Mend It or End It: Redirecting the Search for Interactions in the Organizational Sciences

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Synopsis

Moderator variables are widely hypothesized and studied in the organizational sciences, but the track record of moderator variable studies is very discouraging. These studies often lack sufficient statistical power and the type of designs and measures common in organizational research virtually guarantee that the moderator effects that are found are usually extremely small. We recommend that future attempts to identify and estimate moderator effects should be limited to situations where better measures, stronger research designs and a realistic cost-benefit assessment are available. Researchers should avoid moderator hypotheses in contexts where the measures and research designs employed do not allow them to be tested in a meaningful way, and should be cautious about interpreting the very small effects they are likely to find.

Introduction and Background

There are essentially two types of relationships examined in social, behavioral, and organizational sciences – simple linear relationships involving one or more independent variables and interaction/moderator relationships, in which the relationship between two variables (X and Y) changes as a function of some third variable (Z). Mediation is really just a sequence of linear relationships, while truly nonlinear relationships are rare. Even the briefest review of social, behavioral, and organizational science models suggests moderator relations constitute a key element in our explanations of how things work. Classic examples include the familiar formulations such as Performance = (Ability * Motivation), Effort = (Valence * Instrumentality * Expectancy); virtually all work motivation theories include or are built around interactions and contingencies

A large literature addresses how to meet the challenge of detecting and estimating moderation and interaction effects. For example, a Special Issue of *Organizational Research* Methods (2002, Vol. 5, Issue 3) dealt with estimation of interaction effects in organization studies. Numerous papers discuss methods for detecting and estimating interactions and moderators in both primary research and meta-analysis; a recurring theme in many of these papers is that moderator effects are often extremely small, which makes their detection and estimation challenging. In this paper, we argue that the frequent failure to detect moderator effects is indicative of the limited value moderator hypotheses have for explaining behaviour.

Issues and Questions Considered

Studies of the actual statistical power exhibited by procedures used to detect interaction effects in primary research (most frequently using moderated multiple

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regression) highlight the difficulties in detecting moderator effects. A recent review of 30 years of research examined 261 moderator studies reporting 636 moderated regression effect sizes published in the *Academy of Management Journal, Journal of Applied Psychology,* and *Personnel Psychology* between 1969 and 1998. Interaction effects, to the extent they exist at all, tended to be very small. Median effect size reported in these studies was f^2 = .002; 75% of the studies reviewed reported f^2 values of .0053 or lower. Correcting for measurement error, the median effect size was f^2 = .003.

The most widely accepted definition of a small effect is d= .20 or f^2 = .01, which is five times as large as the median observed moderation effect reported in this review. 95% of all reported studies found moderator effects accounted for less than 7/10 of 1% of outcome variance. One result of this small effect size is that virtually all moderator studies lack the statistical power needed to detect moderators; a sample of over 3200 observations is needed to yield the level of power typically recommended by power analysis textbooks.

A second barrier to testing moderator models arises because organizational research typically relies on measures with interval rather than ratio-scale properties. Direct tests of "pure" interaction models may not be possible because estimates of the regression coefficients that test these models are not invariant to linear transformation when interval scale measures are used.

Outcomes and Findings

The search for latent moderator processes has been a long and often fruitless one. Small moderator effect estimates are typically found and do not replicate well. Investigators of organizational phenomena nonetheless routinely include latent moderator processes in models that grow more complex without growing more useful. Assuming that there is a credible reason to believe that a meaningful moderator

exists our review suggests a three-pronged strategy for mending current practices in the search for moderators: (1) using better measures, (2) using better research designs, and (3) conducting a realistic a priori cost-benefit analyses before proposing moderators. .

First, we recommend that moderator studies should not be conducted unless the investigator has access to reliable measures of X, Y and Z (and that yield a reliable XZ product term), all of which are backed by credible evidence of construct validity, and none of which are severely restricted in range. Second, moderator studies should start with power analyses, based on realistic estimates of moderator strength. The widespread convention of planning studies around the possibility that effects will achieve some arbitrary "small" standard will not be enough; studies should be built around the assumption that moderator effects could be at least 5 times smaller than the conventional definition of a small effect.

Once enough evidence is accumulated to convincingly support moderators in observational designs using interval scale measures, experimental/quasi-experimental studies should be carried out to provide more credible estimate the strength of the moderator effect and whether additive main effects are present simultaneously. More important, experimental/quasi-experimental studies

provide methods of pitting competing theories against one another and providing better insight into causal processes.

Moderator research is in a state of crisis. Unless better measures, better study designs and better procedures for pitting moderator hypotheses against meaningful alternatives are adopted, there is every reason to believe that the long history of failure in the search for moderators will continue to be played out. We believe moderator research can, and must be improved, and provide concrete recommendations for making these improvements

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