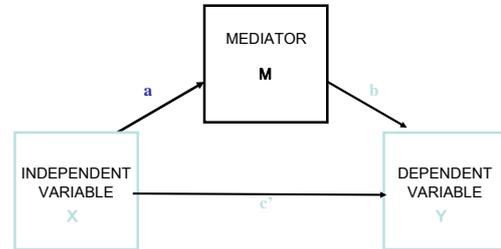


Mediator and Moderator Methods



Single Mediator Model



Mediator Definitions

- A mediator is a variable in a chain whereby an independent variable causes the mediator which in turn causes the outcome variable (Sobel, 1990)
- The generative mechanism through which the focal independent variable is able to influence the dependent variable (Baron & Kenny, 1986)
- A variable that occurs in a causal pathway from an independent variable to a dependent variable. It causes variation in the dependent variable and itself is caused to vary by the independent variable (Last, 1988)

Other names for Mediators and the Mediated Effect

- Intervening variable is a variable that comes in between two others.
- Process variable because it represents the process by which X affects Y.
- Intermediate or surrogate endpoint is a variable that can be used in place of an ultimate endpoint.
- Indirect Effect to indicate that there is a direct effect of X on Y and there is an indirect effect of X on Y through M.
- Proximal to distal variables

Social Support

and

Self-Efficacy:
→ 2 Directions

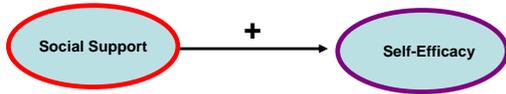


Support enables → Self-Efficacy

Self-Efficacy cultivates → Support

Why does support work?

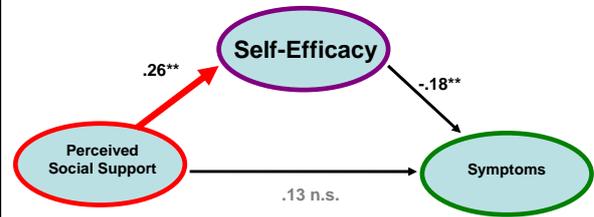
It might raise perceived self-efficacy which represents an optimistic mindset towards coping with adversity:
The enabling function of social support



Albert Bandura



Enabling effect of social support on self-efficacy



Self-efficacy **mediates** the effect of social support on physical symptoms after surgery in 193 cardiac patients (Sobel test, $p < .05$)

Schröder, K. E. E., Schwarzer, R., & Konertz, W. (1998). Coping as a mediator in recovery from heart surgery: A longitudinal study. *Psychology & Health*, 13, (1), 83-97.

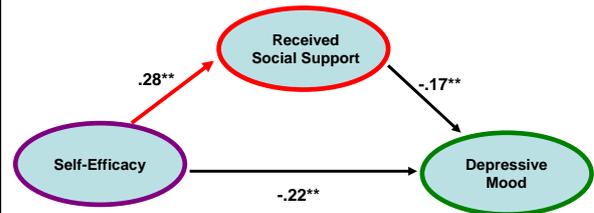
The „Cultivation of Support“ Hypothesis

is opposed to the enabling hypothesis



Albert Bandura

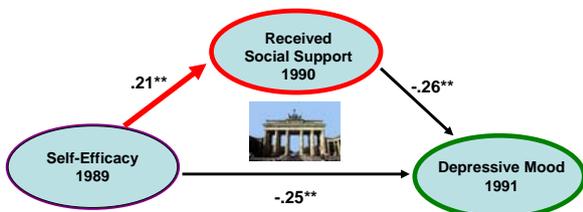
Self-Efficacy cultivates → Support



Support partially mediates the effect of self-efficacy on depressive mood, (Sobel $p < .01$), in 535 factory workers in Costa Rica across a 6-month period..

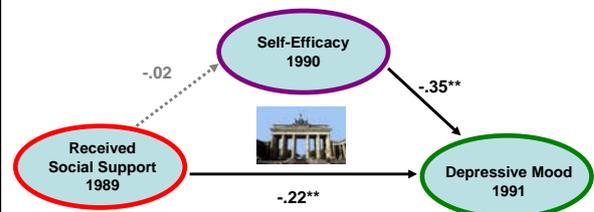
Schwarzer, R., & Gutiérrez-Doña, B. (2005). More spousal support for men than for women: A comparison of sources and types of support. *Sex Roles: A Journal of Research*, 52, 523-532.

Self-Efficacy cultivates → Support



Support partially mediates the effect of self-efficacy on depression, (Sobel $p < .01$), in 265 women from East Germany, across a 2-year period.

No enabling effect of social support

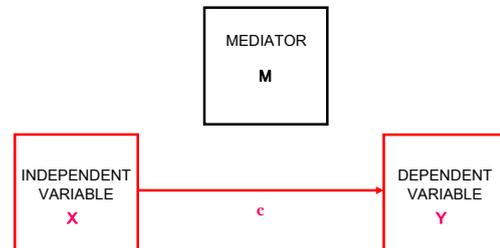


Self-efficacy does **NOT** mediate the effect of social support on depression, (Sobel $p = .74$), in 265 women from East Germany, across a 2-year period.

Mediation Causal Steps Test

- Series of steps described in Judd & Kenny (1981) and Baron & Kenny (1986).
- One of the most widely used methods to assess mediation in psychology.
- Consists of a series of tests required for mediation as shown in the next slides.

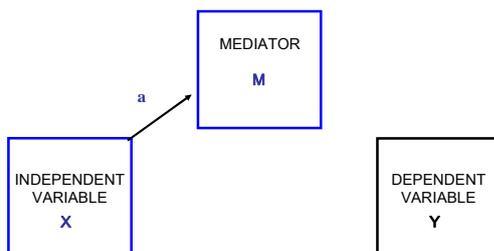
Step 1



1. The independent variable causes the dependent variable:

$$Y = i_1 + cX + \varepsilon_1$$

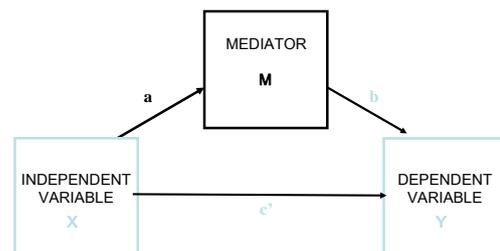
Step 2



2. The independent variable causes the potential mediator:

$$M = i_2 + aX + \varepsilon_2$$

Step 3



3. The mediator must cause the dependent variable controlling for the independent variable:

$$Y = i_3 + c'X + bM + \varepsilon_3$$

Mediated Effect Measures

Mediated effect = ab Standard error = $\sqrt{a^2 s_b^2 + b^2 s_a^2}$

Mediated effect = $ab = c - c'$ (see MacKinnon et al., 1995 for a proof)

Direct effect = c' Total effect = $ab + c' = c$

Test for significant mediation:

$$z' = \frac{ab}{\sqrt{a^2 s_b^2 + b^2 s_a^2}} \text{ or compute Confidence Limits}$$

Results of Statistical Simulation Study (MacKinnon et al., 2002)

- Substantial differences in Type I error rates and power across causal steps, difference in coefficients ($c - c'$), and product of coefficients (ab) methods. Causal steps described in Baron and Kenny (1986) have low power for small effects.
- A product of coefficient test has good balance of power and Type I error rates, can be extended to longitudinal and multiple mediators.

Mediation Methods

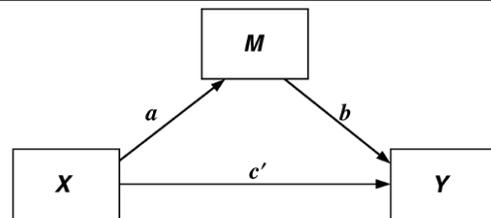
Mediated effect= ab Standard error= $\sqrt{a^2s_b^2 + b^2s_a^2}$

Confidence intervals based on the distribution of the product of two random variables are more accurate than existing methods. Methods in common use have low power (MacKinnon et al., 2002).

Confidence intervals based on the bias-corrected bootstrap are most accurate overall (MacKinnon, Lockwood, & Williams, in press).

It has been found that the method described by Baron and Kenny (1986) suffers from low statistical power in most situations (MacKinnon et al., 2002). Intuition suggests that this may be the result of the requirement that both the a and b coefficients be statistically significant, according to the Baron and Kenny criteria. Especially in small samples, it is possible that either the a or the b coefficient (or both) may be nonsignificant only because of low statistical power. If either of these parameters fails to meet the Baron and Kenny criteria even though they are in fact nonzero in the population, the investigator cannot claim mediation by the Baron and Kenny criteria, and thus a Type II error results. In contrast, testing the null hypothesis that $(c - c')=0$ requires one fewer hypothesis test, and thus a Type II error in the testing of mediation would be less likely. Indeed, joint significance tests involving the product of coefficients such as the Sobel test have been found to have greater statistical power than that of other formal methods of assessing mediation.

MacKinnon, Lockwood, Hoffman, West, and Sheets (2002), in their comparison of 14 methods of assessing mediation effects, settle on the Sobel test (and its variants) as superior in terms of power and intuitive appeal (Preacher & Hayes, 2004).



$$s_{ab} = \sqrt{b^2s_a^2 + a^2s_b^2 + s_a^2s_b^2}$$

In order to conduct the test, ab is divided by s_{ab} to yield a critical ratio that is traditionally compared with the critical value from the standard normal distribution appropriate for a given alpha level.

Bootstrapping

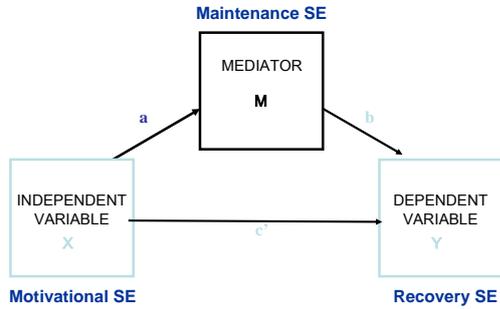
An alternative approach is to bootstrap the sampling distribution of ab and derive a confidence interval with the empirically derived bootstrapped sampling distribution. Bootstrapping is a nonparametric approach to effect-size estimation and hypothesis testing that makes no assumptions about the shape of the distributions of the variables or the sampling distribution of the statistic (Preacher & Hayes, 2004, p. 721).

Use an SPSS macro to test mediation in raw data with the command syntax:

`sobel y=?? / x=?? / m=?? / boot=5000.`

You will get two results: Sobel's z and the bootstrap confidence intervals.

sobel y=recexe1 / x=motexe1 / m=sweexe1 / boot=5000.



DIRECT AND TOTAL EFFECTS

	Coeff	s.e.	t	Sig(two)	
b(YX)	,5805	,0371	15,6530	,0000	= c
b(MX)	,5524	,0335	16,4753	,0000	= a
b(YM.X)	,7434	,0321	23,1758	,0000	= b
b(YX.M)	,1699	,0327	5,1947	,0000	= c'

INDIRECT EFFECT AND SIGNIFICANCE USING NORMAL DISTRIBUTION

	Value	s.e.	LL 95 CI	UL 95 CI	Z	Sig(two)
Sobel	,4107	,0306	,3507	,4706	13,4198	,0000

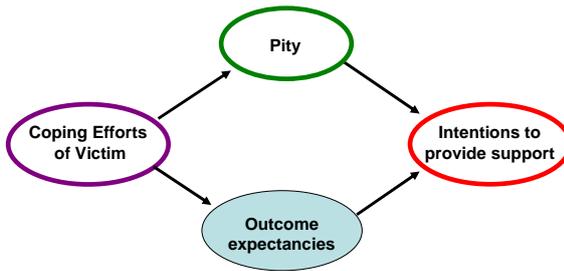
BOOTSTRAP RESULTS FOR INDIRECT EFFECT

	Mean	s.e.	LL 95 CI	UL 95 CI	LL 99 CI	UL 99 CI
Effect	,4105	,0354	,3421	,4813	,3172	,5043

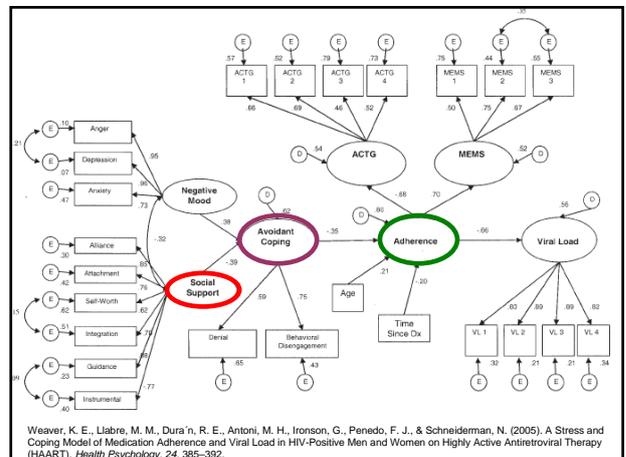
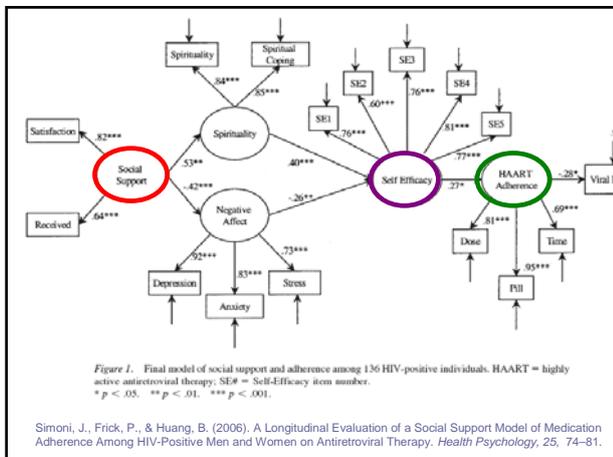
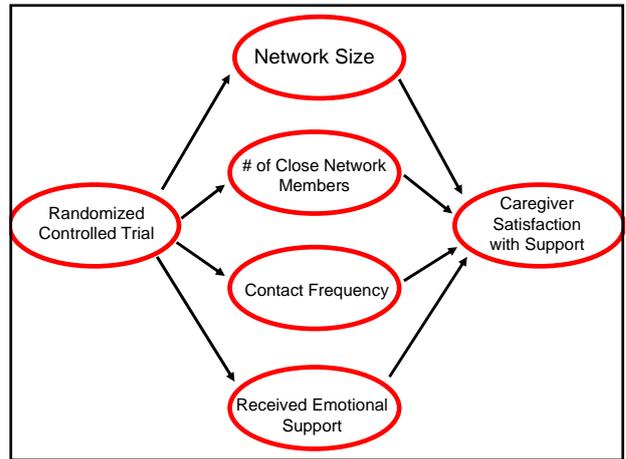
SAMPLE SIZE

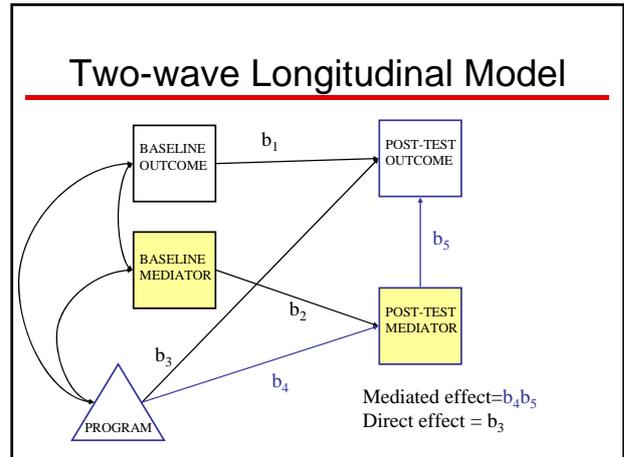
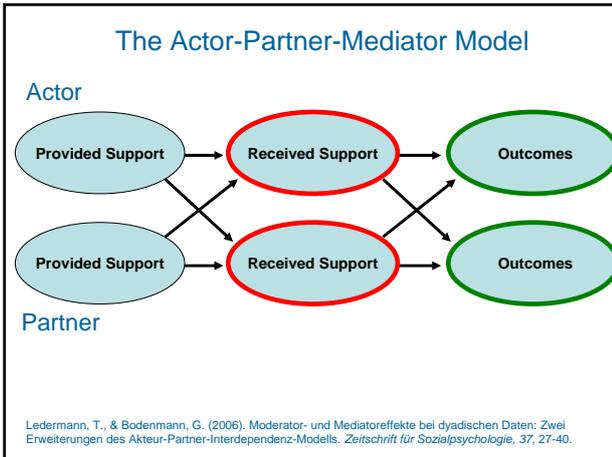
655

What motivates the provider? Pathways from perceived coping efforts of a target person to support provision



Schwarzer, R., Dunkel-Schetter, C., Weiner, B., & Woo, G. (1992). Expectancies as mediators between recipient characteristics and social support intentions. In R. Schwarzer (Ed.), *Self-efficacy: Thought control of action* (pp. 65-87). Washington, DC: Hemisphere.





Mediator versus Moderator

- Moderator is a variable that affects the strength or form of the relation between two variables. The variable is not intermediate in the causal sequence, so it is not a mediator.
- Moderator is also an interaction, the relation between X and Y depends on a third variable. There are other more detailed definitions of a moderator.
- Tested by including interaction effects in addition to main effects of X.

Moderators

- Moderators determine for whom the program is most effective. Could be used to match treatments.
- Moderators may also include mediation, e.g., the relation between X and M differs across groups, a, M and Y differs across groups, b, or whether the mediated effect ab , differs across groups (moderated mediation).

