

## Methodological advances in identifying effective components of behavior change interventions

Steven Belle, PhD, MScHyg  
American Academy of Health Behavior  
Hilton Head, SC  
March 10, 2009

## ACKNOWLEDGEMENTS

- Sara Czaja, PhD
- Marcia Ory, PhD
- Richard Schulz, PhD
- REACH investigators and participants
- Behavioral Change Consortium
- Health Maintenance Consortium

## OVERVIEW

1. The issue
2. The methodology
3. Results
4. Next steps

## THE ISSUE

- The problem
  - How to combine information across multiple, different interventions with a common goal
- The solution
  - enabled us to determine what, if any, components of complex interventions are related to success

## Application - *Reach*

• Designed to examine the effectiveness of interventions to strengthen family members' capacities to care for individuals with ADRD

• 6 sites, 9 "active" interventions, 2 control conditions

## Multi-Component Interventions

- Skill training
- Information and referral
- Voice mail / support / advice / behavioral distraction
- Environmental skills building
- Behavioral management
- Stress management
- Psychoeducational / coping
- Technology

---

- Usual care
- Minimal support (empathic listening)

### THE ISSUE

To combine information across interventions

### THE APPROACH

Decompose the interventions, i.e.,  
“Measure the interventions “

### THE RESULT

Could identify effective components of  
complex interventions

...AND JUST HOW DO YOU  
PROPOSE TO DO “MEASURE THE  
INTERVENTIONS”  
?

### METHODOLOGY STEP 1:

- Identify common features to describe the interventions
- This requires in-depth knowledge of the interventions

### INTERVENTION COMPONENTS IN *Reach*

- Entity targeted
  - Caregiver
  - Care recipient
  - Environment
- Domain targeted
  - Knowledge
  - Skills
  - Behavior
  - Affect
- The entity-domain combinations become the components

### METHODOLOGY STEP 2:

For each intervention, determine which entities and domains are targeted, i.e., what components comprise each intervention?

...AND JUST HOW DO YOU  
PROPOSE TO DO THAT  
?

## METHODOLOGY Task Analysis

- Study of actions or cognitive processes required to achieve a goal
- Method used to understand systems

## TASK ANALYSIS Definitions

- A **goal** is an objective
- A **task** is a set of goal directed activities that can be subdivided into component **subtasks**
- Subtasks are subdivided into **activities**

## METHODOLOGY TASK ANALYSIS



## TASK ANALYSIS Example

### Goal: Clean Your Teeth

- Tasks
  - Prepare the toothbrush
  - Brush your teeth
  - Remove toothpaste from your mouth
  - Replace implements

## Example – Goal: Brushing Your Teeth Tasks and Subtasks

- Prepare the toothbrush
  - Pick up the toothbrush
  - Wet the toothbrush
  - Take the cap off the tube
  - Put paste on the brush

## Example – Goal: Brushing Your Teeth Tasks and Subtasks

- Prepare the toothbrush
  - Pick up the toothbrush
  - Wet the toothbrush
  - Take the cap off the tube
  - Put paste on the brush

### Example – Brushing Your Teeth Subtasks and Activities

- Pick up the toothbrush
  - Locate the toothbrush
  - Reach toward the toothbrush
  - Grasp the toothbrush
  - Turn the bristles upward

### Example – Goal: Clean Your Teeth Tasks

- Prepare the toothbrush
- Brush your teeth
- Remove toothpaste from your mouth
- Replace implements

### Example – Goal: Brushing Your Teeth Tasks and Subtasks

- Brush your teeth
  - Brush the outside of the bottom row of teeth
  - Brush the outside of the top row of teeth
  - Brush the biting surface of the top row of teeth
  - 
  - 
  -

### Get the picture?

This methodology breaks down systems into component parts that can be used to characterize, and ultimately measure complex systems, in our case, the interventions

### METHODOLOGY HOW TO DO A TASK ANALYSIS

- Training session for task analysis
- Provide intervention summaries – **this is a critical step that we will hear more about later**
- Provide definitions of measures (in this example, domain and entity)

### TASK ANALYSIS RESULT

SITE X, INTERVENTION Y

ENTITY	DOMAIN			
	KNOWLEDGE	SKILLS	BEHAVIOR	AFFECT
Caregiver	X		X	
Care-Recipient	X			X
Environment	X			

### LOOKS GOOD, BUT...

- Interventions that target the same entity-domain do so to different extents
- That needs to be taken into account when measuring the interventions

...AND JUST HOW DO YOU  
PROPOSE TO DO THAT

?

### METHODOLOGY: STEP 3 ANALYTIC HIERARCHY PROCESS

For each intervention, determine the relative dominance of each entity-domain targeted.

This is accomplished through pairwise comparisons.

...AND JUST HOW DO YOU  
PROPOSE TO DO THAT

?

### METHODOLOGY DOMINANCE RATINGS

- Entities and domains targeted were already obtained by task analysis
- Training session for Analytical Hierarchy Process (AHP)
- **Raters given intervention summaries**
- Raters given definitions of scale anchors

### COMPARE RELATIVE DOMINANCE

1=EQUAL 3=MODERATE 5=STRONG 7=VERY STRONG 9=EXTREME

CG KNOWL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CG SKILL	
CG KNOWL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9	CR KNOWL
CG KNOWL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9	CR AFFEC
CG KNOWL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9	EN KNOWL
CG BEH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9	CR KNOWL
CG BEH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9	CR AFFEC
CG BEH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9	EN KNOWL
CR KNOWL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9	CR AFFEC
CR KNOWL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9	EN KNOWL
CR AFFEC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9	EN KNOWL

**ENTITY / DOMAIN WEIGHTS**  
SITE X, INTERVENTION Y

PRIMARY ENTITY	PRIMARY DOMAIN			
	KNOWLEDGE	SKILLS	BEHAVIOR	AFFECT
Caregiver	.277		.187	
Care-Recipient	.391			.095
Environment	.052			

**SO NOW WE HAVE QUANTIFIED  
COMPONENTS**

- LOOKS GOOD, BUT**
- The scores sum to 1 for each intervention.
  - This means that interventions that target more entity-domains are likely to have smaller scores for each entity-domain than would interventions that target fewer entity-domains.
  - We need to account for this.

**...AND JUST HOW DO YOU  
PROPOSE TO DO THAT**

?

- METHODOLOGY: STEP 4  
INTENSITY MEASURE**
- Measure intensity as the time spent in intervention
  - Multiply the weights by total intervention time
  - This partitions the total intervention time

**ENTITY / DOMAIN SCORES**  
SITE 2, INTERVENTION 2  
Intervention lasts 4 hours

PRIMARY ENTITY	PRIMARY DOMAIN			
	KNOWLEDGE	SKILLS	BEHAVIOR	AFFECT
Caregiver	$.277 \times 4$ <b>= 1.11</b>		$.187 \times 4$ <b>= 0.75</b>	
Care-Recipient	$.391 \times 4$ <b>= 1.56</b>			$.095 \times 4$ <b>= 0.38</b>
Environment	$.052 \times 4$ <b>= 0.21</b>			

## How do we use this information?

Independent variables in a regression model for outcome

## RESULTS

Variable	Estimate (s.e.)	p-value
Intercept	14.45 (0.45)	
Birmingham	-0.05 (0.22)	
Boston	-0.01 (0.22)	
Memphis	0.01 (0.22)	
Miami	-0.0008 (0.22)	
Palo Alto	-0.09 (0.22)	
Philadelphia	0.14 (0.22)	
Baseline CES-D	0.68 (0.02)	<0.0001
Male Caregiver	0.05 (0.63)	0.940
Black/Afr.-Amer.	-1.19 (0.61)	0.035
Hispanic/Latino	0.80 (0.65)	0.223
Spouse	0.65 (0.50)	0.196
CG Behavior (/ hour)	-0.89 (0.27)	0.0008

## CONCLUSION

By identifying measures that describe the interventions, either active or control, we were able to identify an intervention component (caregiver behavior) that was associated with depressive symptomatology

## HOW TO IMPLEMENT THE PROCESS

1. Fully describe the intervention
  - 1a. Task Analysis to determine components
  - 1b. Define measures of intensity
2. Obtain measures of intervention components
  - 2a. Analytical Hierarchy Process (AHP)
  - 2b. Apply intensity measures
3. Utilize measures of components as independent variables when modeling outcome

## HOW TO IMPLEMENT THE PROCESS

- Fully describe the intervention and obtain measures of components
- This may not be possible from descriptions in the literature.
- We are developing a questionnaire to obtain information necessary to fully describe interventions.
  - Necessary for replication
  - Necessary to enable decomposition

## QUESTIONNAIRE ELEMENTS

- Treatment strategies, e.g.,
  - Entity(ies) targeted
  - Domain(s) targeted
  - Incentives or reinforcement
  - Problem solving techniques
  - Biologic interventions
  - Monitoring

## QUESTIONNAIRE ELEMENTS

- “Dose” (e.g., frequency, time)
- Method of contact
- Adaptability
- Cultural sensitivity

## WHAT'S NEXT?

- Complete questionnaire development
- See if it is relevant, and the technique or decomposition works, for other applications

e.g., Health Maintenance Consortium

21 intervention studies with the common goal “to understand the long-term maintenance of behavior change as well as effective strategies for achieving sustainable health promotion and disease prevention activities”.

## HEALTH MAINTENANCE CONSORTIUM

Interventions being studied for  
e.g., Weight loss

Diet

Exercise

Substance abuse

Other health behaviors

## WHAT'S NEXT?

- Do questionnaire responses provide adequate information for task analysis and implement AHP?
- Can meaningful analyses be performed due to new levels of complexity
  - Different goals
  - Different outcomes
  - Different independent variables

## WHAT'S NEXT?

Complexities will require:

1. Identifying potential mediators that can be applied across all interventions
2. Creating cross-study outcome measures

**This is a discussion for another time!!  
Stay tuned...**