

## PART 3: FIDELITY

# *Mechanisms in Dementia Caregiver Intervention Research*

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### PURPOSE OF THIS HANDOUT

This guidance document explains **how intervention fidelity is conceptually and empirically linked to mechanisms of action** in behavioral intervention research. It is intended for researchers designing, testing, and translating behavioral interventions, with particular relevance to complex, multi-component interventions. This guide complements the companion documents on mechanisms of action and tailoring by focusing specifically on how fidelity enables valid mechanism testing.

### KEY DEFINITIONS

Fidelity **refers to the extent to which an intervention is delivered, received, and enacted as intended by its developers. Fidelity is multi-dimensional and typically includes:**

1. **Design fidelity** - alignment of intervention components with theory and hypothesized mechanisms.
2. **Delivery fidelity** - adherence and competence in delivering intervention components.
3. **Receipt fidelity** - participant understanding and acquisition of skills or knowledge.
4. **Enactment fidelity** - participant use of skills or behaviors in real-world contexts.

The relationship between Fidelity and Mechanism has not been explicitly considered.

Mechanisms of Action are the processes or mediators through which an intervention produces change. They explain how and why an intervention affects outcomes and are typically grounded in behavioral, social, or implementation theory (e.g., self-efficacy, problem-solving skills, stress appraisal, environmental modification).

### WHY FIDELITY MATTERS FOR MECHANISM TESTING

Mechanism testing assumes that:

1. **Core intervention components are delivered as designed** (FIDELITY)
2. Behavioral techniques are used to provide intervention components that **activate targeted mechanisms** (MEDIATION)
3. Activated mechanisms **lead to changes in proximal and distal outcomes** (EFFECTS)

Without adequate fidelity to activate the mechanism, null or weak mechanism effects and outcomes may occur and remain **ambiguous**. Under these circumstances, it is unclear whether: 1) the theory is incorrect, 2) the intervention was not implemented sufficiently to activate the mechanism, 3) whether measures are not capturing changes, 4) the mechanism is wrong, or 5) the intervention is not effective.

**Thus, fidelity is a precondition for valid mechanism testing.**

### CONCEPTUAL PATHWAY LINKING FIDELITY TO MECHANISMS AND OUTCOMES



- Fidelity ensures that participants are consistently exposed to the active ingredients of the intervention or what activates the mechanism
- Mechanisms represent the proximal targets of those ingredients
- Outcomes reflect downstream effects that depend on successful mechanism activation
- Breaks anywhere along this pathway weaken causal inference.

## FIDELITY DOMAINS AND THEIR MECHANISTIC IMPLICATIONS\*

### 1. Design Fidelity

- **Role in mechanisms:** Ensures that intervention components and behavioral techniques are explicitly mapped to hypothesized mechanisms. *How to assess:* Create ‘intervention component-to-mechanism map’ before data collection; ground each component in specific theory. Identify behavioral techniques (e.g., demonstration, practices, validation, reinforcement, etc).
- **Threat if weak:** Mechanisms may be poorly specified or mismatched to components

### 2. Delivery Fidelity (Adherence and Competence)

- **Role in mechanisms:** Adequate dose and quality are required to activate mechanisms (e.g., insufficient coaching may fail to increase self-efficacy) *How to assess:* Session checklists; audio/video recording with expert coding; dose tracking.
- **Threat if weak:** Under-dosing or inconsistent delivery attenuates mechanistic effects

### 3. Receipt Fidelity

- **Role in mechanisms:** Participants must understand and internalize intervention content for mechanisms to operate. *How to assess:* Knowledge tests; teach-back (participant explains content); skill demonstration; homework completion.
- **Threat if weak:** Knowledge or skill-based mechanisms cannot be activated

### 4. Enactment Fidelity

- **Role in mechanisms:** Real-world use of strategies is often the behavioral expression of mechanisms. *How to assess:* Strategy use logs; direct observation; ecological momentary assessment; collateral report.
- **Threat if weak:** Mechanisms may activate transiently but fail to sustain outcomes

### 5. **Practical Implications** Tailor your fidelity assessment to the mechanisms you are testing.

## FIDELITY AS A MODERATOR OF MECHANISMS

Fidelity can function analytically as:

- A **moderator** of mechanism effects (e.g., mechanisms operate only under high fidelity)
- A **necessary condition** for mediation (low fidelity invalidates mediation tests)

Recommended analytic approaches include:

- Stratifying mediation analyses by fidelity level
- Including fidelity · mechanism interaction terms
- Testing sequential models (fidelity→mechanism→outcome)

## IMPLICATIONS FOR INTERVENTION DEVELOPMENT AND TESTING

Early-Stage Research (NIH Stage Model 0-1)

- Use fidelity data to refine component – mechanism alignment
- Identify which components reliably activate intended mechanisms

Efficacy and Effectiveness Trials (NIH Stage Model 2-3)

- Interpret mechanism findings in light of fidelity variability
- Distinguish theory failure from implementation failure

Implementation and Scale-Up (NIH Stage Model 4-5)

- Identify minimum fidelity thresholds needed to activate mechanisms
- Allow adaptation of form while preserving mechanism-relevant functions

## COMMON PITFALLS

- Measuring outcomes without assessing fidelity to mechanism-relevant components
- Treating fidelity as a single global score rather than mechanism-specific
- Assuming mechanisms failed when fidelity data indicate poor delivery or receipt

## KEY TAKE HOME MESSAGES

- Fidelity is **not separate from mechanisms**; it enables them
- Mechanism testing is only interpretable when fidelity is measured and reported
- High-quality behavioral science requires **explicit linkage of components, fidelity, mechanisms, and outcomes**

## SUGGESTED CITATION LANGUAGE

“Intervention fidelity was assessed to ensure that core components intended to activate hypothesized mechanisms were delivered, received, and enacted as designed, thereby supporting valid tests of mechanisms of action.”

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