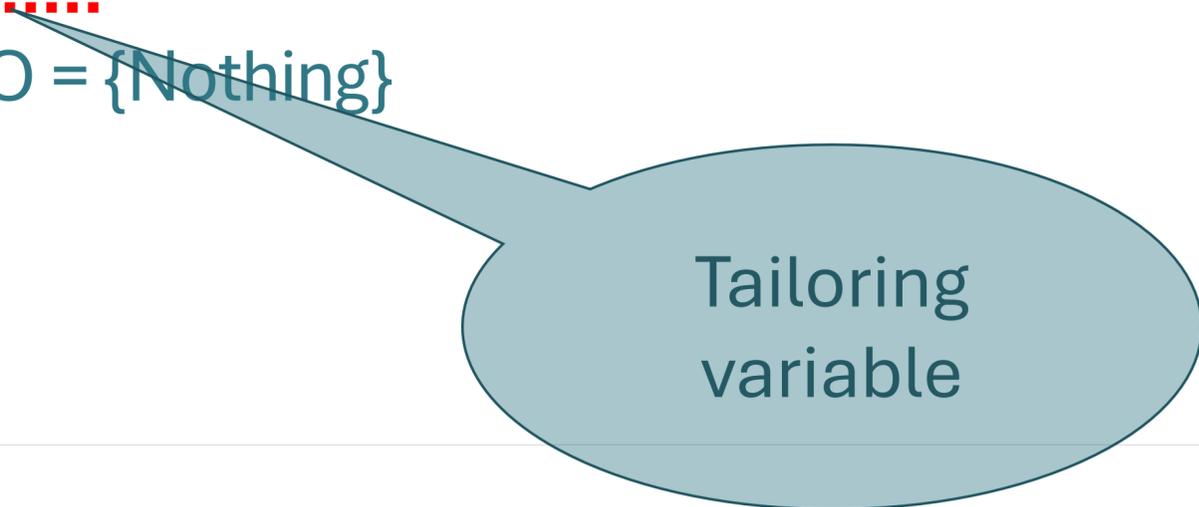Q&As about JITAIs

JITAI Components: Tailoring Variable

Every minute

If Stress =Yes

    Then, IO = {Prompt}

Else if Stress ≠ Yes

    Then, IO = {Nothing}
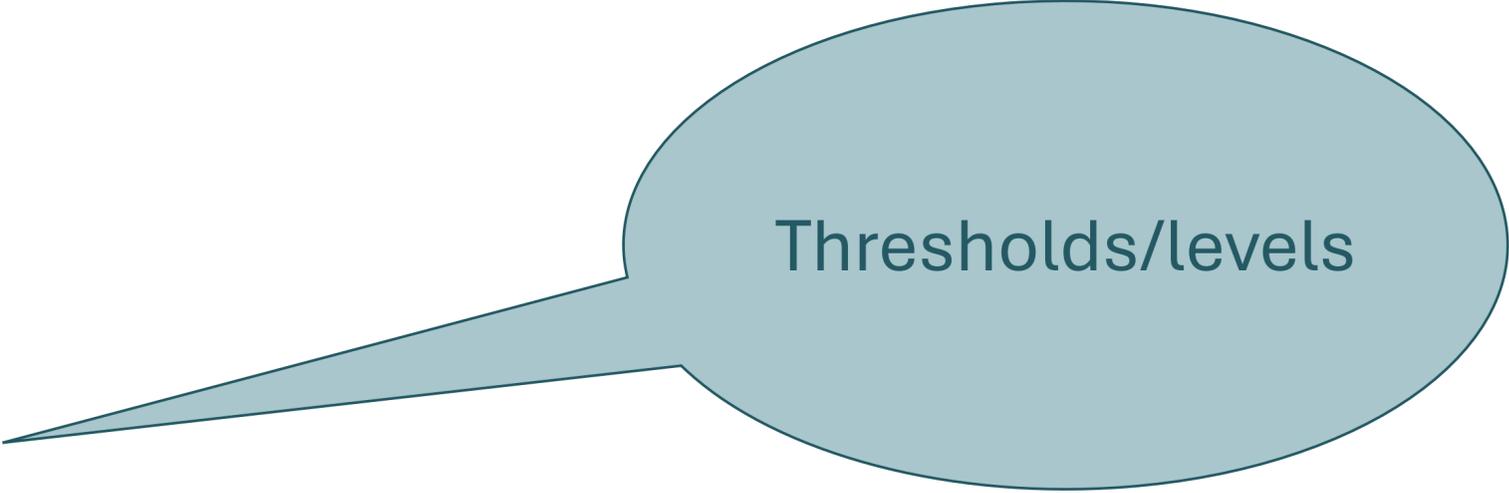
Tailoring variable

JITAI Components: Thresholds

Thresholds/levels

Every minute

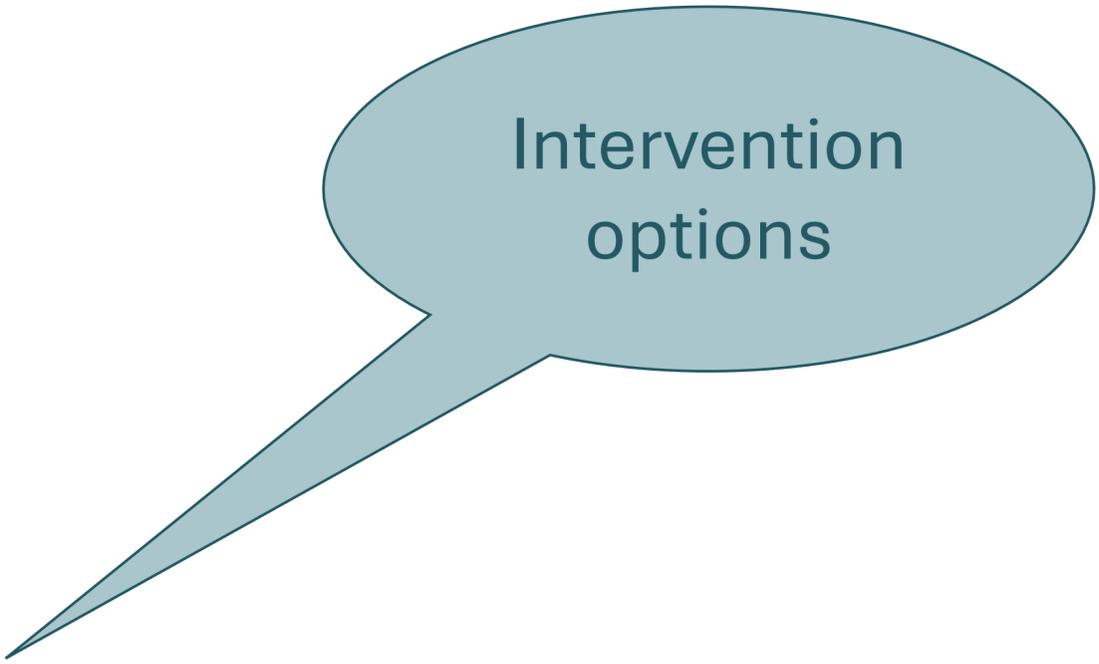*If* Stress =Yes

    Then, IO = {Prompt}

Else if Stress ≠ Yes

    Then, IO = {Nothing}

JITAI Components: Intervention Options

Every minute

If Stress =Yes

    Then, IO = {Prompt}

Else if Stress ≠ Yes

    Then, IO = {Nothing}

Intervention options

JITAI Components: Decision Rules

Decision rule that operationalizes the adaptation process
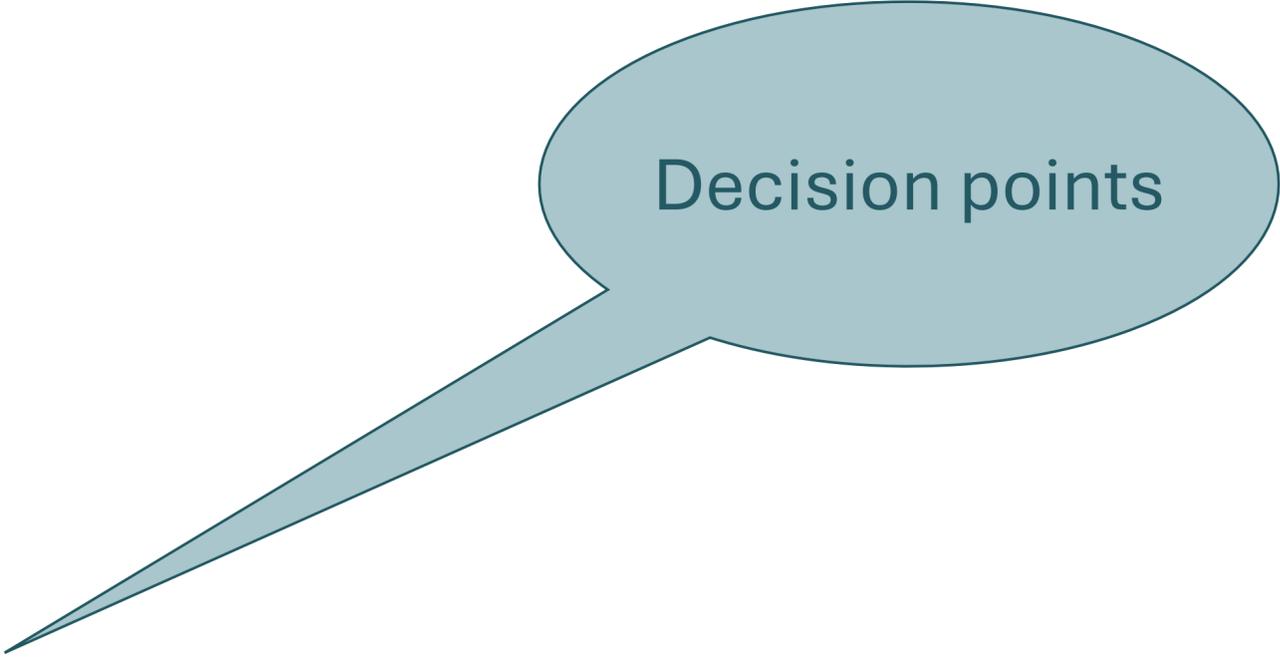
Every minute

If Stress =Yes

    Then, IO = {Prompt}

Else if Stress ≠ Yes

    Then, IO = {Nothing}

JITAI Components: Decision Points

Decision points

Every minute

If Stress =Yes

Then, IO = {Prompt}

Else if Stress ≠ Yes

Then, IO = {Nothing}

Just-in-Time Adaptive Intervention

Foundational Adaptive Intervention

Contrast the time-scales at which decisions are made

Every minute

If Stress =Yes

    Then, IO = {Prompt}

Else if Stress ≠ Yes

    Then, IO = {Nothing}

Then, at weeks 2, 4 and 8

If Response Status =NR

    Then, IO = {Add Coaching}

Else if Response Status = R

    Then, IO = {Continue}

Just-in-Time Adaptive Intervention

Foundational Adaptive Intervention

Every minute

If Stress =Yes

    Then, IO = {Prompt}

Else if Stress ≠ Yes

    Then, IO = {Nothing}

Then, at weeks 2, 4 and 8

If Response Status =NR

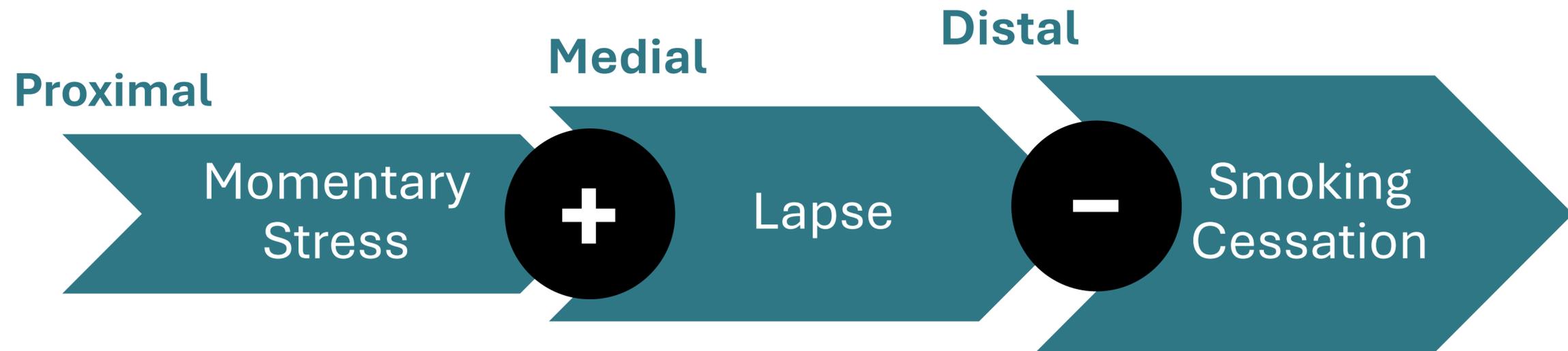   *Then*, IO = {Add Coaching}

Else if Response Status = R

    Then, IO = {Continue}

Notice the intervention options differ

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JITAI Components: Conceptual Model

**Typically, you'll
consider multiple**

**conceptual models
that will drive the rationale for**

the design of your JITAI and its intended outcomes

JITAI Components: Conceptual Model

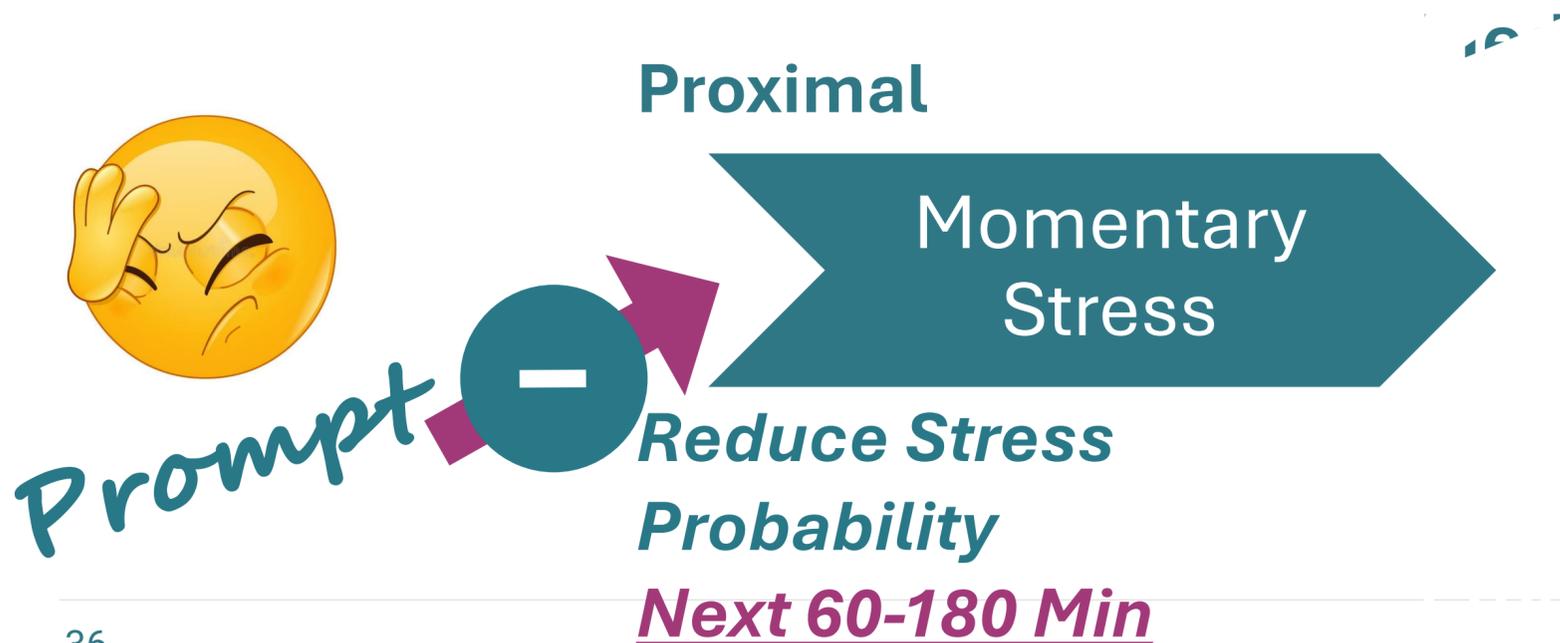# JITAI Components: Proximal Outcome

Every Minute

If Stress = Yes

      Then, IO = {Prompt}

Else if Stress ≠ Yes

      Then, IO = {Nothing}

Proximal

Momentary Stress

Reduce Stress Probability

Next 60-180 Min

Prompt

JITAI Components: Medial Outcome

Every Minute

If Stress = Yes

    Then, IO = {Prompt}

Else if Stress ≠ Yes

    Then, IO = {Nothing}

Proximal

Momentary Stress

Medial

Lapse

Prompt

Reduce Stress Probability
Next 60-180 Min

Reduce Lapse Probability
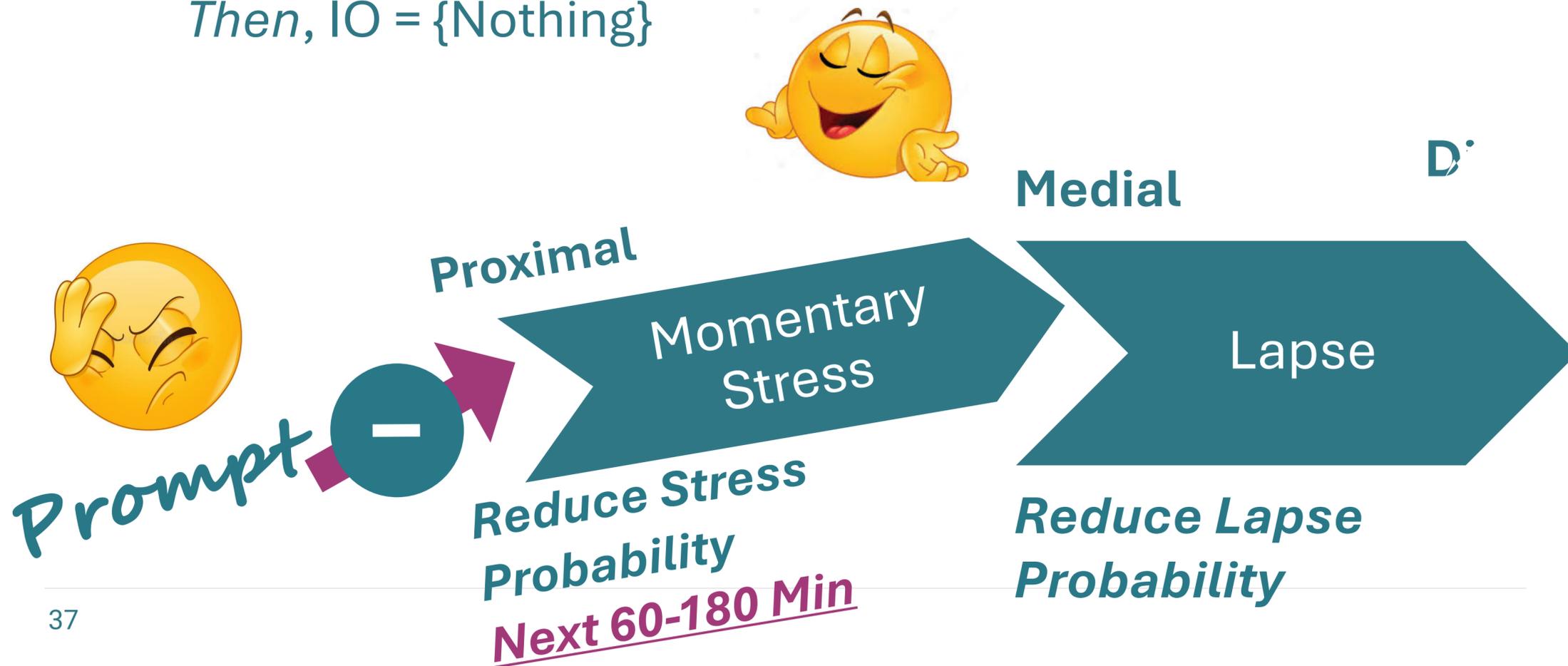
JITAI Components: Distal Outcome

Every Minute
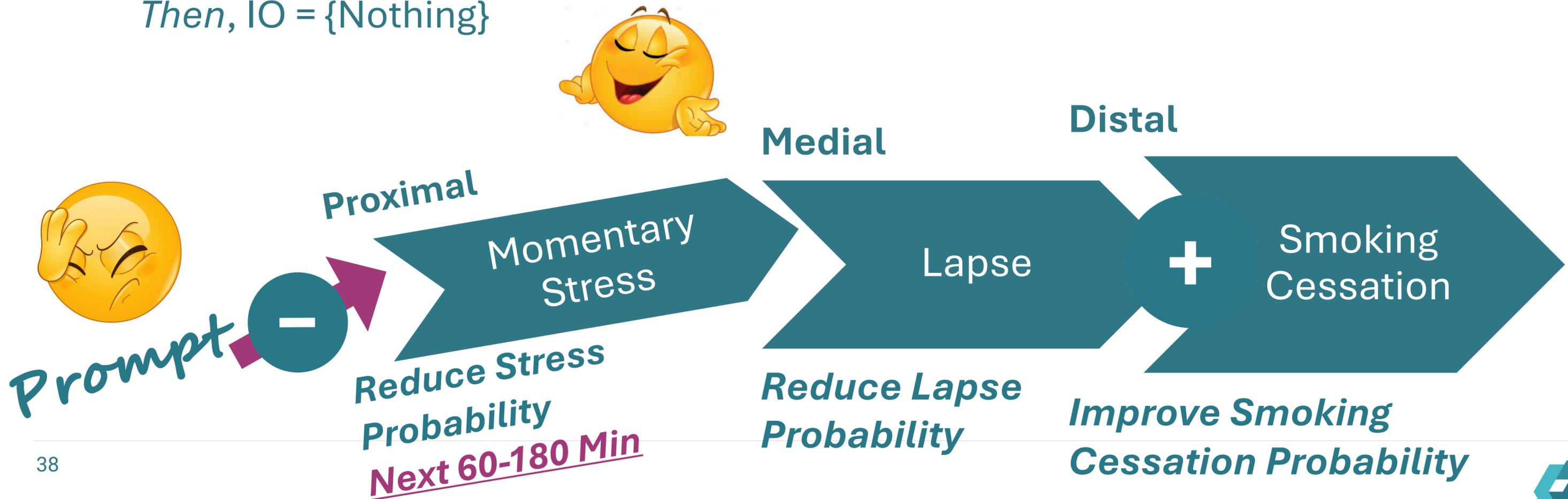
If Stress = Yes

    Then, IO = {Prompt}

Else if Stress ≠ Yes

    Then, IO = {Nothing}

Proximal

Momentary Stress

Reduce Stress Probability
Next 60-180 Min

Medial

Lapse

Reduce Lapse Probability

Distal

+ Smoking Cessation

Improve Smoking Cessation Probability

Prompt

Outline

Defining Just In Time Adaptive
Interventions (JITAIs)

Components of a JITAI

Why use JITAIs

Q&As about JITAIs

Why use a JITAI?

1. Health context is dynamic and changing rapidly

2. Engagement is dynamic and changing rapidly

3. Increase resource efficiency or minimize burden

Why use a JITAI?

1. Health context is dynamic and changing rapidly

Why use a JITAI?

Address rapidly changing conditions

✓ These conditions can represent states of vulnerability or opportunity with respect to the proximal outcome

Vulnerability

Conditions that represent risk for an adverse proximal outcome

Opportunity

Conditions in which delivering an intervention is expected to promote a desirable proximal outcome

Why use a JITAI?

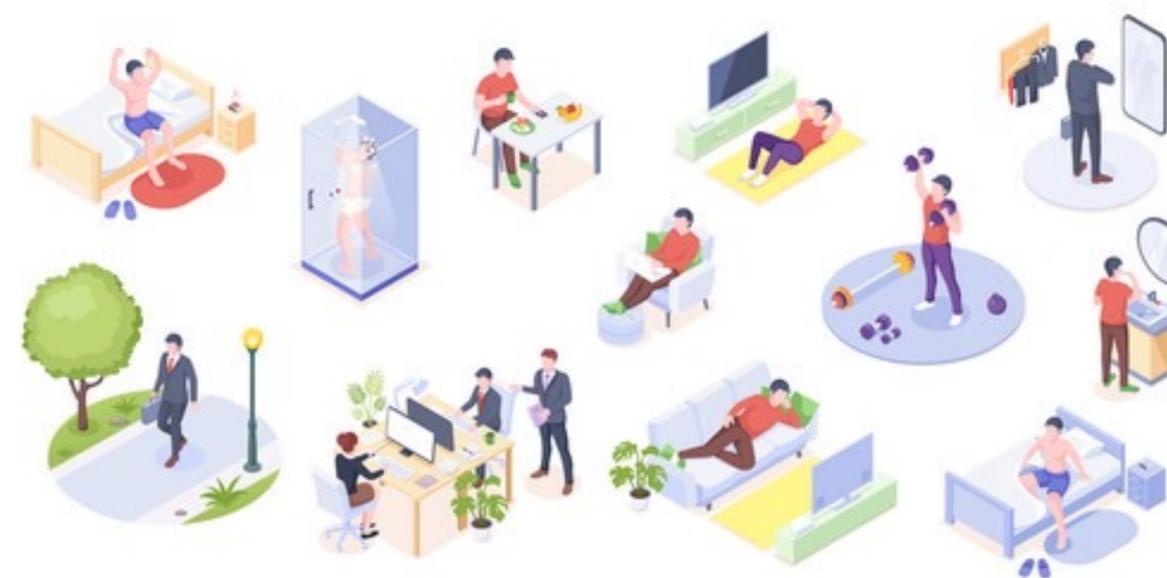**2. Engagement is dynamic and changing rapidly**

Why use a JITAI?

Delivering an intervention when people are receptive

✓ States of vulnerability/opportunity may unfold in daily life where people experience multiple competing demands.

Receptivity Conditions in which an individual is likely to effectively engage with a specific intervention option.

Why use a JITAI?

Every minute

If Stress =Yes **and min since last intervention >60 and driving=No**

    Then, IO = {Prompt}

Else if Stress ≠ Yes **or min since last intervention ≤60 or driving=Yes**

    Then, IO = {Nothing}

Why use a JITAI?

3. Increase resource efficiency or minimize burden

Why use a JITAI?

Minimize the delivery of unnecessary or harmful treatment

✓ States of vulnerability/opportunity may unfold rapidly– sometimes multiple times per day, requiring frequent interventions which can be burdensome
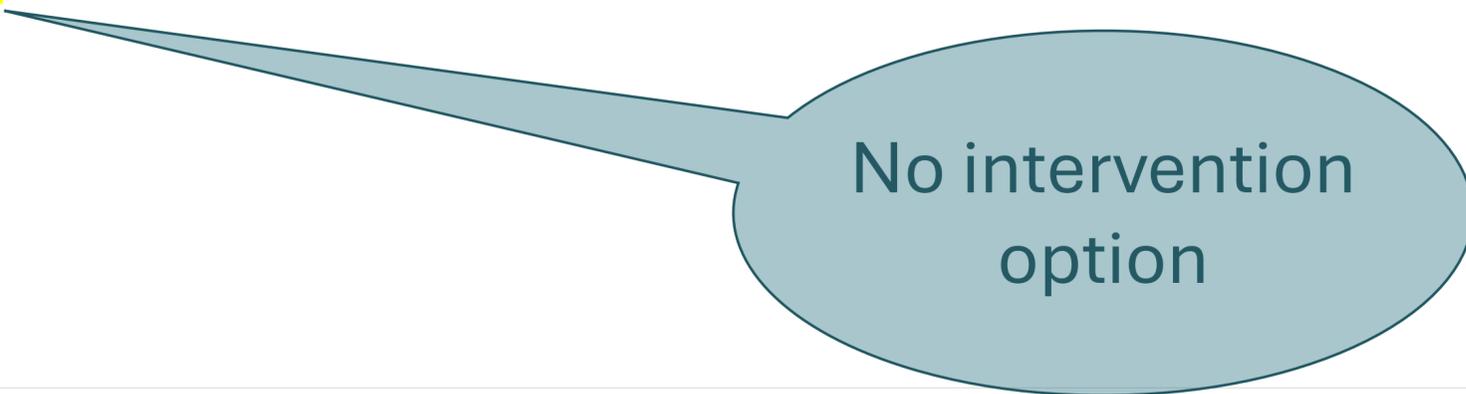
Every minute

If Stress =Yes **and min since last intervention >60 and driving=No**

   Then, IO = {Prompt}

Else if Stress ≠ Yes **or min since last intervention ≤60 or driving=Yes**

   Then, IO = {Nothing}

No intervention option

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Q&As about JITAIs
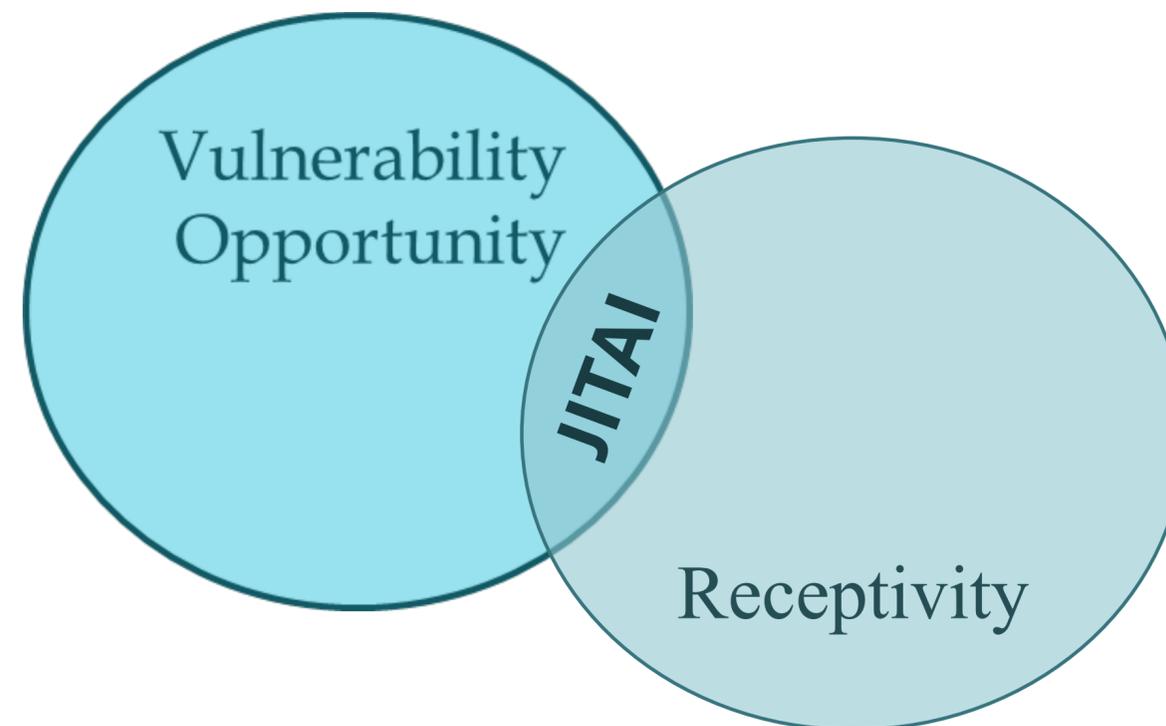
Frequently Asked Questions & Answers

The goal: engage you and help you generate additional questions

1. Go to Kahoot.it (we recommend using your phone)

2. Type the PIN

3. Select a nickname (not your real name)

4. Let's play

Q1: JITAI should always deliver an intervention when the person is vulnerable

A1: No.

- JITAIs can be designed to deliver interventions when the person experiences an opportunity for positive change

- JITAIs can avoid intervention when the individual is not receptive, even if they are vulnerable or experience an opportunity for positive change.

Q2: What is the difference between a state of opportunity and a state of receptivity?

A2: Receptivity is intervention specific and focused on engagement with the focal intervention; opportunity is not intervention specific and focused on a proximal outcome

Opportunity

**Proximal outcome:
Step count in next 60 min**
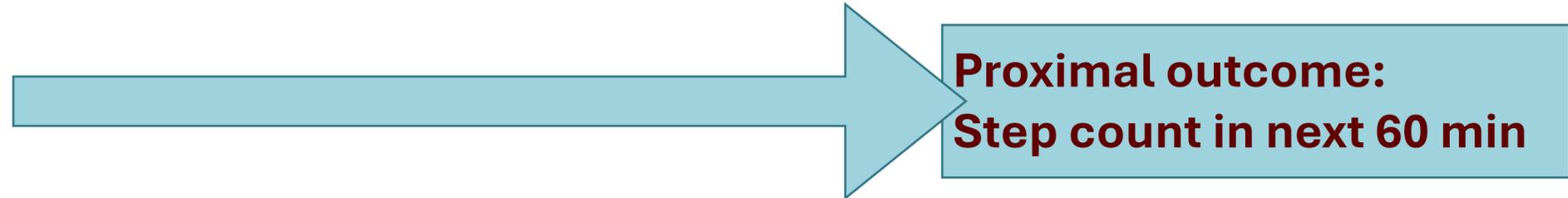
Receptivity	High likelihood of effective engagement with a specific intervention option
Opportunity	High likelihood of promoting a desirable proximal outcome via intervention
Vulnerability	High likelihood of an adverse proximal outcome, that can be prevented via intervention

Q2: What is the difference between a state of opportunity and a state of receptivity?

A2: Receptivity is intervention specific and focused on engagement with the focal intervention; opportunity is not intervention specific and focused on a proximal outcome

Not Receptive to Mobile-Based Prompt

Engagement with prompt

THERE IS A PARK BEHIND YOU. TAKE A WALK.

Proximal outcome: Step count in next 60 min

Receptivity	High likelihood of effective engagement with a specific intervention option
Opportunity	High likelihood of promoting a desirable proximal outcome via intervention
Vulnerability	High likelihood of an adverse proximal outcome, that can be prevented via intervention

Q3: Part-way through intervention, a researcher can change the decision rules in a JITAI.

A3: No. As with any high-quality intervention, all of the components (including decision rules and associated thresholds/cutpoints) in a JITAI are protocolized ahead of time. Recall that a JITAI is an intervention design, not a research design.

Every minute

If Stress ≥ δ

 Then, IO = {Prompt}

Else if Stress < δ

 Then, IO = {Nothing}

Q3: Part-way through intervention, a researcher can change the decision rules in a JITAI.

A3: No.

Caveat for the connoisseur!

Day 3, you'll learn about pJITAIs (Personalized JITAIs), which include an additional component (an algorithm) capable of individualizing aspects of the JITAI to the needs of the individual.

Nonetheless, all components are protocolized!

Q3: Part-way through intervention, a ~~researcher~~ can change the decision rules in a JITAI.

an algorithm (which, itself, is part of the JITAI!)

A3: ~~No.~~ *Yes!!*

Caveat for the connoisseur!

Day 3, you'll learn about pJITAIs (Personalized JITAIs), which include <u>an additional component</u> (an algorithm) capable of individualizing aspects of the JITAI to the needs of the individual.

Nonetheless, all components are protocolized!

Algorithm

Every minute

If Stress ≥ δ_{ti}

    Then, IO = {Prompt}

Else if Stress < δ_{ti}

    Then, IO = {Nothing}
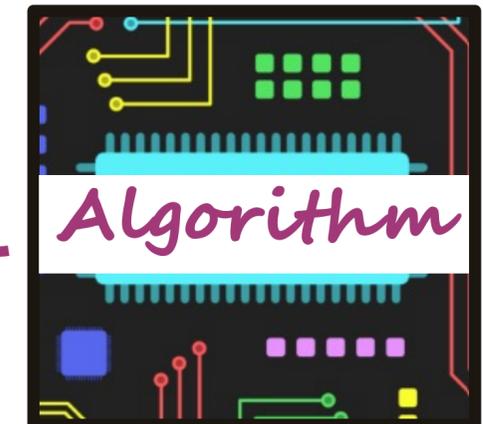
Q4: What is the first step in applying a JITAI to your dataset?

A4: There is no first step because a JITAI is not a data analytic method

A JITAI is an intervention design.

A JITAI is not an experimental design.

A JITAI is not a data analytic method.

Q5: JITAIs always promote intervention engagement

A5: It depends on how well they are designed

What is engagement?

Energy investment in a specific stimulus or task

Engagement with what?

Define the stimuli and tasks

Engagement in Digital Interventions

Inbal Nahum-Shani[1], Steven D. Shaw[2], Stephanie M. Carpenter[1],
Susan A. Murphy[3], and Carolyn Yoon[4]
[1] Institute for Social Research, University of Michigan
[2] The Wharton School, University of Pennsylvania
[3] Department of Statistics & Computer Science, Harvard University
[4] Stephen M. Ross School of Business, University of Michigan

The notion of "engagement," which plays an important role in various domains of psychology, is gaining increased currency as a concept that is critical to the success of digital interventions. However, engagement remains an ill-defined construct, with different fields generating their own domain-specific definitions. Moreover, given that digital interactions in real-world settings are characterized by multiple demands and choice alternatives competing for an individual's effort and attention, they involve fast and often impulsive decision-making. Prior research seeking to uncover the mechanisms underlying engagement has nonetheless focused mainly on psychological factors and social influences and neglected to account for the role of neural mechanisms that shape individual choices. This article aims to integrate theories and empirical

Q5: JITAIs always promote intervention engagement
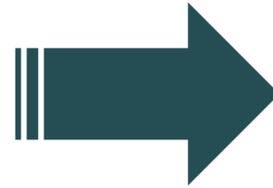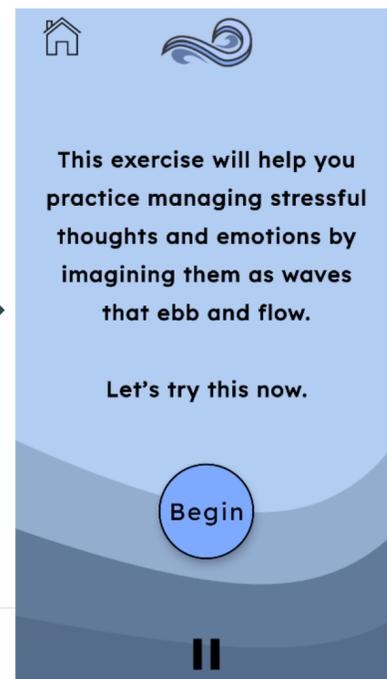
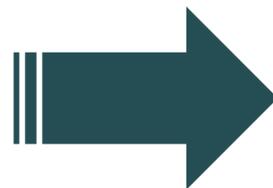## A5: It depends on how well they are designed

Every minute

If Stress =Yes and min since last intervention >60 and driving=No
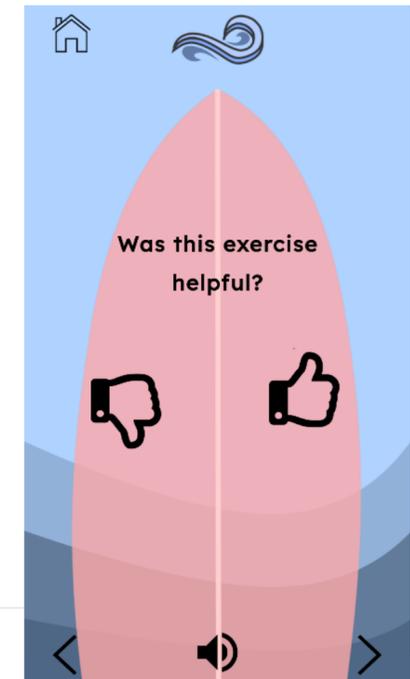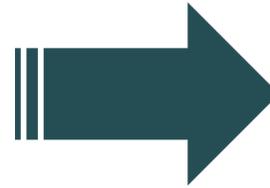
   Then, IO = <mark>{Prompt}</mark>

Else if Stress ≠ Yes or min since last intervention ≤60 or driving=Yes
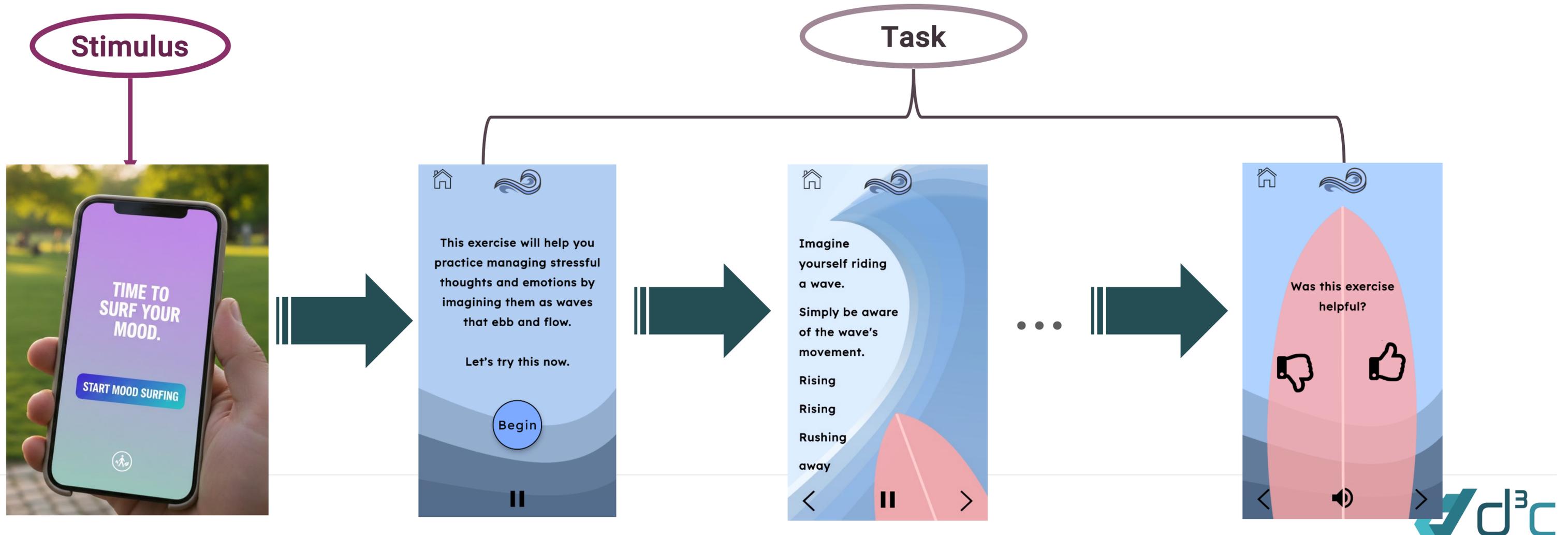
   Then, IO = {Nothing}

Q5: JITAIs always promote intervention engagement

A5: It depends on how well they are designed

Stimulus

Task

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Q5: JITAIs always promote intervention engagement

A5: It depends on how well they are designed

Receptivity to the prompt ➜ high likelihood of effective engagement in the series of stimuli and tasks composing the prompt

To design engaging JITAIs, we need to map out the stimuli and tasks comprising the JITAI and make sure they are

- delivered when individuals are receptive to them

- and are designed in a way that is engaging