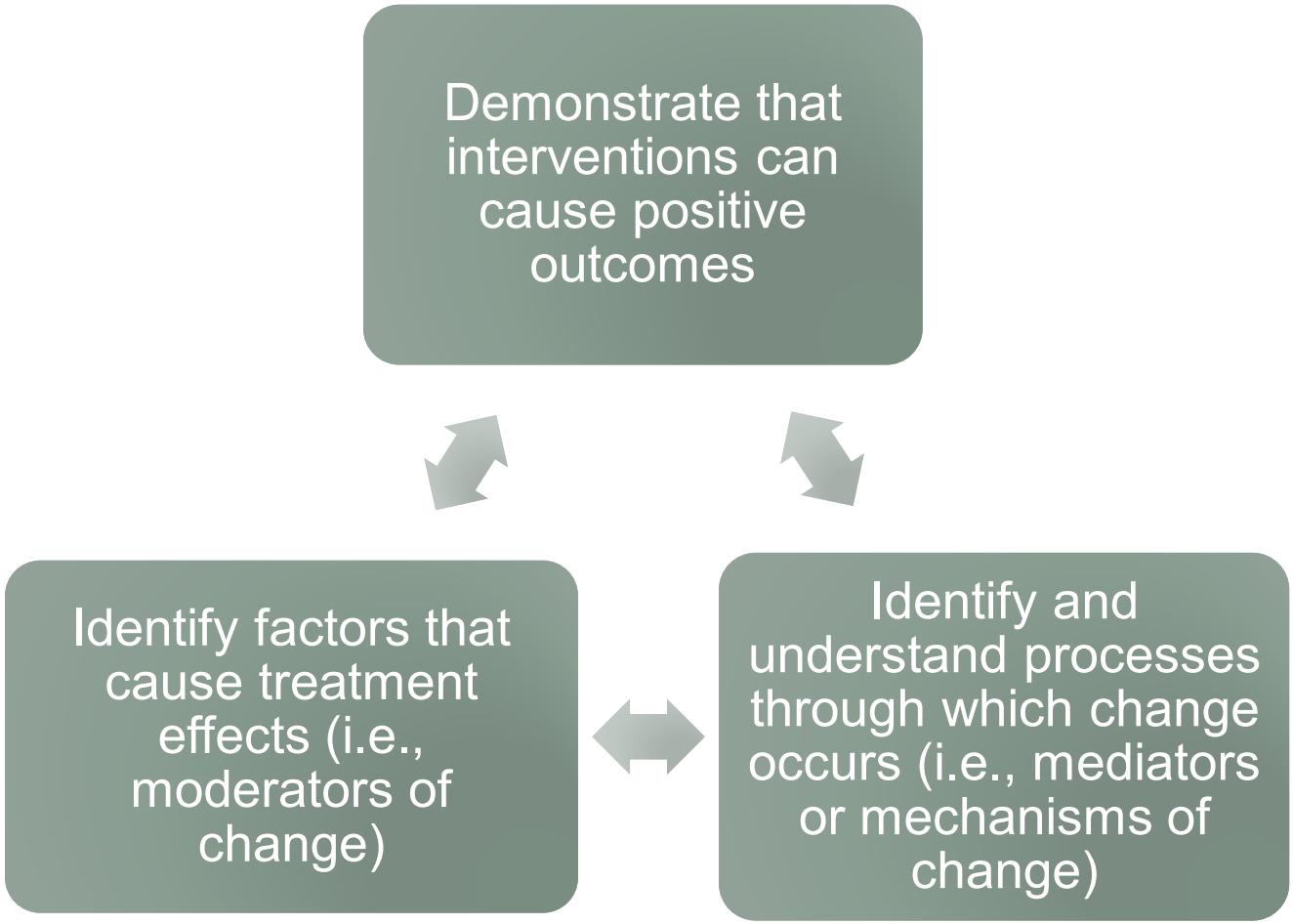
Today

- Health beliefs, health behaviors, and behavior change
  - Addressing the main goals of interventions
  - Social Ecological Framework
  - Health beliefs
  - Addictive behaviors
  - Eating behavior, exercise behavior
- Theoretical foundation of interventions
  - Why do we need theory to guide interventions?
  - What are the most commonly used theories of health behavior?
  - When in the process of intervention planning do we use theory?
- Evaluating the impact of interventions
  - RE-AIM

Goals of Behavioral Interventions

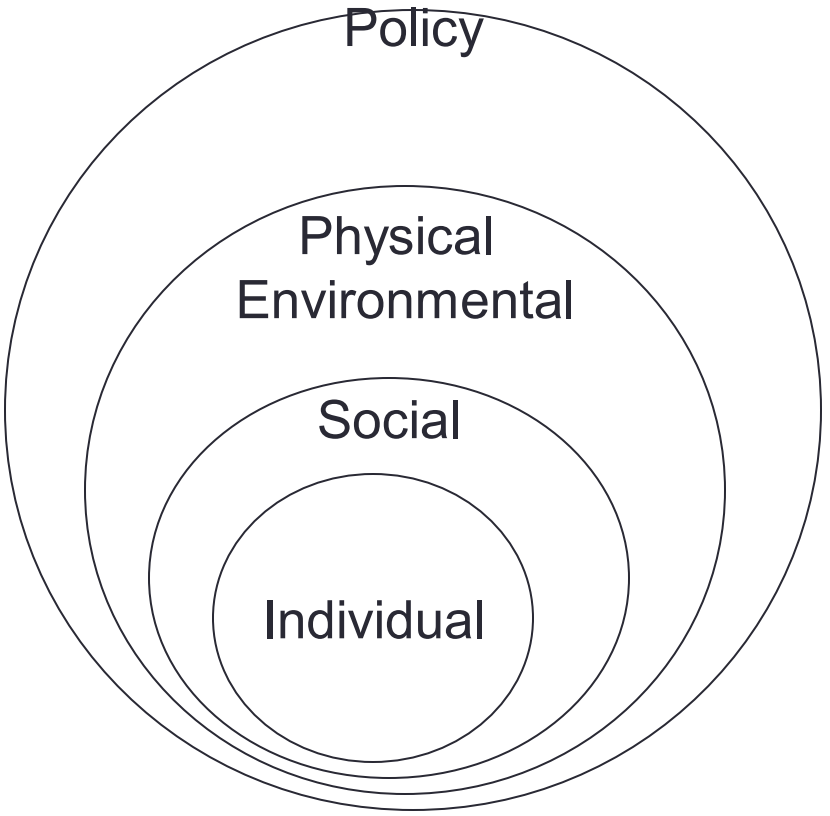


Approaches to Health Promotion

How do we go about promoting healthy behaviors?

Approaches to Health Promotion

Schematic representation of the *ecological framework* for understanding different influences on personal health behaviors



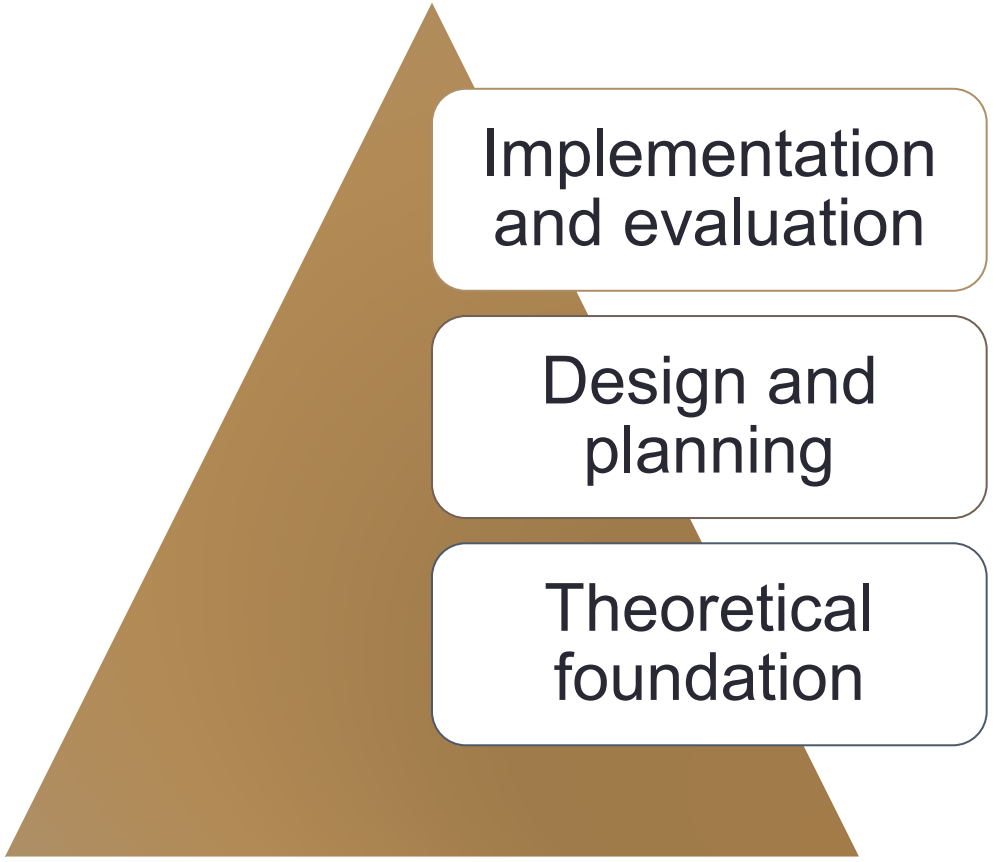
Approaches to Health Promotion

(1) Behavioral and social approaches
- Individually-adapted health behavior changed programs
- Social support interventions in community settings
- Family-based social support
- School-based enhanced health education and practice

(2) Campaign and informational approaches
- Community-wide campaigns
- Mass media campaigns
- Classroom-based health education focused on providing information

(3) Environmental and policy approaches

Focus on Theory-Based Interventions



What are the main reasons that make it difficult for you to reach your health goals?

WHY DO WE NEED THEORY?

Atheoretical Approaches: Motives and Barriers

- Descriptive
- Typically large-scale surveys of attitudinal and motivational factors
- Useful for providing baseline data, plotting trends, or generating ideas and research directions
- Do NOT explain why individuals hold these beliefs

Clarification….

- Theory
  - A generalized statement aimed at explaining a phenomenon/behavior
  - The basis for creating a model
- Model
  - Purposeful representation (symbolic, verbal, visual) of reality or a concept
  - Models can serve as the structure for the step-by-step formulation of a theory
- Framework
  - Way of organizing information about the field (e.g., the health onion)
  - Similar to paradigms but looser

Clarification

- Theories of health behavior
  - Linear
  - Derived from observational studies
  - Mainly explain status, do not predict change in behavior well

VS

- Theories of health behavior change
  - Cyclical, dynamic
  - Must be tested in experimental context
  - Help understand process, goal is to predict change in behavior

Health Behavior Theory

- Only 22.5% of interventions explicitly based on health behavior theory (Davis et al., 2010)
- Most commonly used theories emphasize individual or interpersonal factors; physical and social context often ignored
- Davis at al. (2015)
  - Identified 82 theories of behavior with potential for use in health behavior change
    - 4 theories accounted for 174 (63%) of articles
      - Transtheoretical Model of Change (TTM; N = 91; 33%)
      - Theory of Planned Behaviour (TPB; N = 36; 13%)
      - Social Cognitive Theory (SCT; N = 29; 11%)
      - Information-Motivation-Behavioural-Skills Model (IMB; N = 18; 7%)

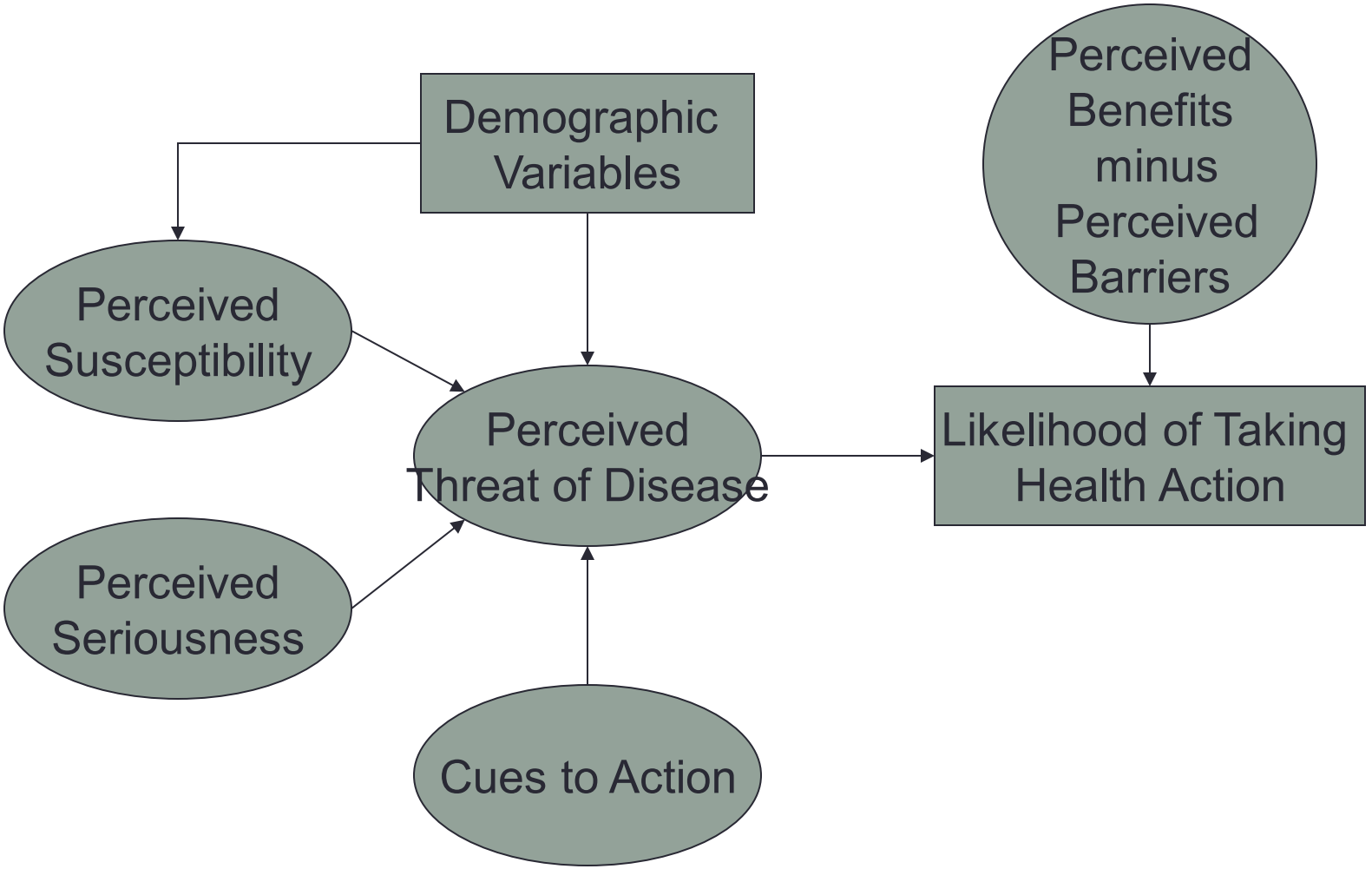
	Theory	First author theorist (date)	Number of articles reporting theory that were included in the review
1	An Action Model of Consumption	Bagozzi (2000)	1[a]
2	Affective Events Theory	Weiss (1996)	1[a]
3	AIDS Risk Reduction Model	Catania (1990)	5[a]
4	Attitude-Social Influence – Efficacy Model and its successor I – Change	DeVries (1998)	2
5	Behavioural Ecological Model of AIDS Prevention	Hovell (1994)	1[a]
6	Change Theory	Lewin (1943)	0
7	Classical Conditioning	Pavlov (1927)	0
8	COMB Model	Michie (2011)	0
9	Consumption of Social Practices	Spaargaren (2000)	0
10	Containment Theory	Reckless (1961)	0
11	Control Theory	Carver (1981/1982)	1
12	Diffusion of Innovations	Rogers (1983)	4
13	Differential Association Theory	Sutherland (1947)	0
14	Ecological Model of Diabetes Prevention	Burnet (2002)	1[a]
15	Extended Information Processing Model	Flay (1980)	1[a]
16	Extended Parallel Process Model	Witte (1992)	2
17	Feedback Intervention Theory	Kluger (1996)	1
18	General Theory of Crime	Goffredson (1990)	0
19	General Theory of Deviant Behaviour	Kaplan (1972)	1
20	Goal Directed Theory	Bagozzi (1992)	2[a]
21	Goal Framing Theory	Lindenberg (2007)	1
22	Goal Setting Theory	Locke (1968)	1
23	Health Action Process Approach	Schwarzer (1992)	8
24	Health Behaviour Goal Model	Gerbhardt (2001)	1[a]
25	Health Behaviour Internalisation Model	Bellg (2003)	1[a]
26	Health Belief Model	Rosenstock (1966)	9
27	Health Promotion Model	Pender (1982)	1
28	Information-Motivation-Behavioural (IMB) Skills Model	Fisher (1992)	18 (17)[b]
29	IMB Model of ART Adherence (extension of IMB)	Fisher (2008)	1[a]
30	Integrative factors influencing smoking behaviour model	Flay (1983)	1[a]
31	Integrative model of health and attitude behaviour change	Flay (1983)	1[a]
32	Integrating the factors influencing smoking behaviour and the model of attitude and behaviour change	Flay (1983)	1[a]
33	Integrative Model of Behavioural Prediction	Fishbein (2000)	2[a]
34	Integrated Theory of Drinking and Behaviour	Wagennar (1994)	1
35	Integrated Theoretical Model for Alcohol and Drug Prevention	Gonzalez (1989)	1[a]
36	Integrative Theory of Health Behaviour Change	Ryan (2009)	1[a]
37	Model of Pro-environmental Behaviour	Kolmuss (2002)	0
38	Motivation Opportunity Abilities Model	Olander (1995)	0
39	Needs Opportunities Abilities (NOA) Model	Gatersleben (1998)	0
40	Norm Activation Theory	Schwartz (1977)	0
41	Operant Learning Theory	Skinner (1954)	0
42	Precaution Adoption Process Model	Weinstein (1988)	1
43	Pressure System Model	Katz (2001)	1[a]
44	PRIME Theory	West (2006)	0
45	Problem Behaviour Theory	Jessor (1977)	0
46	Prospect Theory	Kahneman (1979)	3
47	Protection Motivation Theory	Rogers (1975)	2
48	Prototype Willingness Model	Gibbons (1995)	1[a]
49	Rational Addiction Model	Becker (1988)	3[a]
50	Reflective Impulsive Model/Dual Process Theory	Strack (2004)	1[a]
51	Regulatory Fit Theory	Higgins (2000)	2
52	Relapse Prevention Theory	Marlatt (1980)	1[a]
53	Risks as Feelings Model	Lowenstein (2001)	0
54	Self-determination Theory	Deci (2000)	9 (8)[b]
55	Self-efficacy Theory	Bandura (1977)	2[a]
56	Self-regulation Theory	Kanfer (1970)	1
57	Six Staged Model of Communication Effects	Vaughan (2000)	1[a]
58	Social Action Theory	Ewart (1991)	1[a]
59	Social Action Theory	Weber (1991)	0
60	Social Change Theory	Thompson (1990)	0
61	Social Cognitive Theory	Bandura (1986)	29 (27)[b]
62	Social Consensus Model of Health Education	Romer (1992)	1[a]
63	Social Development Model	Hawkins (1985)	3[a]
64	Social Identity Theory	Tajfel (1979)	0
65	Social Influence Model of Virtual Community Participation	Dholakia (2004)	1[a]
66	Social Ecological Model of Walking	Alfonzo (2005)	1[a]
67	Social Ecological Model of Behaviour Change	Panter-Brick (2006)	1[a]
68	Social Learning Theory	Miller (1941)	6
69	Social Norms Theory	Perkins (1986)	0
70	Systems Model of Health Behaviour Change	Kershell (1985)	1[a]
71	Technology Acceptance Models 1, 2 and 3	Venkatesh (1989, 2000, 2008)	1[a]
72	Temporal Self-regulation Theory	Hall (2007)	1[a]
73	Terror Management Health Model	Goldenberg (2008)	0
74	Terror Management Theory	Greenberg (1986)	1
75	Theory of Normative Conduct	Cialdini (1991)	2
76	Theory of Interpersonal Behaviour	Triandis (1977)	0
77	Theory of Normative Social Behaviour	Rimal (2005)	1[a]
78	Theory of Planned Behaviour/Reasoned Action	Ajzen (1985)	36 (34)[b]
79	Theory of Triadic Influence	Flay (1994)	0
80	Transcontextual Model of Motivation	Hagger (2003)	0
81	Transtheoretical/Stages of Change Model	Prochaska (1983)	91 (87)[b]
82	Value Belief Norm Theory	Stern (1999)	1

Health Belief Model

(Becker & Maiman, 1975)

The likelihood of behavior depends on the person's perception of the severity of health risks and appraisal of the costs and benefits of taking action.

Health Belief Model (HBM)



Limitations of Health Belief Model

- Illness-avoidance orientation
- Limited use in some behaviors (e.g.,PA/exercise) – individuals often engage in behaviros for reasons other than prevention of chronic disease
- May be more useful for explaining avoidance of negative behaviors rather than engagement in positive health behaviors

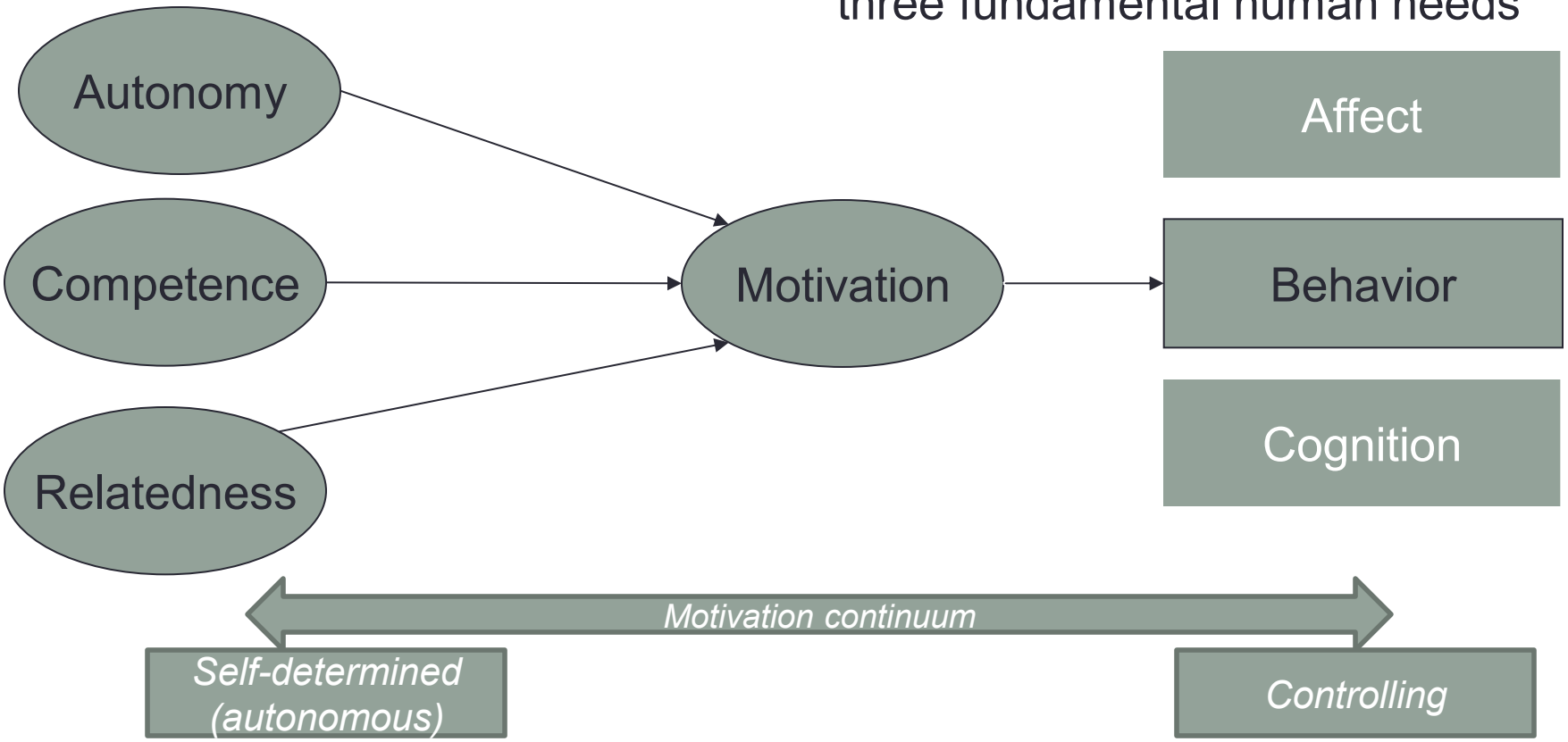
Discussion

- Grandahl et al. (2016)

Self-Determination Theory (SDT)

- Deci & Ryan (1985)

• Individuals possess different types of motivations but all are related to three fundamental human needs



SDT - *Motivation*

- **Intrinsic**
  - for the enjoyment of the activity itself
- **Identified regulation**
  - you identify with it (i.e., self-initiated and of some personal relevance or value)
- **Introjected regulation**
  - wanting to avoid punishment or guilt
- **External regulation**
  - for some external reward or due to pressure to do so (e.g., from significant others)
- **Amotivation**

Theory of Planned Behavior
(Ajzen, 1988)

Exercise behavior can be explained by

- intentions
- subjective norms and attitudes
- perceptions of ability to control behavior

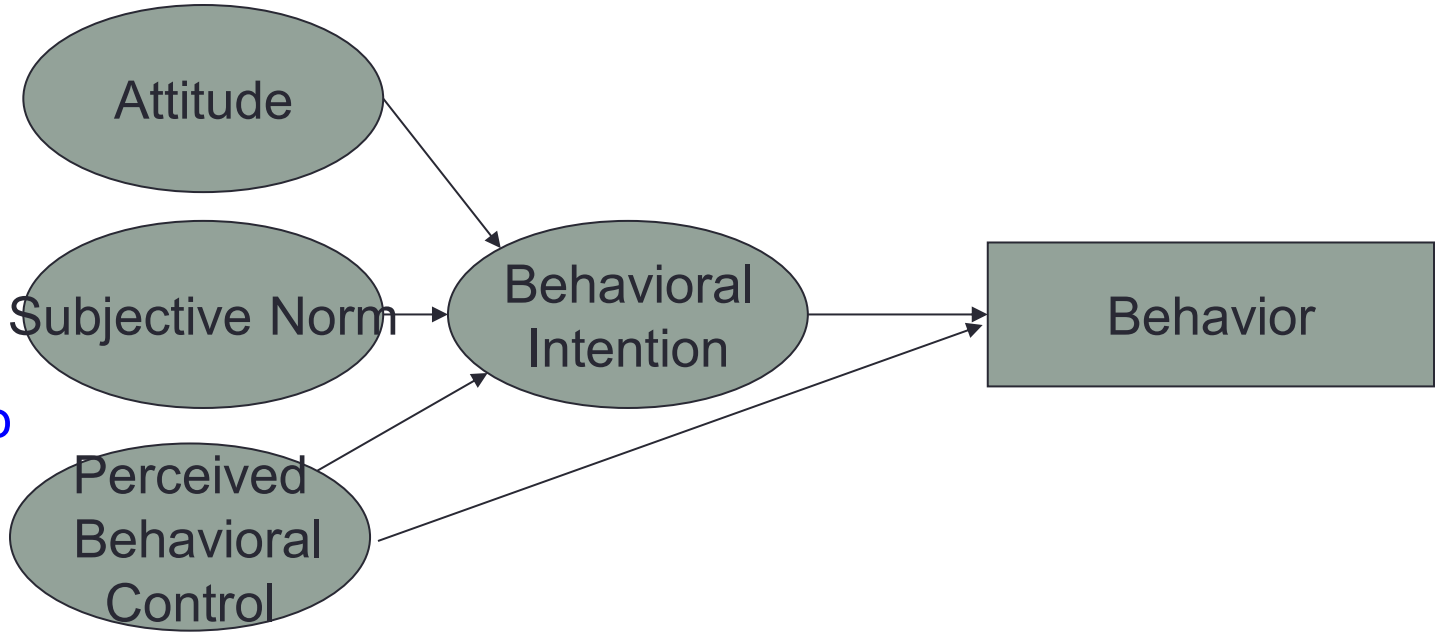
Theory of Planned Behavior (TPB)

- Developed from Theory of Reasoned Action

Beliefs, value, likely outcomes

Beliefs of significant others + motivation to comply with such beliefs

Perceived ease or difficulty of performing the behavior

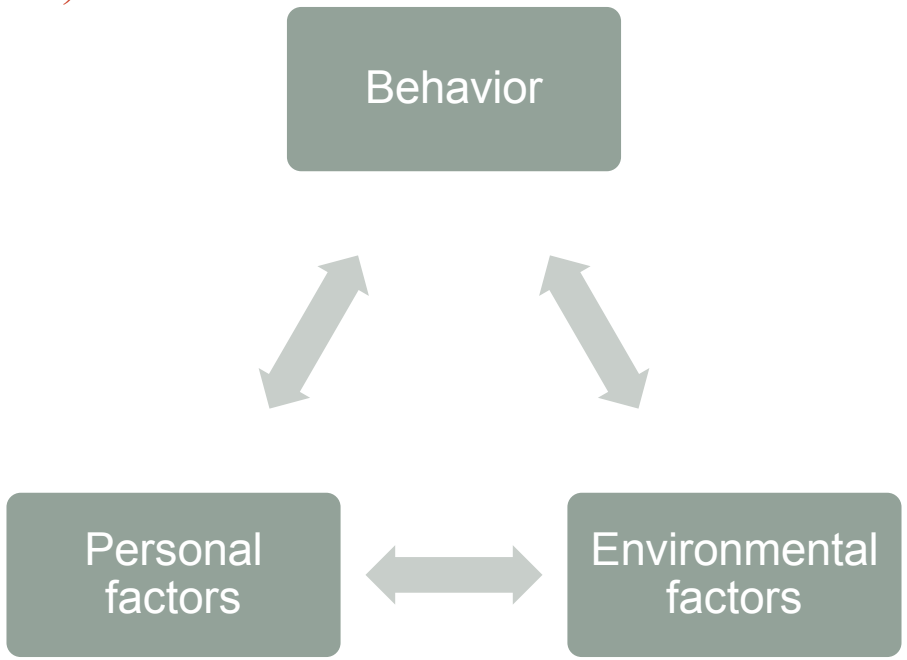


Limitations of TPB

- The model is unidirectional
- Does not account for past behavior
- Focus on social psychological perceptions
- Typically explains more variance in intentions than in behavior

Social Cognitive Theory

(Bandura, 1986, 1997)



Mediating mechanisms

Fundamental human capabilities

Beliefs

Elements of Social Cognitive Theory

- Goals
- Impediments or barriers
- Outcome expectancies versus self-efficacy
  - Outcome expectancies
    - Judgments of the likely consequence/outcomes of one's actions
  - **Self-efficacy**
    - people's judgments of their capabilities to organize and execute courses of action required to attain desired outcomes

Self-Efficacy Theory

Limitations of SCT

- Too comprehensive? Cumbersome to implement
- ?
- ?
- ?

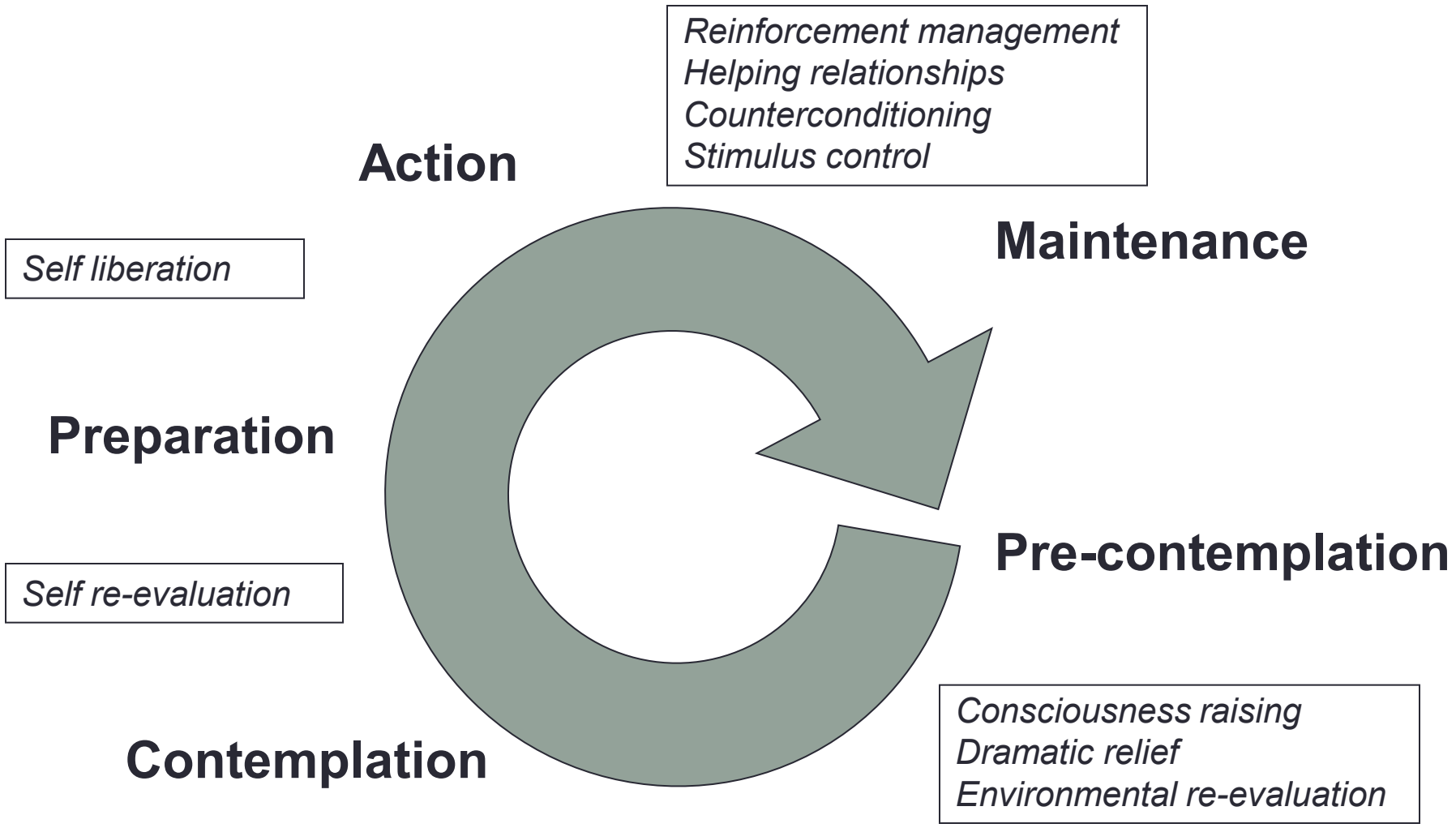
Transtheoretical Model of Behavior Change (TTM)

(Prohaska & DiClemente, 1983)

Exercise behavior can be explained by

- Stages of change
- Processes of change (experiential versus behavioral)
- Decisional balance
- Self-efficacy (added later by Prohaska et al., 1994)

TTM



Adopted from J. Adams & M. White: *Br. J. Sports Med.* 2003;37;106-114.

Defining Stages of Change

Stage	*Meeting criterion level of PA*	*Current behavior*	*Intention to meet criterion level of PA*
Precontemplation	No	Little or no PA	No
Contemplation	No	Little of no PA	Yes
Preparation	No	Small changes in PA	Yes
Action	Yes	Active for < 6 months	Yes
Maintenance	Yes	Active for ≥ 6 months	Yes

TTM Assumptions

Key

During exercise, behavior induction strategies are used during the different transtheoretical stages. (Prochaska, DiClemente, & Norcross, 1992)

Matching the intervention to the stage of change is effective in producing high levels of regular exercise, at least in the short term.

Limitations of TTM

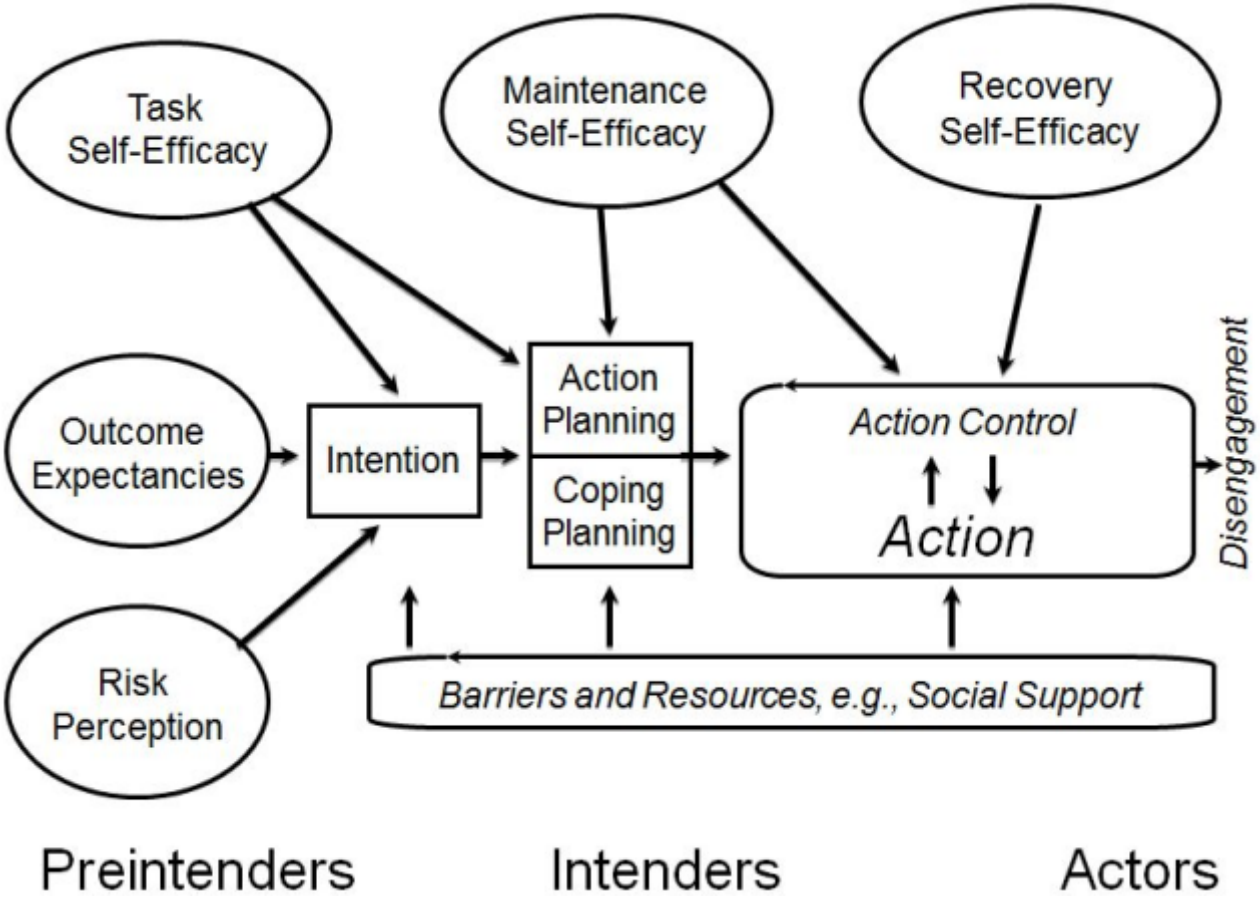
- ?
- ?
- ?

Discussion

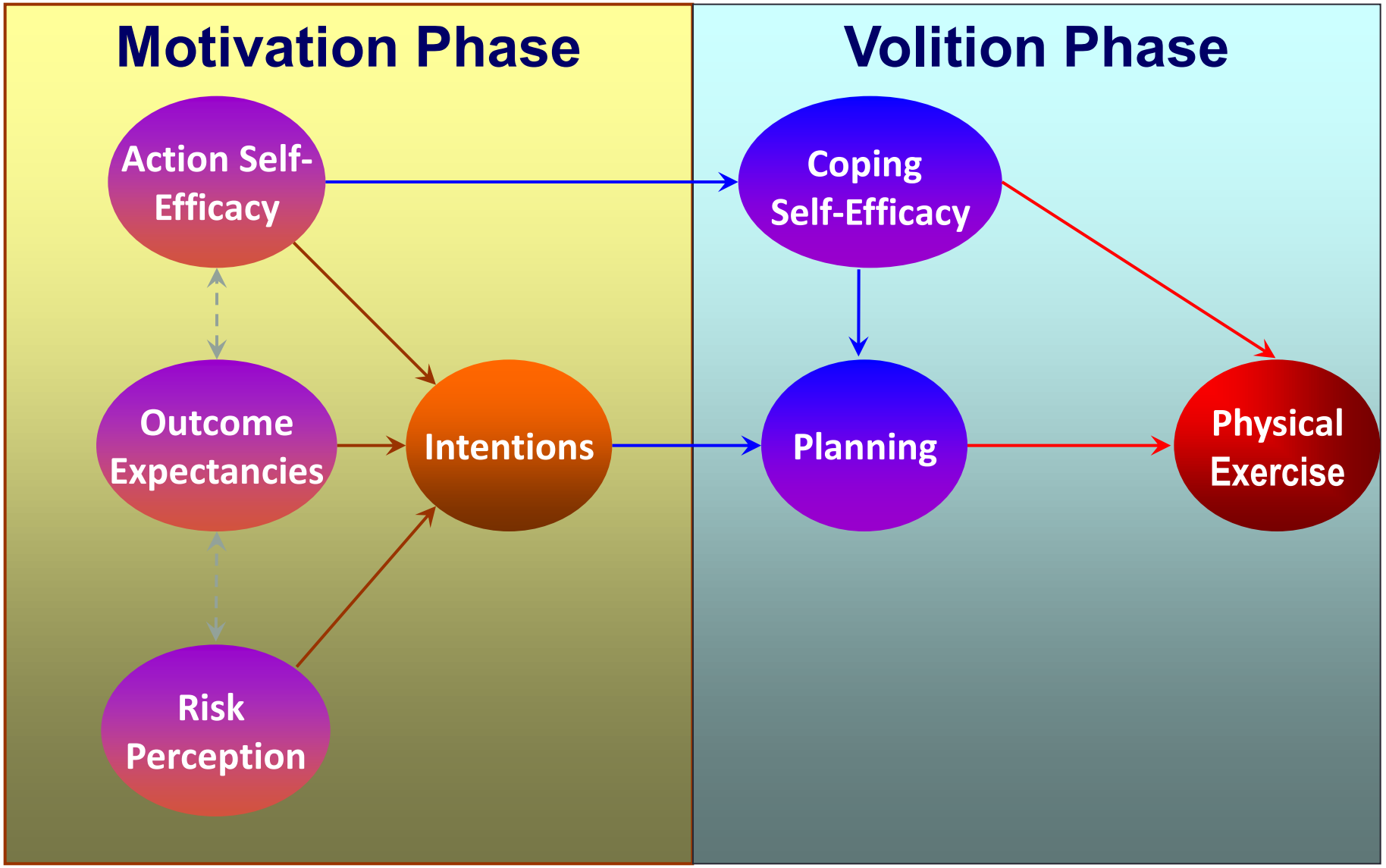
- Noia et al. (2010)

Health Action Process Approach (HAPA)

(Schwarzer, 2003)



http://userpage.fu-berlin.de/health/hapa.htm



What does this "two-phase" model mean from an intervention perspective?

Bottom Line

When deciding on the best approach to encourage *INDIVIDUAL* behavior change, maximize exercise adherence and long-term maintenance of physical activity one must take into account

…….one's motivation to change

…….one's abilities (actual and perceived)

one's resources and opportunities to change

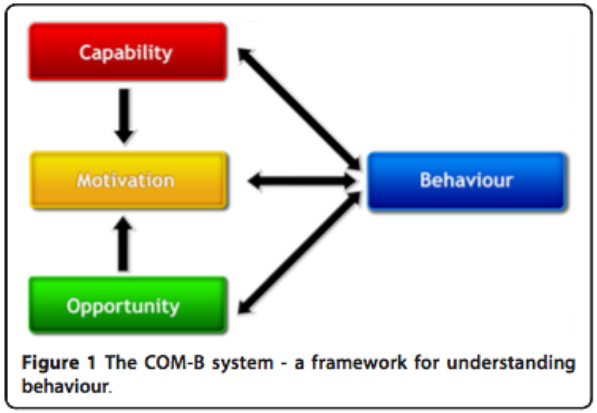
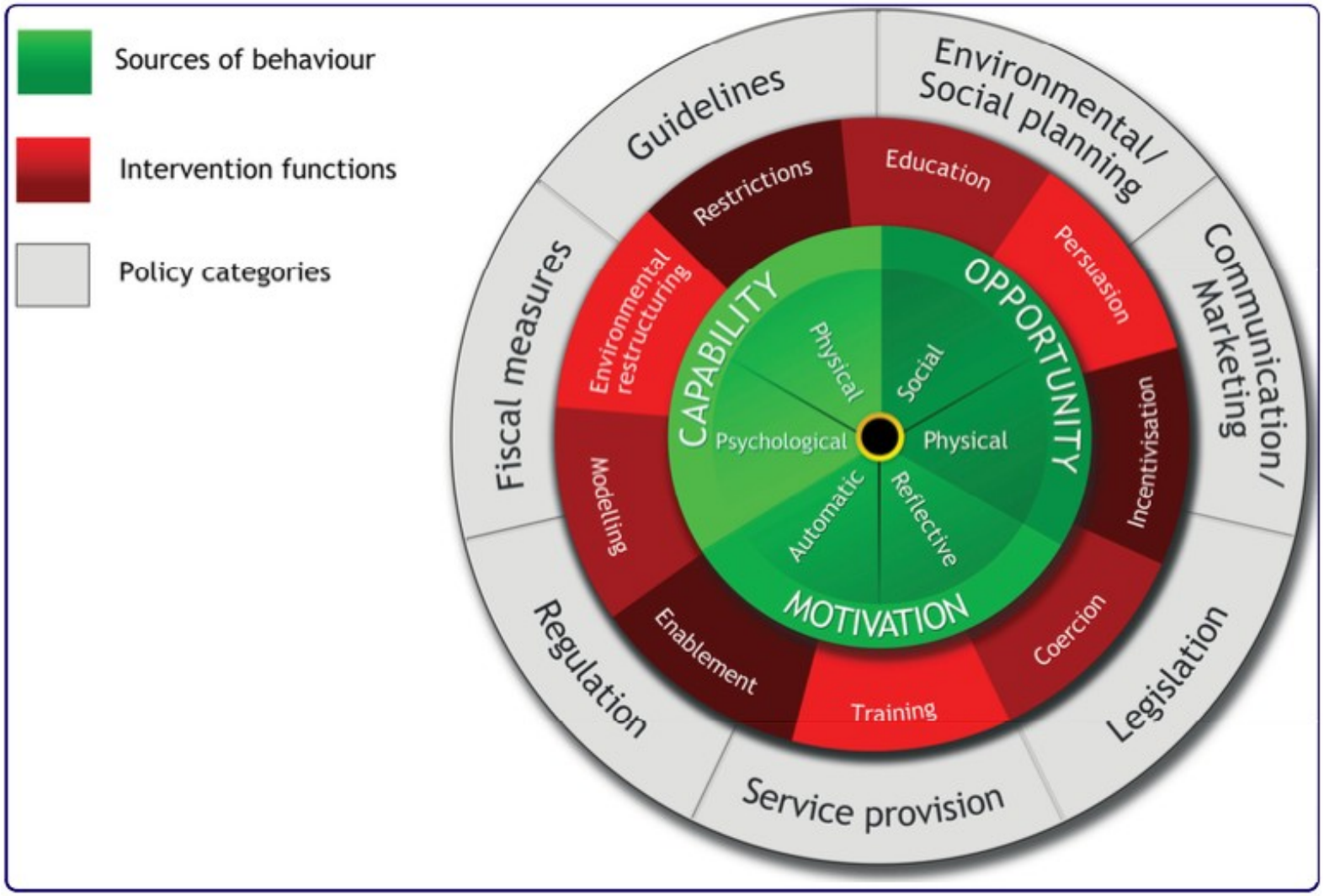


Figure 1 The COM-B system - a framework for understanding behaviour.

Behavior Change Wheel (Michie et al., 2011)



WHICH THEORY IS BEST?

~~WHICH THEORY IS BEST?~~

Some Caveats…

- It is unlikely that a single theory will universally explain physical activity behavior
- Context-specific and population-specific considerations
  - Do we need gender-specific theories?
- Existing theories should be scrutinized and revised based on available evidence
  - This is a very slow process
- Efforts for transtheoretical paradigms
  - Theoretical Domains Framework (Cane et al., 2012, Michie et al., 2005)

Common Mistakes When Using Theory

- Focusing program too narrowly for expected outcomes
- Selecting too few constructs (or only at one level of influence) – a program should be based on important influences on behavior
- Focusing too broadly in relation to the resources available
- Failure to consider the particular situation and target group
- Using constructs from theories without considering implications (should aim for multiple levels if influence)
- Overreliance on familiar methods and strategies
- Overreliance on a favorite theory
- Dismissing theory and relying on experience or intuition

How to Select a Theory

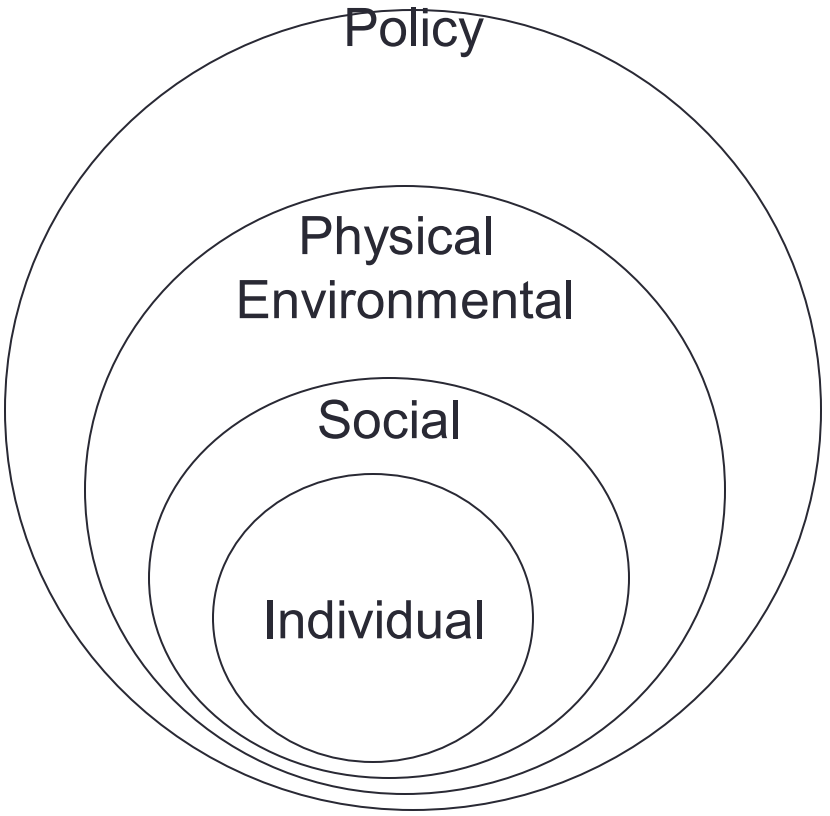
- The social or health problem at hand (what are the needs?)
- The behavior(s) to be targeted
  - Health behavior theory as blueprint identifying salient antecedents of behavior
- The target population and their needs
- Context in which the intervention will take place

PLANNING MODELS CAN PROVIDE GUIDEANCE IN A SYSTEMATIC WAY

STARTING WITH NEEDS ASSESSMENT

Approaches to Health Promotion

Schematic representation of the *ecological framework* for understanding different influences on health behavior



A Shift from a Clinical to a Public Health Approach

Clinical/Medical Approach

- stresses convenience & efficiency of the provider
- "waiting" approach – individuals must look for programs that meet their needs
- serve mostly active and healthy (or patient populations)
- takes place in structured settings

Community-based Approach

- multi-level public health orientation
- "seeking" approach – active approach to collecting and disseminating information to allow for tailoring to individual needs
- target all segments of population, especially those who would particularly benefit (i.e., those at risk)
- takes place in "real-life" environment
- Seeks to instill changes in social networks and structures, organizational norms, policies

Approaches to Health Promotion

(1) Behavioral and social approaches
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(2) Campaign and informational approaches
- Community-wide campaigns
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(3) Environmental and policy approaches

Applying the RE-AIM Framework to Health Behavior Interventions

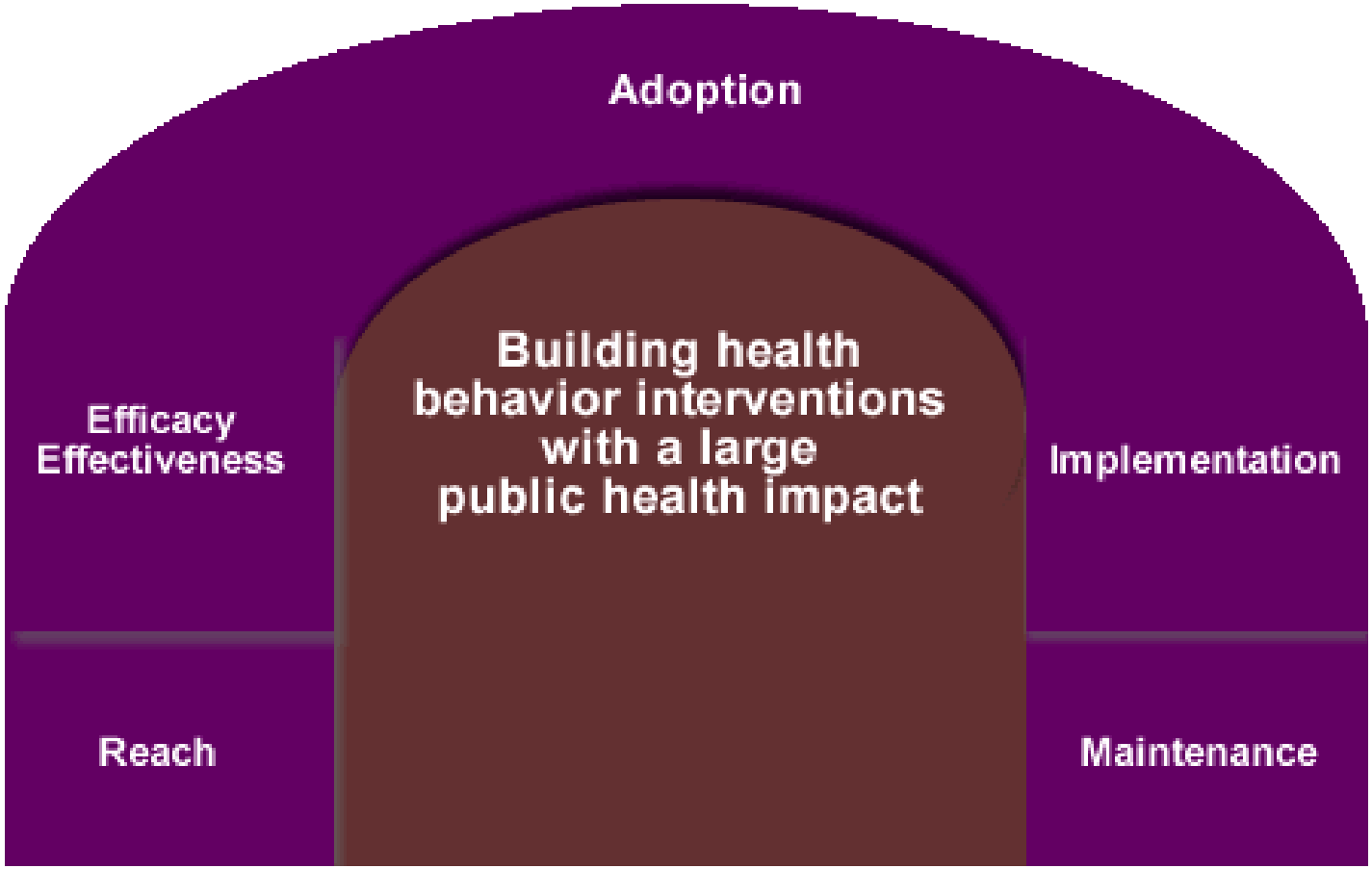
- RE-AIM originally developed to evaluate the public health impact of health promotion efforts and potential for dissemination and sustainability
- Today interventionists use this framework in the planning phases of interventions to maximize their public health impact and long-term effectiveness

Applying the RE-AIM Framework to Physical Activity Interventions

Central questions

- How well does research translate into practice?
- What is …Robustness
- What is …Translatability
- What is …Public health impact
  - Individual level
  - Institutional (or Setting) level

RE-AIM


Adoption
Efficacy
Effectiveness
Building health
behavior interventions
with a large
public health impact
Implementation
Reach
Maintenance

RE-AIM as a planning model: Designing for dissemination

Determine if acceptable program/policy will:

- Reach large numbers of people, especially those who can benefit most
- Be widely adopted by different settings using available "channels" of delivery
- Be consistently implemented by settings and staff members reflective of local community
- Produce relevant, replicable, long-lasting effects (with minimal negative impacts) at reasonable cost

Klesges, et al Ann Beh Med 2005;29:S66-75.

RE-AIM – cont.

R →	Increase	Reach
E →	Increase	Effectiveness
A →	Increase	Adoption
I →	Increase	Implementation
M →	Increase	Maintenance

Glasgow, Klesges, Dzewaltowski, et al., *Ann Behav Med*, 2004

RE-AIM Dimensions

	Dimension	Definitions
Individual Level	REACH	1. Participation rate among potential target group(s) 2. Representativeness of participants in terms of social, demographic, and health characteristics
	EFFICACY/ EFFECTIVENESS	1. Effects of intervention on primary outcome of interest 2. Impact on quality of life and negative outcomes 3. Robust outcomes (similar effects among targeted groups)

Clarification of Terms

- **Efficacy**

  Does the treatment/intervention cause an effect?

  Does the treatment/intervention work under ideal circumstances?

- **Effectiveness**

  Does the treatment/intervention work under real-life circumstances?

RE-AIM Dimensions (cont.)

	Dimension	Definitions
Institutional Level	ADOPTION	1. Participation rate among possible settings and contexts 2. Representativeness of participating settings, intervention staff
Institutional Level	IMPLEMENTATION	1. Extent intervention was delivered as intended in protocol 2. Time & cost of intervention
Both	MAINTENANCE	1. Longer-term effects ≥ 6 months (Individual) 2. Impact of attrition on outcomes (Individual) 3. Sustained delivery or modifications of intervention (Setting)

Some Challenges…

Reach

- Not studying a relevant, high-risk, or representative sample
- *Remedy?*

Efficacy or Effectiveness

- Not thoroughly understanding outcomes or how they come about, e.g., no knowledge of mediators, conflicting or ambiguous results, or inadequate control conditions to rule out alternative hypotheses
- *Remedy?*

Some Challenges – cont.

Adoption

- Program not ever adopted or endorsed — or only used in academic settings
- *Remedy?*

Implementation

- Protocols not delivered as intended (type III error)
- *Remedy?*

Maintenance

- Program or effects not maintained over time
- *Remedy?*

RE-AIM Resources

If we want more evidence-based practice,

we need more practice-based evidence.

L. W. Green, 2004

More information on RE-AIM at **www.re-aim.org**

Multiple Behavior Change Research

- Efforts to promote two or more health behaviors
- The interrelationships among health behaviors and interventions designed to promote change in more than one health behavior at a time
- Presents a unique set of challenges
  - theoretical, methodologic, intervention, statistical, and funding issues

Rationale for MHBC Research

Approximately half of all causes of mortality in the United States are linked to social and behavioral factors such as smoking, diet, alcohol use, sedentary life-style, and accidents. Yet less than 5% of the approximately $1 trillion spent annually on health care in the United States is devoted to reducing risks posed by these preventable conditions. Behavioral and social interventions therefore offer great promise to reduce disease morbidity and mortality, but as yet their potential to improve the public's health has been relatively poorly tapped.

— Institute of Medicine

Rationale for MHBC Research

- The major causes of morbidity and premature mortality in the US (heart disease, cancer, and stroke) influenced by multiple health risk behaviors (including smoking, alcohol abuse, physical inactivity, and poor diet)
- In the US, only 3% of adults meet all four health behavior goals of being a nonsmoker, having a healthy weight, being physically active, and eating 5 or more fruits and vegetables a day (Reeves & Rafferty, 2005)

Rationale for MHBC Research – cont.

- Clustering of unhealthy behaviors
  - In the US, the majority of adults meet criteria for two or more risk behaviors (Fine et al., 2004; Pronk et al., 2004)
- 92% of smokers exhibit at least one additional risk behavior (Fine et al., 2004; Klesges et al., 1990; Pronk et al., 2004)
- 9 out of 10 overweight women at least two eating or activity risk behaviors (Sanchez et al., 2008)

Rationale for MHBC Research – cont.

- Success in changing one or more lifestyle behaviors may increase self-efficacy to improve risk behaviors individuals have low motivation to change
  - PA as a gateway behavior to overall health full lifestyle?
- Limited contact opportunities for health promotion – should aim for interventions that could simultaneously improve multiple risk behaviors
- Interventions targeted at single risk behaviors, even if effective, will be limited in their impact

Methodological Issues in MHBC

- Design issues
  - How many behaviors to target at once?
  - Specific combinations of specific behaviors? Are some more compatible than others?
  - Differential motivation to change different behaviors
  - Implications for timing? Introduce behaviors at the same time or sequentially?

Hyman et al. (2007)

- Is sequential presentation of stage of change–based counseling to stop smoking, reduce dietary sodium level, and increase physical activity by at least 10 000 pedometer steps per week more effective than simultaneous counseling?
- African Americans (N=289) with hypertension, aged 45 to 64 years, initially non-adherent to the 3 behavioral goals, were randomized:
  (1) 1 in-clinic counseling session on all 3 behaviors every 6 months, supplemented by motivational interviewing by telephone for 18 months;
  (2) a similar protocol that addressed a new behavior every 6 months;
  (3) 1-time referral to existing group classes ("usual care").

The primary end point was the proportion in each arm that met at least 2 behavioral criteria after 18 months.

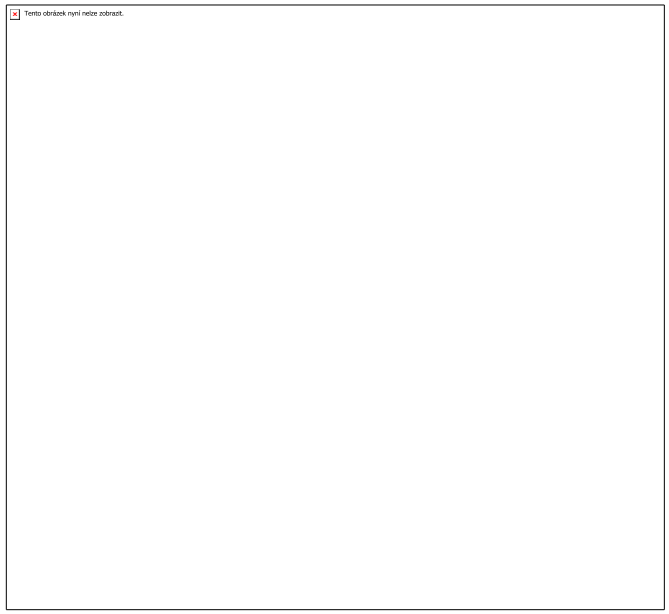
Hyman et al. (2007) - results

- At 18 months, only 6.5% in the simultaneous arm, 5.2% in the sequential arm, and 6.5% in the usual-care arm met the primary end point
- Results for single behavioral goals consistently favored the simultaneous group
  - At 6 months, 29.6% in the simultaneous, 16.5% in the sequential, and 13.4% in the usual-care arms had reached the urine sodium goal
  - At 18 months, 20.3% in the simultaneous,16.9% in the sequential, and 10.1% in the usual care arms were urine cotinine negative

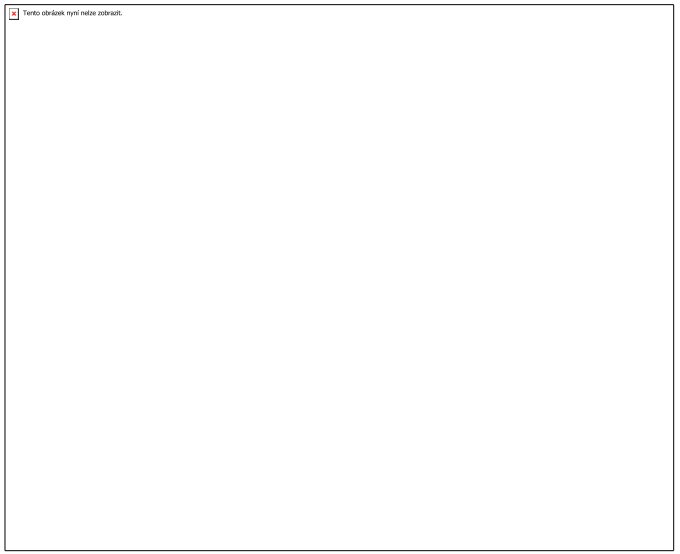
King et al. 2013

- Four intervention groups: a sequential exercise-first group, a sequential diet-first group, a simultaneous group, and a control group
- 12 months interventions; 4 months in between sequential behaviors
- Telephone-based counseling (SCT, TTM); control received stress management advice

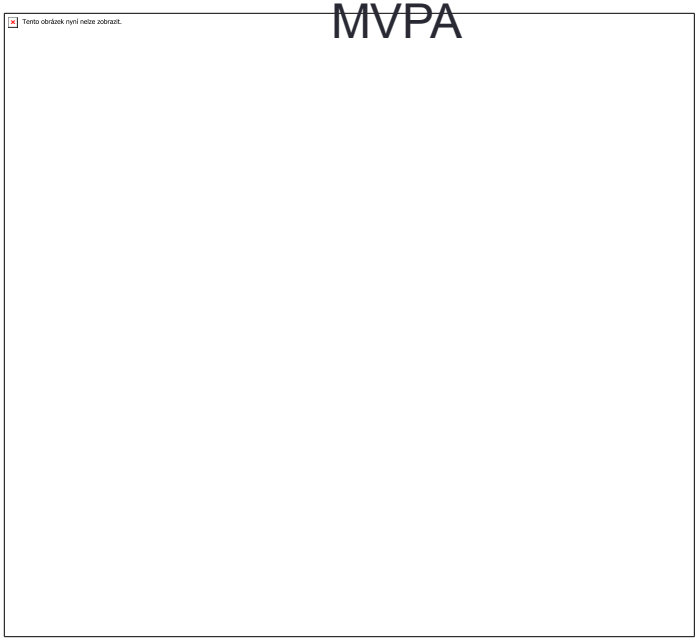
Fruit & Vegetable Intake



Calorie Intake from Sat. Fat



MVPA



- The behaviors presented first, showed greater improvement in sequential interventions (suppression effect of “diet first” on physical activity)
- In simultaneous group, changes in both behaviors comparable, the size of the effect similar to that of “first behavior” in the sequential group

Methodological Issues in MHBC

- Measurement issues
  - Separate or composite measures?
- Data analysis
- Theory testing across behaviors
- Participant burden

Behavior Change from the Perspective of Motivational Interviewing

Motivational interviewing is a directive, client-centered counseling style for eliciting behavior change by helping clients to explore and resolve ambivalence.

Source: http://www.motivationalinterview.org/

Miller WR, et al. Motivational Interviewing, 2nd ed. Guilford Press; 2002.

Berger B. Motivational interviewing helps patients confront change. Available at:http://www.uspharmacist.com/oldformat.asp?url=newlook/files/Phar/nov99relationships.cfm&pub_id=8&article_id=450.

The Spirit of Motivational Interviewing

- Collaborate with the patient
- Evoke their readiness to take action (elicit “change talk”)
- Develop patient’s autonomy to take responsibility for their own health

Behavior change can be facilitated but not coerced.

Strategies for Successful Interaction with Patients

Elicit-Provide-Elicit

- Menu of Strategies

The Five Principles

- READS

Helpful Tools

- Readiness Rulers
- The Envelope

Rollnick S, et al. *Health Behavior Change: A Guide For Practitioners*. Churchill Livingstone; 2003.
Berger B. Motivational interviewing helps patients confront change. Available at: http://www.uspharmacist.com/oldformat.asp?url=newlook/files/Phar/nov99relationships.cfm&pub_id=8&article_id=450

Strategies for Successful Interaction with Patients

ELICIT-PROVIDE-ELICIT

- The good things and bad things
- What do they like and dislike about the proposed changes?
- What is their representation of the illness and its treatment?
- Do they agree with the NP/MD?
- Do they believe they can do what is asked? What will help?
- What are the barriers?
- IS THE PATIENT READY FOR THE CHANGE?

Five Principles of MI

- Express empathy
- Develop discrepancy
- Avoid argumentation
- Roll with resistance
- Support self-efficacy

Building Motivation

- Explore ambivalence and build motivation

(1) Open-ended questions

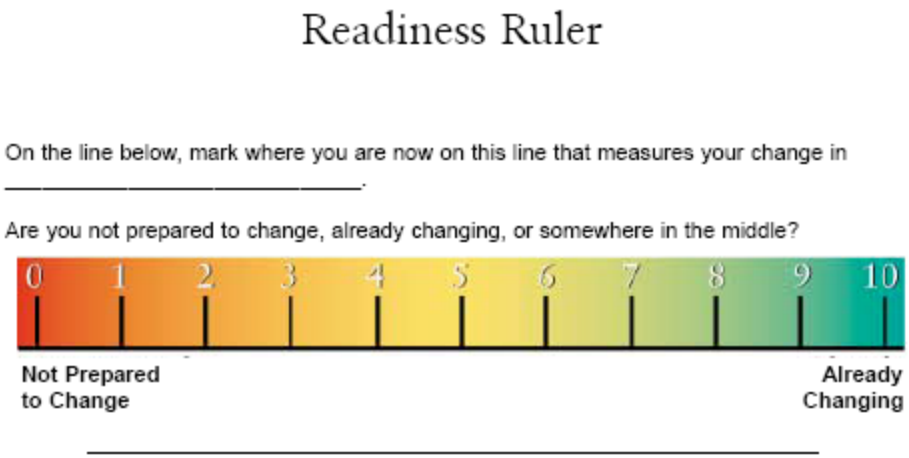
(2) Reflective listening

(3) Affirmations

(4) Summaries

(5) Elicit self-motivational statements (change talk)

Readiness to Change: Eliciting Change Talk



"If I handed you an envelope, what would the message inside have to say to get you to _____?"

Building Motivation

- Goal is to get patient/client to articulate:

  - The steps I plan to take are:
  - Challenges that may interfere:
  - How I will handle these challenge
  - I'll know my plan is working if:

MHBC Challenges

- Timing of treatment
- Measuring changes in multiple behaviors
- Theory testing across behaviors
- Participant burden

Some Statistics

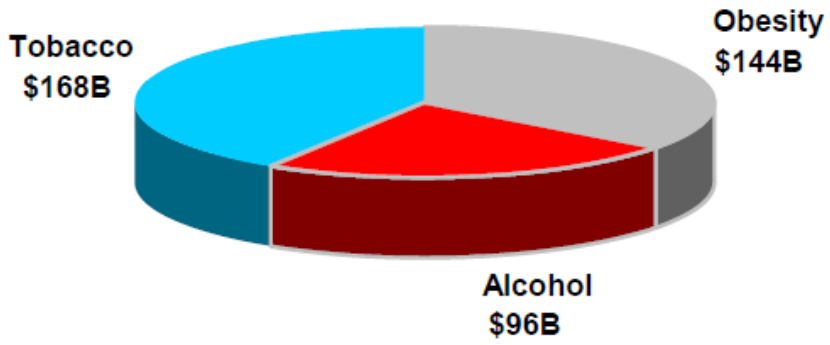
(Lightwood & Glantz, 2007)

- 1% absolute reduction in smoking prevalence (AMIs and strokes)
- In the first year, there would be 924±679 (mean±SD) fewer hospitalizations for AMI and 538±508 for stroke, resulting in an immediate savings of $44±26 million
- A 7-year program that reduced smoking prevalence by 1% per year would result in a total savings of $3.20±0.59 billion in costs, and would prevent 13,100 deaths resulting from AMI/stroke.

Some Statistics

(The Lewin Group Review, 2009)

- The midpoint of the cost-savings estimates is $408 billion per year, equivalent to 17% of 2008 national health expenditures (NHE)
- The range of expected savings from the respective studies is $264 billion to $552 billion per year and includes several significant studies by the CDC and NIH



Hyman et al. (2007) – results

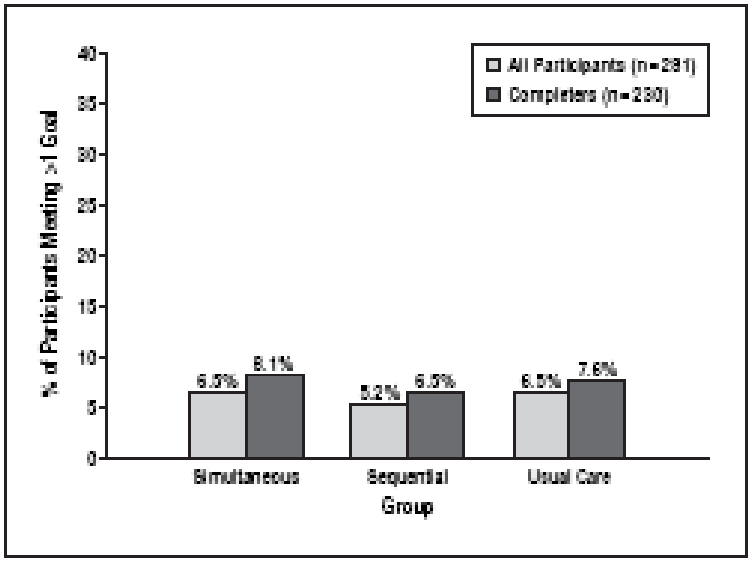


Figure 2. Proportion of each group that met more than 1 behavioral goal at 18 months (primary end point). All statistical contrasts resulted in $P > .05$. In the intention-to-treat analysis, $P = .99$ for the simultaneous vs the usual-care group, $P = .72$ for the sequential vs the usual-care group, and $P = .70$ for the simultaneous vs the sequential group. The P values for the contrasts involving completers were of similar magnitude.

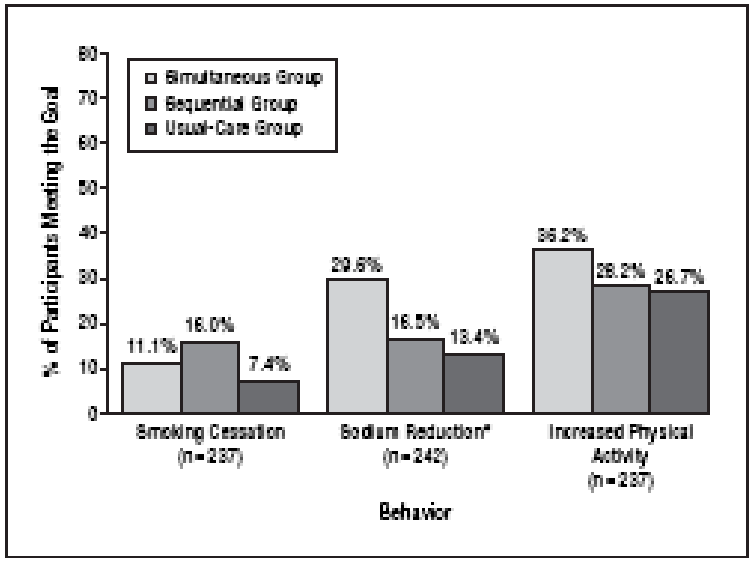


Figure 3. Proportion of each group that adhered to the goal at 6 months after the introduction of the behavior. In the sequential group, the measurement corresponding to the 6-month postintroduction point, rather than chronological follow-up, was used. The number of measurements available for each behavior at the 6-month postintroduction visit is noted. The asterisk indicates that $P = .01$ for the simultaneous group vs the usual-care group and $P = .046$ for the simultaneous group vs the sequential group.

Hyman et al. (2007) – results

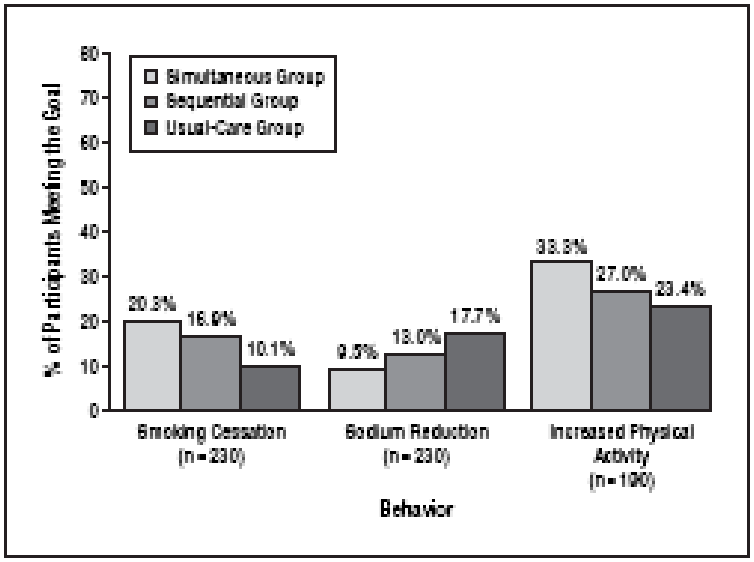


Figure 4. Proportion of each group that adhered to the goal at 18 months after the introduction of the behavior. The number of participants who provided pedometer measurements was less than that of participants who provided urine specimens for cotinine and sodium measurements. None of the individual group contrasts reached a significance level of ≤.05, although $P = .06$ for the simultaneous group vs the usual-care group and $P = .08$ for overall trend in smoking cessation.

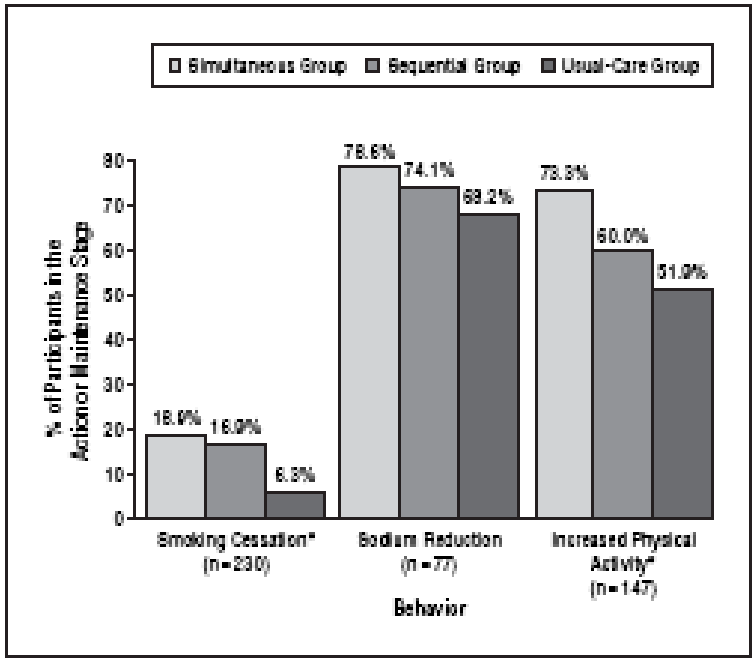


Figure 5. Effect of interventions on stage of change for each behavior. The asterisk indicates behaviors with a significant treatment effect: smoking cessation, $P = .02$ for the simultaneous group vs the usual-care group, $P = .04$ for the sequential group vs the usual-care group, and $P = .74$ for the simultaneous group vs the sequential group; sodium reduction, $P = .41$ for the simultaneous vs the usual-care group, $P = .65$ for the sequential vs the usual-care group, $P = .70$ for the simultaneous vs the sequential group; and physical activity increase, $P = .03$ for the simultaneous group vs the usual-care group, $P = .41$ for the sequential vs the usual-care group, and $P = .17$ for the simultaneous vs the sequential group. The denominator for each comparison varies depending on the proportion of subjects in each stage at baseline.