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Moderation in the actor–partner interdependence model

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Abstract

Potential moderators of effects in the actor–partner interdependence model (APIM) include variables that vary within dyads, between dyads, or both between and within dyads (i.e., mixed moderators). Another factor in the moderation of the APIM is whether dyads are indistinguishable (e.g., same-sex friendship pairs) or distinguishable (e.g., heterosexual couples). For each possibility, what are the potential moderator effects (up to 8), how they might be estimated and tested, and how they can be interpreted are discussed. Submodels are also presented, based on patterns of moderation of the actor and partner effects, which are statistically simpler, more conceptually meaningful, and more powerful in testing moderator effects. Example analyses illustrate the recommended steps involved in an APIM moderation analysis.

The actor–partner interdependence model (APIM; Kenny, Kashy, & Cook, 2006) has become a widely used vehicle for analyzing dyadic data. The APIM's popularity is in part because it allows for modeling interdependence between dyad members. Furthermore, recent work has detailed how the APIM might be used to test interdependence theory (Wickham & Knee, 2012). In the basic APIM, each dyad member's score on the same variable, X, is used to predict both members' scores on the outcome variable, Y. The effect of a person's own X on his or her own Y is referred to as the *actor effect* and the effect of the partner's X on the other person's Y is referred to as the *partner effect*. Partner effects capture a part of the interdependent nature of relationships.

Dyads can be categorized as either indistinguishable or distinguishable. For example, monozygotic twins and gay and lesbian couples are said to be theoretically indistinguishable in that there is no meaningful difference between the two members. Other dyad members are said to be theoretically distinguishable—for example, parent–child dyads and heterosexual couples—in that the two members can be differentiated by a meaningful variable in the same way for all dyads. To estimate the actor and partner effects for either type of dyads, either multilevel modeling (MLM) or structural equation modeling (SEM) can be used (Kenny et al., 2006).

Most APIM studies examine how the actor and partner effects might change depending on characteristics of the dyad members and of their relationship. This article reviews the methodologies available to achieve this goal by focusing on how an additional variable interacts with actor and partner variables—the moderation of actor and partner effects. For example, a researcher might want to know if

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the effect of the partner's X on the person's Y is stronger or weaker depending on whether the person is the husband or the wife, how long the dyad members have known each other, or how close each feels toward each other. Although many APIM studies have investigated the moderation of actor and partner effects, to date there has not been a systematic description of the possible moderating effects for different types of dyadic variables, how these effects can be estimated and tested, and, importantly, how these effects can be simplified to make them more theoretically meaningful. We shall see that researchers often have difficulty measuring and testing moderation, and we hope that our framework might aid them in future analyses.

The initial goal of this article is to present a typology of the types of APIM moderation, a typology that largely depends on the type of dyadic variable that the moderator is (i.e., within, between, or mixed—a distinction that is fully discussed below). We shall also explain how these moderator effects can be estimated, interpreted, and tested using both SEM and MLM. Finally, we outline different patterns of moderating effects. For example, do the actor and partner effects increase in strength at an equal rate the longer romantic couples have been together? Or is the actor effect stable while the strength of the partner effect increases as the relationship develops? Finding patterns can simplify the model, increase statistical power, and, most importantly, aid researchers in understanding the theoretical meaning of these moderation effects. We refer to the APIM with moderation as the actor–partner interdependence moderation model (APIMoM).

We adopt here the standard assumption that the moderation is linear—the change in actor or partner effects is constant across levels of the moderator variable. This type of moderation can be tested through the use of product terms, for example, actor variable times the moderator. Whenever product terms are included in the model, it is presumed that the "main effects" of the terms used to form the product variable (and all lower order terms) are also included in the model. To aid in the interpretation of interaction effects and to reduce collinearity, it is helpful to center the moderator and other predictors (i.e., subtract the mean from all scores before computing the product), or have zero be a plausible and interpretable value for the moderator and predictors (Aiken & West, 1991).

Typology of APIM Moderation

Our typology of moderator effects is based on the different types of dyadic variables (Kenny et al., 2006). The moderator variable can be a within-dyads variable, a between-dyads variable, or a mixed variable. A within-dyads variable varies only within dyads (i.e., every dyad has the same average score but each member might have a different score). For example, percent talking time is a within-dyads variable, as well as percentage of housework completed by each member. A prototypical within-dyads variable is gender in heterosexual couples or role in mother–child dyads. In fact, if there is a distinguishing variable, it is necessarily a dichotomous within-dyads variable. For example, Millings and Walsh (2009) studied how gender moderated heterosexual couples' actor and partner effects of attachment style on the quality of social support provided. In this study, gender is a within-dyads moderator variable and it is also a distinguishing variable. Many APIM studies focus on the interaction of a distinguishing variable with actor and partner effects—referred to simply as a distinguishable dyads model. Although not typically thought of this way, an APIM with distinguishable dyads is an APIM moderation model where the moderator is within dyads. For example, Jackson and Beauchamp (2010) studied how the role of coach versus athlete moderated actor and partner effects of self-efficacy on satisfaction in the coach–athlete relationship—that is, the partner effect of self-efficacy on satisfaction was larger for coaches than for athletes. In their study, role (coach vs. athlete) is a dichotomous within-dyads moderator variable, and it is also a distinguishing variable.

For a between-dyads variable—sometimes called a *level-two variable* in MLM—both members have the same score, and thus the scores vary between dyads but not within dyads. For example, Cillessen, Jiang, West, and Lazkowski (2005) found for same-sex friends that the effect of positive social behavior on friendship security changed depending on the gender of the friendship pair. Gender, in this example, is a between-dyads moderator. Other potential between-dyads moderators include length of the relationship and number of children in the household.

Mixed variables vary both between *and* within dyads. When a mixed variable is used in an APIMoM, there are two moderator variables, one for each of the dyad members. For example, Vinkers, Finkenauer, and Hawk (2011) studied how trust, a mixed dyadic variable, moderated the effects of disclosure on snooping behavior in newlywed couples. Note that in this example there are potentially two moderators, how much the person trusts his/her spouse (actor moderator) and how much the person's spouse trusts him or her (partner moderator).

In the following sections, we consider moderators that are within dyads, between dyads, and mixed. For each of the cases below, we describe the model that is estimated and what terms in that model capture moderation effects. We explain how each model can be estimated by using MLM and SEM. The analyses in the illustrations below are completed with SEM—MLM versions of these analyses are available in Appendix S1 (available in the online Supporting Information and at davidakenny.net/papers/APIMoM/tech.pdf). In addition, extended details about the models and both SEM and MLM syntax with output are also presented in Appendix S1.

Dichotomous within-dyads moderator (distinguishable dyads)

The simplest form of moderation in the APIM is when dyad members are distinguishable. For example, in heterosexual married couples, one member is always a man and the other member is always a woman. There are two actor and two partner effects: one actor and one partner effect for each of the two members. Said another way, the actor and partner effects may be moderated by the distinguishing variable—a within-dyads variable. For the heterosexual married couples example, the husband and wife would each have an actor effect and there is one partner effect from the husband to the wife and another from the wife to the husband. In this article, we adopt the convention that the partner effect refers to the Y variable. So the husband to wife partner effect is called the *wife partner effect* and wife to husband partner effect is called the *husband partner effect*.

The distinguishable dyads model can be estimated by either MLM or SEM. For MLM, a pairwise data set (see Kenny et al., 2006, for a description of this structure) is created and a single equation is estimated for both dyad members with own X and partner's X as predictors. Nonindependence is modeled either as a random intercept at the level of the dyad or by the correlation of errors. When using MLM, the interaction of the distinguishing variable with the actor and partner effects tests the moderating effects. The model for person i in dyad j with gender as the distinguishing variable, denoted as G (e.g., gender), which acts as a moderator, is

$$Y_{ij} = b_0 + b_1 X_{ij} + b_2 X'_{ij} + b_3 G_{ij} + b_4 X_{ij} G_{ij} + b_5 X'_{ij} G_{ij} + e_{ij}, \tag{1}$$

where X is the actor variable, X' is the partner variable, b_0 is the intercept, b_1 is the coefficient of X_{ij} on Y_{ij} (actor effect), b_2 is the coefficient of X'_{ij} on Y_{ij} (partner effect), b_3 is the gender difference in Y_{ij}, b_4 is the actor interaction with gender, b_5 is the partner interaction with gender, and e_{ij} represents the residual term. If the interaction between gender and the actor variable, b_4, is statistically significant, then the actor effect for husbands is statistically different from the actor effect for wives. That is, gender moderates the actor effect. For instance, Millings and Walsh (2009) tested the interaction of actor's attachment avoidance and gender on compulsion to give care, and found that the negative actor effect of avoidance on caregiving was stronger for husbands than for wives. Likewise, the interaction of gender and the partner variable, b_5, indicates the difference in the two partner effects.

For SEM, a dyad data set (see Kenny et al., 2006) is created and members are denoted as

Persons 1 and 2 (e.g., Person 1 is the coach and Person 2 is the athlete). The APIM is defined by two structural equations, one for Y_1 and one for Y_2. Both X_1 and X_2 predict Y_1 and Y_2, the paths from X_1 to Y_1 and from X_2 to Y_2 being actor effects and the paths from X_2 to Y_1 and from X_1 to Y_2 being partner effects. Nonindependence in the X and Y variable is commonly estimated by a correlation between the two X variables and between the residuals of Y_1 and Y_2, respectively. Note that in SEM the two predictor variables are Person 1's X and Person 2's X, whereas in MLM the predictor variables are actor and partner variables. The equation for Person 1 is

$$Y_1 = b_0 + a_1X_1 + p_1X_2 + e_1, \qquad (2)$$

and for Person 2, it is

$$Y_2 = b_1 + p_2X_1 + a_2X_2 + e_2. \qquad (3)$$

This model is saturated and so has 0 *df*. Note that a_1 and a_2 are the actor effects and p_1 and p_2 are the partner effects. To test statistically whether paths are equal across levels of the distinguishing variable, the two actor or two partner paths are set equal to each other and that equality constraint is evaluated by the change in fit of the model. For instance, Lawrence et al. (2008) used SEM to study the effects social support solicited on relationship satisfaction in heterosexual couples. To test if the actor and partner effects of support solicitation were different across husbands and wives, they constrained the two actor paths and the two partner paths to be equal and tested whether there was a significant decrease in model fit.

Regardless of whether MLM or SEM is used, it is essential in the distinguishable case to statistically evaluate whether actor and partner effects are different for the two members, something that is quite often overlooked. All too often researchers present only the two actor and two partner effects, and interpret any difference as meaningful without presenting statistical evidence that they are different. In contrast, with distinguishable dyads, it is problematic when only a single actor and a single partner effect is reported without ever explicitly reporting whether they are in fact statistically the same for the two types of dyad members.

There are several reasons why it is important to test for the equality of actor and partner effects. First, it is the result from this test that permits the researcher to claim moderation. Showing that only one actor effect (or partner effect) is statistically significant and the other is not does not demonstrate that the actor (or partner) effects are statistically different from each other. That is, a statistical test is required to show that the effects are different. Second, if the effects are not different, then it makes sense to compute a single actor or partner effect because the test of that single effect has more power than the test of the two effects separately.

A within-dyads moderator need not be a dichotomy but could be a continuous variable such as the percent time speaking. However, every within-dyads moderator variable that we found in the literature was a dichotomy. Should one have a continuous within-dyads moderator, one can use the analysis strategy for a between-dyads moderator that we discuss next.

Between-dyads moderator

Indistinguishable dyads

The second type of potential moderator of the APIM is a variable that varies only between dyads—a between-dyads moderator. Examples of this type of moderator include the gender of same-gender friendship pairs (Cillessen et al., 2005) and the reciprocity of friendship in pairs of children (Adams, Bukowski, & Bagwell, 2005)—that is, children nominated each other as friends (reciprocal friendship), or nominations were one-sided (nonreciprocal friendship). When a between-dyads moderator is included in an analysis of indistinguishable dyads, there are two potential moderating effects: moderation of the actor effect and moderation of the partner effect. The magnitude of the effect of the actor's X on the actor's Y may depend on the level of the between-dyads variable, and the effect of the partner's X on the actor's Y may depend on the between-dyad moderator. For example, Cillessen et al. (2005) found that the effect of self-rated prosocial behavior on friendship security was larger when the friends were female than when they were male, an example of an actor effect being moderated by a between-dyads variable. The partner effect can also be moderated by a between-dyads variable. For example, Adams et al. (2005) tested whether the reciprocity of the friendship moderated the influence of prior aggression on partner's aggression measured 6 months later.

When there is a between-dyads moderator, again, either MLM or SEM can be used to estimate this model. When using MLM, two interaction terms are included in the model—the interaction of the moderator and the actor variable, XM, and the interaction of the moderator and the partner variable, $X'M$. That is, as in the model with a within-dyads moderator, there are three main effects and two interaction effects. The significance tests of these interactions evaluate the null hypothesis that the actor and partner effects do not change depending on values of the between-dyads moderator.

When using SEM to estimate a model with a continuous between-dyads moderator, two interaction terms need to be added to the model: the interaction of the moderator with X_1 (X_1M) and the interaction of the moderator with X_2 (X_2M). As shown in Figure 1, there are then four moderation effects: the effect of X_1M on Y_1 or am_1 (*a*ctor effect by the *m*oderator for Person 1), the effect of X_2M on Y_2 or am_2 (*a*ctor effect by the *m*oderator for Person 2), the effect of X_2M on Y_1 or pm_1 (*p*artner effect by the *m*oderator for Person 1), and the effect of X_1M on Y_2 or pm_2 (*p*artner effect by the *m*oderator for Person 2). Note the first two are actor moderation effects and the second two are partner moderation effects. Because the dyad members are indistinguishable, the equality constraints of $am_1 = am_2$ and $pm_1 = pm_2$ need to be imposed (as well as all the other equality constraints on the means, variances, and intercepts for Persons 1 and 2; see Olsen & Kenny, 2006, for details).

Distinguishable dyads

If dyad members are distinguishable and there is a between-dyads moderator, then the distinguishable dyads model discussed above expands to four moderation effects. For example, using gender in heterosexual couples as the distinguishing variable, the between-dyads variable can moderate the actor and partner effects for women and for men thus producing the four moderator effects:

1. the woman's actor effect moderated by the between-dyads variable (am_1 in Figure 1),
2. the woman's partner effect moderated by the between-dyads variable (pm_1),
3. the man's actor effect moderated by the between-dyads variable (am_2), and
4. the man's partner effect moderated by the between-dyads variable (pm_2).

For example, Stroud, Durbin, Saigal, and Knobloch-Fedders (2010) found that the positive actor and partner effects of a person's negative emotions on marital dissatisfaction were reduced by length of marriage for both husbands and wives.

Typically a key question in an analysis of distinguishable dyads with a between-dyads moderator is whether the moderation of the actor or partner effects is the same for the two members, moderation of the between-dyad effect by a within-dyad moderator. When using MLM, the differences across levels of the distinguishing variable in the between-dyads moderation effects are included in the model as two three-way interactions of the moderating variable, M; the distinguishing variable, G; and the actor variable, X, or the partner variable, X': XGM and $X'GM$. In addition, the two-way interactions and the main effects are included in the model. The tests of the two three-way interactions indicate whether the between-dyads moderator differentially moderates the actor and partner effects across levels of the distinguishing variable.

For SEM, the products of the moderator with X_1 and X_2 are added to the model (X_1M and X_2M in Figure 1), and the paths from each of these products to the outcome variables yield two different moderator effects for each person. By imposing equality constraints on the interaction effects (paths), the appropriate tests of differential moderation across dyad members can be obtained. For instance, to test if

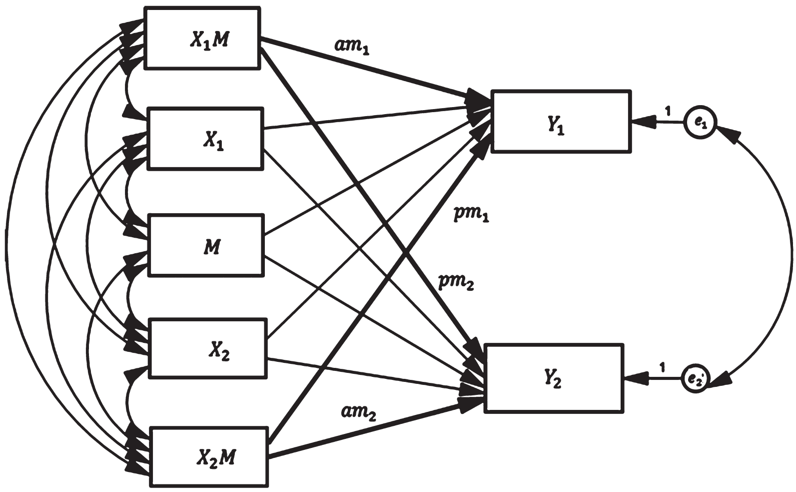

Figure 1. Structural equation model for actor–partner interdependence model with a between-dyads moderator.

actor moderation is the same for both members, the path from X_1M to Y_1 or am_1 and the path from X_2M to Y_2 or am_2 are set equal, and then model fit is assessed. Such a test is equivalent to the test of the actor by moderator by distinguishing variable interaction, *XGM*, when using MLM.

Mixed moderator

The moderation effects in the APIM become more complicated when a mixed variable is used as a moderator. If the moderator is mixed, there are then two potential moderators of the actor and partner effects. We refer to one as the *actor moderator*, which is the person's own score on the moderator (or when the moderator variable and outcome variable are from the same person in SEM models), and we refer to the other is as the *partner moderator*, which is the person's partner's score on the moderator (or when the moderator variable and outcome variable are from different persons in SEM models). So, for instance, in examining the effect of hostile marital behavior on depressive symptoms, a person's own warmth, an actor moderator, might moderate the actor and partner effects of hostile martial behavior on his or her depressive symptoms; the partner's warmth, a partner moderator, might also moderate these effects (Proulx, Buehler, & Helms, 2009). Note that in SEM the same variable can be either an actor or a partner moderator depending on which person's outcome variable it is pointing to (see Figure 2). For example, M_1 is an actor moderator when X_1M_1 or X_2M_1 affect Y_1, and the same M_1 is a partner moderator when X_1M_1 or X_2M_1 affect Y_2. In Figure 2, the actor by actor moderator interaction for Person 1 is denoted as *aam1* (*a*ctor–*a*ctor *m*oderator—Person *1*) and the actor by partner moderator for Person 1 is denoted as *apm1* (*a*ctor–*p*artner *m*oderator—Person *1*).

Because both the *X* variable, hostile behavior in the example above, and the moderator are mixed variables, the researcher can decide to flip the two,[1] for instance, make hostile marital behavior the moderator and warmth the *X* variable: A person's own hostile behavior can alter the actor and partner effects of warmth on change in depressive symptoms, and his or her partner's hostile behavior can alter these effects. These two formulations are statistically equivalent, but often one way makes more sense theoretically or empirically.

1. For instance, for the mixed moderator example discussed later in this article, we initially had depressive symptoms as the moderator and work–family conflict as the predictor. When we flipped the two, the interpretation of the interaction became clearer.

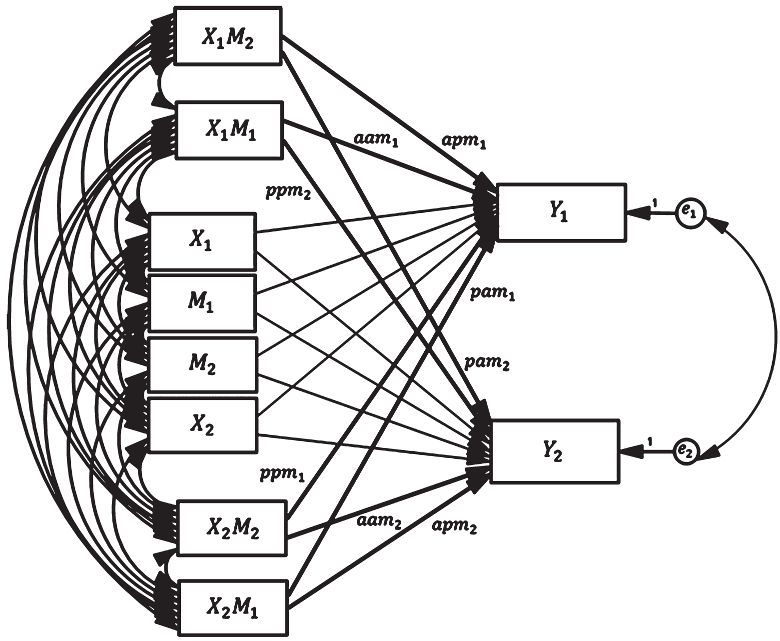

Figure 2. Structural equation model for actor–partner interdependence model with a mixed moderator.

Indistinguishable dyads

In the indistinguishable case, two separate moderation variables are included in the model: the actor's moderator variable and the partner's moderator variable. For MLM, four two-way interaction terms are added to the model—the interaction of the actor moderator with both the actor and partner variables or MX and MX' and the interaction of the partner moderator with both the actor and partner variables or $M'X$ and $M'X'$. These four interaction terms are in addition to the main effects that also need to be in the model. The tests of the four interaction terms determine whether the actor or partner moderators significantly change the direction and/or magnitude of the actor and partner effects.

Using SEM, this inclusion adds four paths (see Figure 2) to the model:

1. the actor effect moderated by the actor's moderator variable ($X_1M_1 \rightarrow Y_1$ and $X_2M_2 \rightarrow Y_2$),
2. the actor effect moderated by the partner's moderator variable ($X_1M_2 \rightarrow Y_1$ and $X_2M_1 \rightarrow Y_2$),
3. the partner effect moderated by the actor's moderator variable ($X_2M_1 \rightarrow Y_1$ and $X_1M_2 \rightarrow Y_2$), and
4. the partner effect moderated by the partner's moderator variable ($X_2M_2 \rightarrow Y_1$ and $X_1M_1 \rightarrow Y_2$).

To estimate these moderating effects, four two-way interactions of X_1M_1, X_2M_1, X_1M_2, and X_2M_2 are added as predictors in the model (see Figure 2). The four interactions each have two paths—one to Y_1 and the other to Y_2—and appropriate equality constraints must be made to take into account indistinguishability (see Appendix S1 for details). Tests of the paths from the interaction terms evaluate the four different moderator effects.

Although with a mixed moderator there are two moderators, either for theoretical or methodological reasons, an investigator might choose to examine just one of the two. For example, Barelds and Dijkstra (2009) examined in their study of romantic couples if age moderates the effect of positive illusions on relationship quality. For theoretical reasons, they used only the actor's age as moderator and did not include partner's age. This choice, while theoretically driven, had the added benefit of reducing a complex model. In the section on patterns below, we discuss how simplifications can be evaluated systematically and statistically.

Distinguishable dyads

The most complex APIMoM involves distinguishable dyads and mixed moderators. In the distinguishable case, there are two actor effects and two partner effects. If the moderating variable is mixed, then one may have the actor's score on that variable as well as the partner's score on that variable moderating each of the four base distinguishable effects for a total of eight interaction effects added to the model. Using gender as the distinguishable variable, the eight interaction effects are as follows:

1. the woman's actor effect moderated by the woman's moderator variable,
2. the woman's partner effect moderated by the woman's moderator variable,
3. the woman's actor effect moderated by the man's moderator variable,
4. the woman's partner effect moderated by the man's moderator variable,
5. the man's actor effect moderated by the man's moderator variable,
6. the man's partner effect moderated by the man's moderator variable,
7. the man's actor effect moderated by the woman's moderator variable, and
8. the man's partner effect moderated by the woman's moderator variable.

To estimate these eight moderating effects using MLM, a model that includes four three-way interaction terms needs to be estimated. These four interaction terms are XGM, $X'GM$, XGM', and $X'GM'$. The significance test for XGM indicates whether the moderation of the actor effect by the actor moderator is different across levels of the distinguishing variable, while the test for $X'GM$ indicates if the moderation of the partner effect by the actor moderator is different across levels of the distinguishing variable. The significance tests for XGM' and $X'GM'$ indicate if the moderation of the actor and partner effects by the partner's moderator is different across levels of the distinguishing variable.

For SEM, the four interactions of the two moderators with actor and partner effects are added as predictors: X_1M_1, X_2M_1, X_1M_2, and X_2M_2 (see Figure 2). Because dyad members are treated as distinguishable, their effects on Y_1 and Y_2 are allowed to differ, which results in a total of eight possible interaction effects. To test if the moderation is significantly different across levels of the distinguishing variable, the parameters for the two relevant interaction effects can be set equal across levels and a χ^2 difference test can be used. For example, in a model with actor variable–actor moderator interaction terms, X_1M_1 and X_2M_2, Bodenmann, Ledermann, and Bradbury (2007) examined whether marital satisfaction moderated the effect of daily stress on sexual activity differentially for husbands and wives.

As was the case with mixed moderators and indistinguishable dyads, using only the actor's score on the mixed moderator variable is more common in past research than using only the partner's score on the moderator, or both the actor's and the partner's scores. For example, Caughlin and Afifi (2004) examined whether for dating couples the negative effect of trying to avoid certain discussion topics—such as sex, relationship issues, and past negative events—on relationship satisfaction (actor effect) was reduced by the actor's motivations to protect the relationship (actor's moderator variable). With such complex models, finding patterns among these moderation effects can be crucial for making theoretical sense of the results and simplifying the model. We now focus on detailing and estimating such patterns.

Simplifying Moderation Effects: Finding Submodels

As we have seen, these moderation models can become quite large, which has two negative side effects. First, large samples are required to detect substantial effects. Second, the discussion of the results can be overwhelming. Finding patterns among the moderation effects can help to reduce this complexity and aid in the theoretical understanding of the results.

In addition, the individual tests of moderation have lower statistical power than simplified models implying specific patterns.

The strategy that we discourage is the trimming of nonsignificant moderator effects (i.e., only statistically significant interactions are retained and nonsignificant ones are dropped) without considering specific patterns among the effects. One problem with trimming is that tests of moderation are typically low in statistical power (McClelland & Judd, 1993). Consider the case of a mixed moderator with distinguishable dyads for which there are eight moderator effects. It might be the case that all eight of these effects equal approximately the same value—the actor and partner effects for both members of dyad change the same amount across levels of both members moderator variables. Even if the estimates of the coefficients are all about the same, given likely low power, a few might be significant and most not. However, the test that the eight effects equal the same value would have more power, be simpler and more parsimonious, and would likely be more conceptually meaningful—such a pattern might point to a highly interdependent process. Another problem is that trimming capitalizes on chance. For instance, in a situation in which there are four independent tests and all parameter estimates equal the same value, each with a power of .5, the probability that all four would be significant is only .0625, which is the same probability that none of them are significant. However, the test of the null hypothesis that they all equal the same value has a power of approximately .975. Well-informed hypotheses about a pattern are much more likely to yield meaningful results than piecemeal tests of multiple moderator effects. The patterns described in this section can guide these hypotheses.

First, we describe the four basic theoretically relevant APIM patterns before detailing how these patterns play out in moderation models. Kenny and colleagues (Kenny & Cook, 1999; Kenny & Ledermann, 2010) discussed in detail the patterns among actor and partner effects in the basic APIM—the patterns in Table 1. In Table 1, the role refers to the type of dyad member, and the a's and b's represent the nonzero effect estimates in the model. There are two roles for distinguishable dyads (e.g., males and females), but only one role for indistinguishable dyads. Within each column, identical letters signify that those two effects are assumed to be of equal magnitude, and the signs of the letters indicate if the effect estimates have the same or opposing directions. When two a's or two b's are in the same column, then they are the same sign and magnitude, except where indicated by a negative sign. Each dyad member can have either of four specific patterns: an actor-only model, a partner-only model, a couple-level model, or a contrast model. The actor-only model (the first column of Table 1) appears when only the actor's X variable influences one's own outcome but not the partner's X variable (i.e., the actor affect is different from 0 and the partner effect is 0), whereas the partner-only model (second column of Table 1) indicates that only the partner's X variable influences the person's outcome (i.e., the actor affect is 0 and the partner effect is different from 0). The couple model (third column of Table 1) is where both actor and partner effects are present (both are "a" in Table 1), of equal magnitude and in the same direction. The contrast model (last column of Table 1) is when the partner effect is of equal but opposite sign to the actor effect. This pattern implies either the actor's variable has a positive effect on some outcome whereas the partner's variable has a reducing effect on that outcome or the actor effect is negative and the partner effect is positive and relatively equal magnitude.[2]

The alternative strategy to trimming that we recommend is the testing of the four theoretically relevant patterns. Tables 1–3 show the patterns for models with a dichotomous within-dyads moderator (distinguishable dyads), a between-dyads moderator, and a mixed moderator, respectively. The specific patterns are found in each column and the

2. It is possible that there might be a pattern with a distinguishable variable where the effects refer to one member of the dyad. For instance, with gender as the distinguishing variable, it might be that the moderator interacts with actor and partner effects for males and not females or vice versa. See Appendix S1 for more detail about these patterns.

Table 1. *Patterns of basic models for distinguishable dyads (dichotomous within-dyads moderator)*

Effect	Actor only	Partner only	Couple	Contrast
Role 1				
Actor	a	0	a	a
Partner	0	a	a	−a
Role 2				
Actor	b	0	b	b
Partner	0	b	b	−b

Note. Roles 1 and 2 distinguish between the two types of dyad members in distinguishable dyads. The a's and b's represent nonzero effect estimates and if two values are the same, both a or both b, they are set equal. If dyad members are indistinguishable, then a = b, and only the top half of the table is necessary.

rows contain the effect estimates for the interaction term in the row header. Table 1 gives the patterns for the basic actor and partner effects, while Tables 2 and 3 show the patterns possible among the between-dyads and mixed moderation effects, respectively. Just as there are actor-only, partner-only, couple, and contrast patterns for the actor and partner effect, we shall see that there are analogous patterns among the moderation effects. Next we discuss patterns of moderation effects for models with a between-dyads moderator; then we discuss patterns for mixed moderators.

Between-dyads moderator

Indistinguishable dyads

If there is a between-dyads moderator with indistinguishable dyads, there are two potential moderation effects because between-dyads variables are by definition the same for both partners of the dyad—moderation of the actor effect and moderation of the partner effect. The upper half of Table 2 presents the different patterns of moderation results for indistinguishable dyads. Reading the columns of Table 2 from left to right, we might find that only the actor effect is moderated by the between-dyads variable (the actor-only moderation model), only the partner effect is moderated (the partner-only moderation model),

Table 2. *Patterns of moderation models for distinguishable dyads with a between-dyads moderator*

Moderation effect	Actor only	Partner only	Couple	Contrast
Role 1				
Actor by moderator	a	0	a	a
Partner by moderator	0	a	a	−a
Role 2				
Actor by moderator	b	0	b	b
Partner by moderator	0	b	b	−b

Note. If dyad members are indistinguishable, then a = b and only the top half of the table is used. The a's and b's represent nonzero effect estimates and if two values are the same, both a or b, they are set equal.

both the actor and partner effects are moderated, and these interaction effects are of equal sign and similar magnitude (the couple moderation model), or both the actor and partner effects can be moderated by the between-dyads variable and these effects are of opposite sign but similar magnitude (the contrast moderation model). For example, Cillessen et al. (2005) found the actor-only moderation pattern—only the actor effect of prosocial behavior on security was moderated by gender. The actor-only moderation pattern points to a process where only within-person effects are sensitive to the moderator, whereas in the partner-only moderation pattern the interdependence of the couple is what is sensitive to changes in levels of the moderator. However, the specific theoretical implications of the pattern depend on the size of the actor and partner effects and the direction of the moderation—that is, does an increase in the moderator amplify or dampen the actor and partner effects?

It is important to note that these four models in Table 2 refer to patterns between the two interaction effects, and not the main actor and partner effects as in Table 1. The main effects may have a completely different pattern from the moderation effects. We discuss the

Table 3. *Patterns of moderation models for distinguishable dyads with a mixed moderator*

Moderation effect	Actor M only	Partner M only	Couple M	Contrast M	Actor X only	Partner X only	Couple X	Contrast X
Role 1								
Actor X by actor M	a	0	a	a	a	0	a	a
Partner X by actor M	b	0	b	b	0	a	a	−a
Actor X by partner M	0	a	a	−a	b	0	b	b
Partner X by partner M	0	b	b	−b	0	b	b	−b
Role 2								
Actor X by actor M	c	0	c	c	c	c	c	c
Partner X by actor M	d	0	d	d	0	d	c	−c
Actor X by partner M	0	c	c	−c	d	c	d	d
Partner X by partner M	0	d	d	−d	0	d	d	−d

Note. If dyad members are indistinguishable, then a = c and b = d and only the top half of the table is used. The a's, b's, c's, and d's represent nonzero effect estimates and if two values are the same, both a, both b, both c, and both d, they are set equal.

estimation and testing of the four patterns using SEM and MLM later in this article.

Distinguishable dyads

If a between-dyads moderator is added to the distinguishable case, the same theoretical patterns can arise among the interaction terms as discussed for indistinguishable dyads. Those models again are the actor-only moderation model, the partner-only moderation model, the couple, and the contrast moderation models (see Table 2). As was the convention earlier, if both the actor and partner effects are moderated similarly (same sign and magnitude) this is called the *couple moderation model*, and when the actor and partner effects are moderated to a similar magnitude but in an opposite direction by the between-dyads moderator this is called the *contrast moderation model*.

When dyads are distinguishable, there may be a different pattern for each member of the dyad. For example, it may be the case that there is an actor-only moderation pattern for one member of the dyad and a partner-only moderation pattern for the other. For example, the effect of her work stress on her marital satisfaction goes up the longer the couple is married but the effect of his work stress on her satisfaction is not affected by the marital duration, whereas (actor only) the effect of the husband's work stress on his marital satisfaction stays stable and the effect of the wife's work stress on the husband's marital satisfaction (his partner effect) increases the longer they are married (partner only). Alternatively both members' partner effects could be moderated in a similar way, or there could be moderation for only one member, or the two members' partner effects could be moderated in opposite directions. Stroud et al. (2010) found couple moderation models for both members of married couples—husbands' and wives' own and their partners' negative emotions had less of an impact on their martial dissatisfaction as the length of the marriage increased.

Mixed moderator

When the moderator is mixed, there are two moderator variables—the actor moderator variable and the partner moderator variable. We discuss moderation first for indistinguishable dyads and then for distinguishable dyads.

Indistinguishable dyads

With a mixed moderator the four patterns—actor only, partner only, couple, and contrast—can occur for both the actor and partner X variables and the actor and partner moderators. The upper half of Table 3 contains the patterns for the indistinguishable, mixed moderator case. In the actor *M* only model, both the actor and partner effects change across levels of the actor's moderator variable, but the partner's moderator variable does not moderate either effect. Alternatively, in the actor *X* only, the actor effect is moderated by both the actor and partner moderator variables but the partner effect is not moderated by either variable. In sum, in the actor *M* only model, actor and partner effects change across levels of the actor moderator, whereas in the actor *X* only model the actor effect changes across levels of both the actor and partner moderators. In the partner *M* only model, only the partner's moderator variable moderates both the actor and partner effects, and in the partner *X* only model, the partner effect is moderated by both the actor and partner moderator variables, but the actor effect is not moderated by either variable. In addition, there are two couple models and two contrast models for the mixed moderator indistinguishable dyads case.

In the couple *M* model, the actor and partner effects are both moderated to a similar degree by the actor's moderator variable, and the actor and partner effects are both moderated to a similar degree by the partner's moderator variable, but these last two moderation effects may be different from the first two moderation effects. In the couple *X* model, the actor effect is moderated to a similar magnitude and in the same direction by both the actor and partner moderator variables, and the partner effect is moderated to a similar magnitude and in the same direction by both the actor and partner moderators. In the contrast *M* model, the partner effect is moderated by each of the two moderators to a similar magnitude but in the opposite direction as the actor effect, whereas in the contrast *X* model, the moderation of the actor effect by the actor and partner moderator variables is equal in magnitude but in the opposite direction. The partner effect is also moderated by the actor and partner moderator variables in a contrast pattern, but the moderation of the partner effect can be a different strength compared to moderation of the actor effect.

Not contained in Table 3 are combinations of patterns for *X* and *M*. For instance, the study might result in an actor *M* only model—only the actor's moderator is used—with a contrast model for *X*—the actor and partner effects are moderated to the same extent but in the opposite direction by the actor moderator. We might first select the best fitting model for the four ways of conceptualizing the moderator: actor *M* only, partner *M* only, couple *M*, and contrast *M*. If dyad members are distinguishable, this would be done separately for each member. Then one would estimate the four models for the effect of *X*: actor *X* only, partner *X* only, couple *X*, and contrast *X*. A table with all of the possible combinations of *X* and *M* models can be found in Appendix S1.

Although these models might seem abstract, many of these patterns can be found in the extant literature. For example, Vinkers et al. (2011) found that newlyweds' perceptions of their partners' low disclosure increased their snooping to the extent that they distrusted their partners. In this study, only the actor effect was moderated by the actor's moderator variable corresponding to either the actor moderator-only model or the actor-only model. So both *X* and *M* had actor-only patterns.

Distinguishable dyads

As can be seen in Table 3, the two dyad members may have the same moderation pattern (e.g., both members have a couple *X* pattern—their actor and partner effects are moderated in the same direction and magnitude by each moderator). Even if both members have the same pattern, the size of the effects could be different across members. Alternatively, each member of the dyad can have a separate moderation model. For example, the first dyad member can have the partner-only moderation model, whereas the second member has the actor-only moderation model, such as in Caughlin and Huston (2002) where they found that the effect of the husband's demand/withdrawal pattern on both spouses' marital satisfaction was moderated by the wife's expression of affection, but the effect of the wife's demand/withdrawal pattern was not. This is an actor *X* only–partner *M* only pattern for husbands and a partner *X* only–actor *M* only pattern for wives.

Basic Strategy for Testing Patterns in Moderation Models

We propose the following general three-step strategy for testing moderation. Step 1 is to determine if dyads are distinguishable in terms of moderation, assuming that we have distinguishable dyads. We need to show that distinguishability matters among the moderation effects. We do this by testing if the moderation effects vary across levels of the distinguishing variable with an omnibus test. If the result of this test indicates no differences in moderation across levels of the distinguishing variable, then we can test for moderation patterns as if the dyad members were indistinguishable in the moderation effects. Note that even if the moderation effects are found to be indistinguishable, the actor and partner effects themselves might still be distinguishable.

Step 2, assuming that we do find distinguishability on the moderation effects, is to find the best pattern for both members of the dyad. There are two ways to accomplish this. First, most parsimoniously we test whether there is the *same* pattern for the two members but that pattern varies in strength. For instance, for a between-dyads moderator, we might have a couple pattern for both members but it is stronger for wives than for husbands. Thus, for a between-dyads moderator, the four models in Table 2 would be estimated, and the best fitting (see criteria below) model would be selected. Alternatively for a mixed moderator, the first four models in Table 3 would be estimated, and the best fitting M model would be selected for the moderator, and then the next four models in Table 3 would be estimated, and the best fitting X model would be selected for the X variable. Second, we might want to allow for there to be a different pattern for each of the two members. For instance, there might be a couple pattern for wives and a contrast pattern for husbands. To accomplish this efficiently, we might find the best pattern for one member while assuming an unrestricted model for the other member, then reverse the process for the other member—thus, finding the best fitting pattern for each member separately. The choice between these two options should be clear from the unrestricted estimates obtained from the models estimated in the first step; however, one needs to be careful to avoid capitalizing on chance especially when different models are chosen for the two members. If different patterns are chosen, there should be a theoretical rationale for this choice. Step 2 is simpler if dyad members are indistinguishable or we find that we have the same pattern for both members. We just find the best fitting pattern for X and for M if the moderator is mixed.

Finally, Step 3 is to choose the best fitting model. When testing for a pattern, ideally four things should happen if it is the best pattern: First, the candidate pattern model should fit as well as the model in which there are no restrictions on the coefficients (i.e., all moderator effects free), a model called the *unrestricted model*. If the candidate model does not fit as well as the unrestricted model (it never fits better as it is necessarily a simpler model), then the more complicated unrestricted model must be chosen. Second, the model fit of the candidate pattern model should be better than the fit of a model that assumes no moderation at all (i.e., all moderator effects set to 0). Third, the coefficient(s) for the pattern should be robust, which is ordinarily determined by a test of statistical significance. Fourth, the fit of the candidate pattern model should be the best relative to the fit of the other plausible pattern models. We refer to these as the *four criteria* of a good-fitting pattern model.

For a fit index, we suggest using the sampling-error-adjusted Bayesian information criterion (SABIC) for which smaller values indicate better model fit. We use the SABIC because it can be used for saturated models, something that is not possible for other fit indices (e.g., the root mean square error of approximation). Not all programs calculate SABIC, but it can be calculated given the χ^2 statistic as $\chi^2 + \ln[(N+2)/24)][p]$, where ln is the natural logarithm, N is the number of dyads, and p is the number of free parameters in the model. If MLM is used, maximum likelihood estimation should be used (and not the default estimation method of restricted maximum likelihood) and χ^2 is replaced by the deviance, that is, $-2 \times$ Log Likelihood (sometimes labeled as -2LL).

To estimate the couple and contrast models, two different strategies are available. First, some MLM programs (e.g., HLM and SAS) and all SEM programs allow the user to place contrasts or equality constraints on the coefficients.[3] Second, one can have the actor and partner variables interact with the sum of the actor and partner moderators for the couple M model or the difference between the actor and partner variables for the contrast M model. For instance, for the couple M model the sum of the two moderator variables in the mixed moderator example, or $M_1 + M_2$, is computed, and this term interacts with the actor and partner variables. For the contrast M model, the difference score, $M_1 - M_2$, interacts with the actor and partner variables. Furthermore, if these interaction terms are statistically different across levels of the distinguishing variable, then there is a different couple or contrast model for the two dyad members. If it is not statistically different but the interaction term of the sum or contrast is, then the two dyad members have the same model.

Illustrations

We illustrate the application of the APIMoM first with a between-dyads moderator and second with a mixed moderator. We use data from The 500 Family Study (1998–2000: United States; Schneider & Waite, 2008), which investigated middle class, dual-career families living in the United States. For both illustrations, we used SEM, but we could have just as easily used MLM.

Between-dyads moderator

For the model with a between-dyads moderator, we used happy with role responsibility as the outcome variable, depressive symptoms as the predictor, and time living together as the moderator. The variable happy with role responsibility, measured by the item "I am very happy with how we handle role responsibilities in our relationship," could range from 1 (*strongly disagree*) to 5 (*strongly agree*). The depressive symptoms were assessed by the Center for Epidemiologic Studies Depression Scale (CES–D; Radloff, 1977), which has a theoretical range of 0–60 with higher scores indicating more depressive symptoms. We divided the variable years lived together by 10 to turn it into decades together—it ranged from 0.08 to 3.35 decades. There were 290 heterosexual couples who provided complete data for the example variables. We centered the moderator and predictors using the mean across both husbands and wives for depression ($M = 7.70$), and the mean for decades together ($M = 1.75$).

Unrestricted model

Treating the dyads as distinguishable, we estimated first the saturated or unrestricted model whose estimates are presented in Table 4. We see that all four actor and partner effects are negative and statistically significant. People who are more depressed and who have more depressed partners report that they are less happy with their role responsibility. When we examine the pattern of moderating effects of decades together, we see that three of the four interactions are negative, the one positive effect being the interaction of husband's actor effect by the moderator. The negative effects indicate that the longer a couple has been together, the stronger the negative effect of his or her depression on his or her happiness. The positive effect suggests that the longer the partners have been together, the greater the effect of his depression on his happiness with role responsibility. Three of the four moderation effects are statistically significant, the one not significant being the interaction of the wife's partner effect by the moderator.

Submodels

Table 5 includes estimates of the interaction effects and fit statistics for the unrestricted model and the submodels. First, we fitted a model with all interaction effects set to 0. The

3. Some SEM programs (e.g., Amos) do not allow the constraint required by the contrast model and a phantom variable (Rindskopf, 1984) is needed to force that constraint. A phantom variable is a latent variable without a disturbance that is added to a model to force some sort of constraint, but it has no theoretical interpretation. For more details, on how phantom variables can be used to estimate the contrast model, see Appendix S1.

Table 4. *Unrestricted model with a between-dyads moderator*

Effect	Coefficient	*SE*	*p*
Intercept			
Husband	4.036	0.053	<.001
Wife	3.734	0.065	<.001
Actor effects of depression			
Husband	−0.032	0.008	<.001
Wife	−0.026	0.009	.006
Partner effects of depression			
Husband	−0.018	0.008	.021
Wife	−0.036	0.009	<.001
Decades together			
Husband	−0.026	0.072	.717
Wife	−0.001	0.088	.988
Actor depression by decades			
Husband	0.024	0.010	.019
Wife	−0.031	0.011	.005
Partner depression by decades			
Husband	−0.023	0.009	.011
Wife	−0.014	0.012	.244

Note. $N = 290$ couples. The outcome variable is happiness with role responsibility.

fit of this model was poor, which indicates that time living together moderates the effects of depressive symptoms on happiness with role responsibility. Following the strategy outlined above, we first tested whether the two interactions differed by gender by fitting a submodel with the interaction effects set equal across partners. This model was not consistent with the data—that is, the interactions were not the same for husbands and wives, $\chi^2(2) = 13.535$, $p = .001$. We conclude that there is moderation by gender, or said another way, there is distinguishability in the moderation effects.

We then tested the four patterns in Table 2, which have the same pattern for husbands and wives but differing in magnitude, and did not find a good fit for any of them. Thus, we allowed for different patterns for wives and husbands. The estimates of the interaction effects suggest a couple pattern for wives and a contrast pattern for husbands. Table 5 also includes results for these patterns: the wife couple model (husband unrestricted), the husband contrast model (wife unrestricted), and finally the wife couple with husband contrast model. Using our four criteria, we see that the wife couple–husband contrast model is the best fitting model. It has the smallest SABIC, its coefficients are statistically significant, it fits as well as the unrestricted model, better than the model with no moderation coefficients, and better than other plausible pattern models. The structural equation of this simpler model for wives is

$$\hat{Y}_w = 3.740 - 0.025X_w - 0.032X_h - 0.005M - 0.023MX_w - 0.023MX_h, \quad (4)$$

and for husbands it is

$$\hat{Y}_h = 4.037 - 0.032X_h - 0.018X_w - 0.027M + 0.021MX_h - 0.021MX_w. \quad (5)$$

For wives, the longer the couple has lived together, the stronger the negative effect of her own and his depression on her happiness. However, for husbands, the pattern is different. The longer the two have lived together, the greater the effect of her depression relative to his depression on his happiness.

As seen in Figure 3, depression of either spouse has little or no effect on the wife's happiness with role responsibilities when the relationship is new, but as decades together increases both her depression and his depression have negative effects on her happiness. Similarly, for husbands, when the couple is newlywed, his wife's depression has little effect on his happiness but as decades together increases her depression has more of a negative effect on his happiness. Interestingly, in the early stages of marriage the husband's own depression has a negative effect on his happiness with role responsibilities, but as time goes on the effect of his depression on his happiness goes to zero.

Mixed moderator

For the model with a mixed moderator, we used marital satisfaction as the outcome, degree of depressive symptoms as again the predictor,

Table 5. *Moderation submodels with the distinguishable dyads with a between-dyads moderator*

	Effect interacting with decades together				Fit			
Model	Wife actor by moderator	Wife partner by moderator	Husband actor by moderator	Husband partner by moderator	χ^2	*df*	*p*	SABIC
Unrestricted	−0.031**	−0.014	0.024*	−0.023*	—	0	—	87.45
Interaction effects zero	0	0	0	0	19.922	4	.001	97.38
Indistinguishable interaction effects	−0.001	−0.018*	−0.001	0.018*	13.535	2	.001	95.99
Wife couple, husband unrestricted	−0.023**	−0.023**	0.021*	−0.021*	0.953	1	.329	85.91
Husband contrast, wife unrestricted	−0.031**	−0.014	0.023***	−0.023***	0.002	1	.962	84.96
Wife couple, husband contrast	−0.023**	−0.023**	0.021**	−0.021**	0.954	2	.621	83.41

Note. $N = 290$ couples. SABIC = sampling-error-adjusted Bayesian information criterion.
*$p < .05$. **$p < .01$. ***$p < .001$.

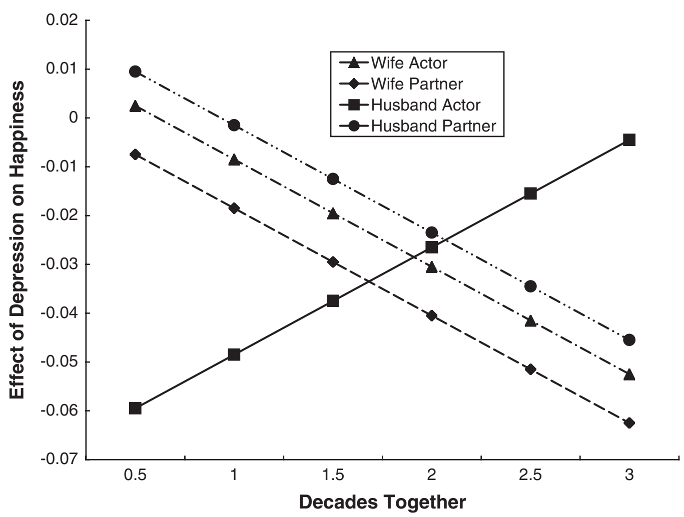

Figure 3. Actor and partner effects of depression on happiness for wives and husbands as a function of the number of decades together.

and work–family conflict as the moderator. Marital satisfaction was assessed by the ENRICH Marital Inventory (Olson, Fournier, & Druckman, 1983). The composite score of the 15 items could range from 15 to 50, with higher scores reflecting higher satisfaction. Depressive symptoms were again measured by the CES–D. A total of 218 heterosexual couples provided complete data on the variables. Work–family conflict was assessed by the item “How often do you feel that work roles and family roles conflict?” rated on a 5-point scale with a range of 0 (*never*) to 4 (*almost always*). We centered both the predictor and moderator using the mean across husbands and wives ($M = 8.07$ and $SD = 6.972$ for husbands' and 6.542 for wives' depression and $M = 2.31$ and $SD = 0.715$ for husbands' and 0.895 for wives' work–family conflict).

Unrestricted model

First, we estimated the unrestricted model treating the dyads as distinguishable (see Table 6). For the depressive symptoms, both actor effects and partner effects on satisfaction are negative and statistically significant, with actor effects somewhat larger than partner effects. That is, husband's and wife's satisfaction seem to be negatively affected by one's own and the partner's depressive symptoms. For the moderator, the actor effect of husband's work–family conflict is negative and statistically significant, which means that the higher the husband's work–family conflict, the lower his satisfaction with the relationship. None of the other actor and partner effects for work–family conflict are statistically significant.

Of the eight interaction effects, three are statistically significant: Both the wife's actor and partner effects of depression are moderated by her work–family conflict, and the husband's partner effect of depressive symptoms is moderated by the wife's work–family conflict. That is, the effect of wife's depression and her partner's depression on her marital satisfaction depends on her own work–family conflict, whereas the effect of the wife's depression on the husband's satisfaction depends on her level of work–family conflict.

Submodels

The fit measures and interaction estimates of various models are in Table 7. First, we tested whether constraining the four interactions to be the same for men and women would reduce the fit of the model. We found that the fit of this simpler model was poor, $\chi^2(4) = 15.935$, $p = .003$. This indicates that we have distinguishability in moderation—evidence that there is a difference in moderation patterns between men and women.

Table 6. *Unrestricted model with a mixed moderator*

Effect	Coefficient	*SE*	*p*
Intercept			
Husband	37.173	0.418	<.001
Wife	36.441	0.423	<.001
Actor effect			
Husband	−0.372	0.059	<.001
Wife	−0.457	0.064	<.001
Partner effect			
Husband	−0.271	0.063	<.001
Wife	−0.197	0.060	.001
Moderator actor effect			
Husband	−1.219	0.580	.036
Wife	0.204	0.470	.664
Moderator partner effect			
Husband	0.164	0.464	.725
Wife	−0.831	0.587	.157
Actor X by actor M			
Husband	0.117	0.083	.157
Wife	0.294	0.069	<.001
Partner X by actor M			
Husband	−0.070	0.092	.444
Wife	−0.210	0.068	.002
Actor X by partner M			
Husband	−0.076	0.067	.257
Wife	−0.161	0.093	.083
Partner X by partner M			
Husband	0.268	0.069	<.001
Wife	−0.059	0.084	.480

Note. $N = 218$ couples. Y = marital satisfaction; M = depressive symptoms; X = work–family conflict.

Next, we tested that the same specific patterns held for husbands and wives but to a different extent by fitting the eight patterns in Table 3. The best fitting model, nearly as good as the unrestricted model, was a contrast model for the X. Thus, we used as the predictor variable the difference between a person's depression and his or her partner's depression—a contrast X model. However, none of the four patterns for the M (work–family conflict) had anywhere near an adequate fit. Thus, we allowed for a different pattern for husbands and wives for the M variable. As

Table 7. *Estimates and fit statistics for the moderation submodels with a mixed moderator*

	Effect								Fit			
Submodel	Actor X by actor M (husband)	Actor X by actor M (wife)	Actor X by partner M (husband)	Actor X by partner M (wife)	Partner X by actor M (husband)	Partner X by actor M (wife)	Partner X by partner M (husband)	Partner X by partner M (wife)	χ^2	df	p	SABIC
Unrestricted model	0.117	0.294***	−0.076	−0.161	−0.070	−0.210**	0.268***	−0.059	—	0	—	144.01
Interaction effects zero	0	0	0	0	0	0	0	0	36.66	8	<.001	162.95
Indistinguishable interaction effects	0.227***	0.227***	−0.114*	−0.114*	−0.178**	−0.178**	0.143*	0.143	15.94	4	0.003	151.08
Wives contrast X and actor-only M, husband contrast X and M model	0.132**	0.223***	−0.132**	0	−0.132**	−0.223***	0.132**	0	11.93	6	0.064	142.64

Note. $N = 218$ couples. SABIC = sampling-error-adjusted Bayesian information criterion.
*$p < .05$. **$p < .01$. ***$p < .001$.

described in the Analysis Strategy section, the patterns that we chose were based on models that were plausible, given the estimates from the unrestricted model. The estimates of the interaction effects suggest the following: an actor *M* only for the wife and contrast *M* pattern for the husband both with a contrast *X* pattern. We tested this combination of patterns and found evidence for it. Using again our four criteria, we found that this model is a better fitting model than the unrestricted model, which tells us that a model with just two interaction effects fits as well as a model with eight. We also see in Table 7 that the model fits better than a model with no interactions. Moreover, the two effects in the model are statistically significant. Finally when we compared the models to other models (not shown in Table 7), its fit was always better.

The equation of this model for wives is

$$\begin{aligned}\widehat{Y}_w = {} & 36.428 - 0.453X_w - 0.216X_h \\ & + 0.114M_w - 0.829M_h + 0.223X_wM_w \\ & - 0.223X_hM_w - (0)\,X_wM_h + (0)\,X_hM_h,\end{aligned} \tag{6}$$

and for husbands

$$\begin{aligned}\widehat{Y}_h = {} & 37.284 - 0.385X_h - 0.257X_w \\ & - 1.098M_h + 0.055M_w + 0.132X_hM_h \\ & - 0.132X_hM_w - 0.132X_wM_h \\ & + 0.132X_wM_w.\end{aligned} \tag{7}$$

Figures 4 and 5 illustrate how own and partner's depression affect marital satisfaction as a function of the work–family conflict. In both figures, we see that at low levels of work–family conflict (for wives their own work–family conflict, whereas for husbands their own work–family conflict relative to their wives' work–family conflict), the actor effect is large and the partner effect is small. But as work–family conflict increases, we see a decline in the strength of the actor effect and an increase in the strength of the partner effect. So at high levels of work–family conflict, it is partner depression that affects satisfaction, not own depression. In Figure 4, we see for wives that when she experiences high levels of work–family conflict (1 *SD* above the mean), it is the level of couple depression that leads to less satisfaction (actor effect: $b = -0.253$, $p < .001$; partner effect: $b = -0.416$, $p < .001$), but if she experiences low levels of work–family conflict (1 *SD* below the mean), it is only her depression that leads to lower levels of satisfaction ($b = -0.653$, $p < .001$) and not her husband's depression ($b = -0.016$, $p = .827$). In Figure 5, we see for husbands that when he experiences the same level of work–family conflict as his wife, it is the level of couple depression (i.e., actor: $b = -0.385$, $p < .001$; partner: $b = -0.257$, $p < .001$, effects equal) that leads to less satisfaction, but if he experiences low levels of work–family conflict relative to his wife (1 *SD* below equal), it is only his depression that leads to lower levels of satisfaction (actor effect: $b = -0.662$, $p < .001$; partner effect: $b = 0.020$, $p = .098$). If his work–family conflict is much higher than his wife's (1 *SD* above equal), then it is her depression that leads to lower satisfaction for him (actor effect: $b = -0.108$, $p = .335$; partner effect: $b = -0.534$, $p < .001$).

Extensions

We can allow for more complicated moderation models, and one possibility would be to add nonlinear (e.g., moderator squared) terms to the model (Aiken & West, 1991). In addition to only linear effects, this article considered only normally distributed outcomes. Theoretically one could estimate all pattern models with non-normal (e.g., dichotomous, count) outcomes as well by using a program that allows for them. When using SEM the program Mplus allows for non-normal outcomes and the program HLM as well as more recent versions of SPSS allow for non-normal outcomes with MLM. Another interesting addition would be to use latent variable modeling to reduce measurement error in the actor and partner variables and the moderator(s). Although computationally intensive, SEM programs allow for estimating interaction effects between two latent variables or a latent variable and a manifest variable. With the goal of describing systematically how moderation can be incorporated into the APIM, we have

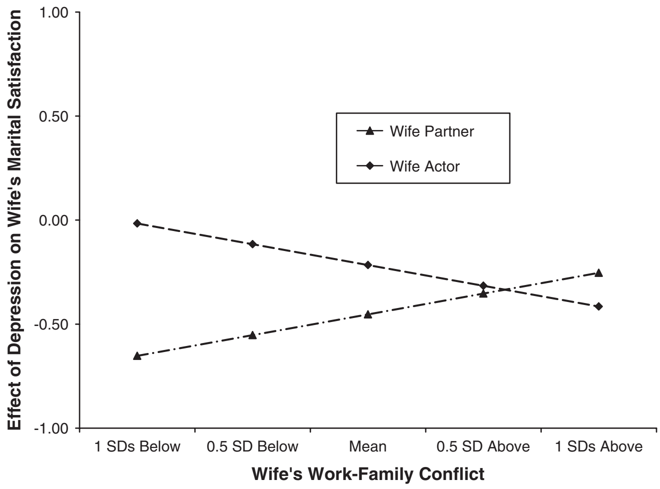

Figure 4. Wife's actor and partner effects of depression on marital satisfaction as a function of the wife's work–family conflict.

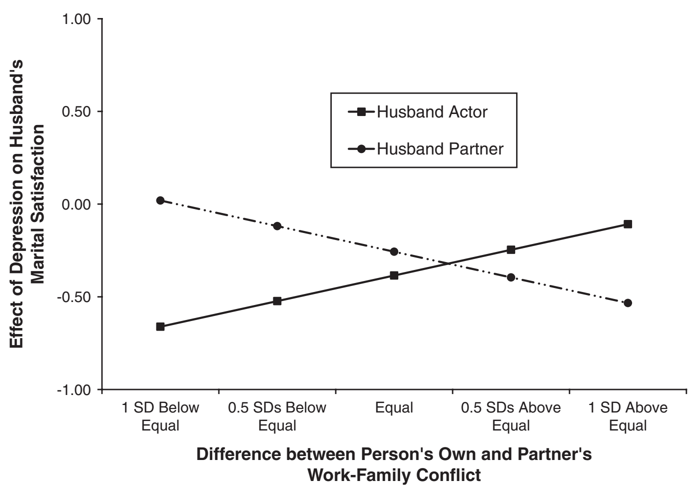

Figure 5. Husband's actor and partner effects of depression on marital satisfaction as a function of the difference in his own depression and her depression.

limited the models presented to include a single X, Y, and M. As with any model, we can make it more complicated by adding more variables—additional moderators and covariates. Furthermore, Ledermann, Macho, and Kenny (2011) describe in detail how mediation models can be tested within the APIM. Combining these two models, we also could have added moderated mediation or mediated moderation. No doubt the reader is grateful that we have not added these complications, but they could each, in principle, be added.

It is customary in a discussion about moderation to address the testing of simple slopes, or the effects of one variable at specific values of the moderator. Thus far we have not emphasized testing simple slopes because our focus was on considering all of the moderation effects at once to arrive at a theoretically meaningful pattern among these effects. However, simple slopes are indeed an important part of any moderation analysis (Aiken & West, 1991). Some of the effects tested and discussed in the article are in fact simple effects.

For example, the interaction of actor depression and work–family conflict on satisfaction is tested at both levels of the distinguishing variable (i.e., for husbands and for wives). This two-way interaction was further broken down for husbands and wives—the effect of depression on satisfaction was estimated for husbands and wives at high and low levels of work–family conflict.

This article emphasized looking at patterns among all moderation effects, but we want to reiterate that there indeed might be a theoretical or methodological reason to include only a subset of moderation effects in the model. For instance, we can imagine the utility of including only partner moderators for methodological reasons.[4] An actor moderator might share method variance with the outcome and by only using a partner moderator that confound would be eliminated. It is important to remember that we should not be eliminating moderation effects purely on the basis of individual significance tests without first considering the patterns among the effects.

Because our focus was on moderation effects, we have not emphasized the main effects in these models. Patterns can be found among the main effects just as with the moderation effects and it may be theoretically important to determine if the main effects pattern is consistent with moderation patterns. For example, if the moderator effects show a couple model, then perhaps the main effects are also couple level. One way patterns among the main effects have been summarized is to use a parameter that Kenny and Ledermann (2010) have proposed: k is the ratio of the partner effect to the actor effect. When k is 1 we have couple-level model, k equal to -1 is a contrast model, and k equal to 0 is an actor-only model. Just as with the main effects, for moderation k can be used to place constraints on the interaction coefficients. For example, for an indistinguishable model with a between-dyads moderator, we can define k as the ratio of the partner effect to the actor and k_M as the ratio of the interaction effect of XM to the effect of $X'M$. Defining k_M allows us to then test if $k = k_M$, that is, test if the pattern of actor and partner effects change across levels of the moderator. More detail on the use of k_M is given in Appendix S1.

The reader should not confuse tests of patterns of moderation with testing behavioral patterns in dyads over time. Although we have discussed in detail how to find patterns among moderation effects, this should not be confused with being able to test for patterns in behavior. These more complicated patterns established over time (Cox & Paley, 1997) or of reciprocity within a dyad (Rusbult & Van Lange, 2003) might be most appropriately tested with repeated measurements of dyads over time. The APIM can also be used to test these models (Laurenceau & Bolger, 2012), but this was not our focus in this article. In these models, time would be a moderating variable and we might find some of these moderation patterns with time.

Conclusion

We have provided helpful information about this important but neglected topic. Most APIM articles examine moderation—even by simply including a distinguishing variable—and we hope that we have provided the tools to make this effort easier and the possibilities of these models clearer.

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Supporting Information

Additional Supporting Information for this article may be found in the online version of this article and on the first author's website at http://bbs.utdallas.edu/pairlab/materials/.

Appendix S1. Technical Appendix.