Web Appendix for Analyzing the Effects of Group Members’ Characteristics: A Guide to the

Group Actor-Partner Interdependence Model

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**GAPIM-D.** For dyadic outcomes (e.g., how similar person $i$ feels towards person $j$ in group $k$), the GAPIM decomposes diversity into seven group composition variables and each of these variables might have a separate effect on perceptions of similarity, there are seven effects of gender (our example variable) composition on feelings of similarity: three main effects and four interactions.

1) The *actor variable* denoted as $X_{ik}$, is an effect coded variable with men coded as 1 and women coded as -1.

2) The *partner variable* is denoted as $X_{jk}$ and it is also effect coded.

3) The *others’ variable* is denoted as $X_{ijk}$ which is the average of the others genders which have also been effect coded.

4) Actor by partner interaction or how similar actor $i$ is to partner $j$; we refer to this interaction as *dyad similarity*; note that it equals 1 when $i$ and $j$ are both men or women and –1 when one is a man and the other a woman; we denote this variable as $I_{ijk}$ which equals $X_{ik}X_{jk}$. The variable measures whether the actor and partner are same gendered or not.

5) Actor by others interaction or how similar person $i$ is to the other $n – 2$ members of the group; we refer to this as *actor similarity*; this variable equals 1 when the person has the same gender as the other $n – 2$ persons in the group and –1 when the person is of a different gender; we denote this variable as $I_{i,k}$ and it measures how similar gender is between the actor and the others.
6) Partner by others interaction or how similar person \( j \) is to the other \( n - 2 \) members of the group; we refer to this as partner similarity; note that this variable equals 1 when the partner has the same gender as the other \( n - 2 \) persons in the group and \(-1\) when the partner is of a different gender; we denote this variable as \( I_{jk} \) and it measures how similar the partner is to the others.

7) Interaction of all pairs of the others’ effects or how similar the other \( n - 2 \) are to each other, a total of \((n - 2)(n - 3)/2\) dyads; we call this variable the others’ similarity and denote it as \( I_{ijk}' \) and it measures how similar the others are to each other.

The Complete Model with all seven effects is

\[
Y_{ijk} = b_0 + b_1X_{ik} + b_2X_{jk} + b_3X_{ijk}' + b_4I_{ijk} + b_5I_{i,k} + b_6I_{.jk} + b_7I_{ijk}' + e_{ijk}
\]

where \(X_{ijk}'\) is the mean of all \(X\)s in group \(k\) besides persons \(i\) and \(j\). Thus, if person \(i\) is a man, person \(j\) is woman, and the other members of the group were all women, then \(X_{ik}\) would equal \(+1\), \(X_{jk}\) would equal \(-1\), and \(X_{ijk}'\) would equal \(-1\). The coefficient \(b_1\) is the actor effect—the person making the judgment’s gender and measures if being male or female affects judgments of similarity; \(b_2\) is the partner effect—the gender of the person being judged, and measures whether the person being judged affects similarity judgments; and \(b_3\) is the group effect—the gender of the other group members or whether the gender of the others affects similarity judgments. These three main effects interact in four ways, these are the four interaction terms which are in the equation above: \(b_4\) is the dyad similarity effect—the similarity in gender of the two dyad members of when the actor and partner have similar genders, is there a greater perception of similarity; \(b_5\) is the actor similarity effect—the similarity in gender of the judge to the rest of the group (except the person being judged) results in greater perception of similarity to the target; \(b_6\) is partner similarity—the similarity in gender of the person being judged to the others in the
group (expect the judge) results in greater perceptions of similarity; and lastly, $b_7$ is the effect of the other’s similarity—the similarity in gender of the others in the group to each other affect perception of similarity.

For the GAPIM with dyadic outcomes there are a large number of submodels we can test. Here we present six of these models and a demonstration of how they are tested can be found in Example 3. These six models are 1) the Norm Model, 2) the Diversity Model, 3) the Person Fit Model for the actor, 4) the Person Fit Model for the partner, 5) the Us against Them Model and 5) the Dyad Model. First, the Norm Model sets all of the main effects equal by using a weighted average of the four main effect terms. This model implies that it is the group norm, or mean, on the composition variable that matters for the outcome. The Diversity Model sets all for interaction effects equal. This model implies that if the four interaction terms were aggregated into a measure of group diversity, the fit of the model would not suffer. Such a model is implicitly assumed by researchers who typically test diversity. The Person Fit Actor Model, posits that the important similarity variables are actor similarity, the effect of the actor’s similarity to the others, and dyad similarity. Together these variables represent the actor’s similarity to everyone else in the group and are proposed by those who test the relational demography hypothesis. Analogously, what might be most important in perceiving one’s partner to be similar to one’s self might be how similar the partner is to the others in the group and not the actor’s similarity. This model is referred to as the Person Fit Partner Model. A model that might be particularly relevant in inter-group studies is the Us against Them Model: The actor and partner are similar to each other but different from the others in the group who are all similar to each other. When this effect is at its maximum, the actor and partner are the only two persons in the group with the same identity. Lastly, we introduce a new submodel, not previously
considered by Kenny and Garcia (2012), the Dyad Model. This model includes only those terms
that involve the actor and partner and not the others: the main effect of actor, the main effect of
partner, and dyadic similarity. This model says that it is only the dyad that is important for
perceptions of similarity; the others in the group do not matter.

Example 3

The example uses group data collected at the University of Connecticut in the fall of
2009. These data consist of groups with varying gender composition levels with each member
rating how similar he or she felt towards each other person in the group. This study tested the
effects of the GAPIM-D gender composition variables on similarity ratings.

Method

Participants. Group interaction data was collected from 58 groups of four to five
students. Gender composition varied across groups. Six groups were eliminated because one
person in their group had missing gender information. The remaining 52 groups had 4 and 5
members with 87 men and 154 women. The ages ranged from 17 to 22 with the average age
being 18.6. The sample included 24 Asian-Americans (10.0%), 11 Latinos (4.6%), 6
Black/African-Americans (2.5%), 195 White/European-Americans (80.9%), and 5 people
indicated Other (2.1%) as their ethnicity. In these 52 groups, 2 of the 888 round-robin rating of
similarity were missing resulting in 886 cases in the dyadic analyses of perceptions of similarity.

Procedure. Groups of four to five University of Connecticut students varying in gender
composition arrived at the lab. They were told that the researchers were looking at group
composition and interactions, and all necessary consents were obtained. It was necessary to
withhold that the hypothesis was explicitly about gender because I did not want to prime them
with gender stereotypes and expectations. If they are primed in such a way at the beginning of
the study, this priming may have influenced the way the composition of the group effects perceptions of other group members. They then filled out a short demographic questionnaire stating their gender, and to collect information about other potentially relevant characteristics such as race, sexual orientation, and religiosity. Because the sample was not very racially diverse (80.9% White), this study does not consider racial group composition, only gender composition.

For the group interaction portion of the study, the participants were shown a picture and asked to write an individual short story, three to four sentences, about what is going on or has happened in the picture. It was selected because of its relatively neutral content. Before composing their individual stories, they were informed that after this step, they will compile a story as a group of approximately the same length.

After their individual stories were complete, the experimenter asked the group to create one group story about the same picture. The experimenter then made it clear that the group can use the same ideas from the individual stories or entirely new ideas. Leadership was not assigned, and there was no requirement about whose individual ideas were to be incorporated into the final story. After they finished their group stories, the stories were collected and members were asked to complete a series of outcome measures. Round-robin ratings of feelings of similarity to each group member were given first.

**Results**

First the seven GAPIM-D effects of gender composition on dyadic perceptions of similarity are estimated. In addition, submodels of these composition effects are tested. MLM was used to estimate the effects in SAS. Because the main outcome, perceptions of similarity, was dyadic or round-robin (all group members rating all other group members) the usual Social Relations Model (SRM) variances (actor, partner, relationship—or error, and group) and
covariances (generalized reciprocity and dyadic reciprocity) were estimated along with the fixed effects of interest (Kenny, 1994; Kenny & Garcia, 2012). Model fit for each of the models tested is given by the Sample Size Adjusted Bayesian Information Criterion (SABIC), with smaller values indicating better model fit. The SAS syntax for computing the GAPIM-D variables and estimating all of their effects on a dyadic outcome with the appropriate random effects is in Appendix C.

**Random Effects.** Reported here are the random effect results from the Complete Model, as the results are essentially the same for the different submodels. Actor variance measures the extent to which some judgers see their partners as more similar than other judges see their partners, and so reflects either a bias to think others are similar or the fact that the person is similar to the others. Partner variance measures the extent to which some partners are seen as more similar to the judgers than other partners are seen by the judgers. Lastly, relationship variance measures how the judge uniquely views a partner as particularly similar. Because there was no statistically significant group variance (no group effect) in ratings of similarity, \( p = .897 \), this terms was removed from the model before any further analyses. There was statistically significant actor variance ( \( p < .001 \) ), which accounted for 27.48% of the variance in similarity scores; partner variance accounted for 18.12% ( \( p < .001 \) ) of the variance while relationship/error variance accounted for the other 54.40% ( \( p < .001 \) ) of the variance. There was statistically significant generalized reciprocity correlation, \( .168, p = .001 \), but no statistically significant dyadic reciprocity, \( .071, p = .302 \).

**Gender Composition and Perceptions of Similarity.** To test whether gender composition had an effect on perceptions of similarity, the seven GAPIM-D terms were used as predictors of the round-robin ratings of similarity: actor gender, partner gender, others gender,
dyadic similarity, actor similarity, partner similarity and others similarity. Estimates from the model with all 7 GAPIM-D effects (see Table X), which is referred to as the Complete Model, indicate that there was no statistically significant actor gender effect, $b = -0.062$, $t(254) = -0.97$, $p = .335$, and no statistically significant partner gender effect, $b = -0.008$, $t(558) = -0.15$, $p = .882$. The negative direction of these effects indicates that women (coded as -1) actors found their partners to be more similar to themselves and actors tended to find women more similar to themselves than men (coded as 1)—but these effects were not statistically different from zero. There was a marginally significant effect of others’ gender, $b = 0.172$, $t(237) = 1.66$, $p = .098$. This effect was in the positive direction which indicates that actors felt more similar to their partner when the others were more male. As expected there was a statistically significant effect of dyadic similarity in gender, $b = 0.120$, $t(717) = 2.46$, $p = .014$. If the actor and partner were same gendered, the actor felt more similar to the partner than when they were different genders. Dyadic similarity was the only statistically significant effect in this model. The three remaining effects were all positive indicating a general increase in perceptions of similarity as gender similarity in the group increased: actor similarity, $b = 0.020$, $t(390) = 0.23$, $p = .820$, partner similarity, $b = 0.003$, $t(513) = 0.04$, $p = .972$, and others’ similarity, $b = 0.038$, $t(664) = 0.56$, $p = .579$. The Complete Model had a lower SABIC ($= 2917.18$) than the Empty Model (SABIC $= 2923.30$) indicating that gender composition variables explain perceptions of similarity better than no predictors at all.

**Submodels.** Five submodels of the Complete Model were also tested. These five submodels are, 1) the Diversity Model, 2) the Person Fit Actor Model, 3) the Person Fit Partner Model, 4) the Us against Them model and 5) the Dyad Model. Because the sample used in this study contains groups with different sizes (i.e., some 4 person groups and some 5 person groups)
the predictors for these submodels are calculated with different weights across groups of varying sizes. This results in a situation in which the submodels are not necessarily nested within the Complete Model. Because of this fact, model comparisons will be made with the Sample Size Adjusted Bayesian Information Criterion (SABIC) and not with deviance difference tests. Smaller values of the SABIC indicate better fitting models. All model comparisons are contained in Table X.

The Diversity Model, which tests if the gender diversity of the whole group affects dyadic perceptions of similarity, found no statistically significant effect of gender diversity on similarity perceptions, \( b = -0.144, t(140) = -0.82, p = .415, SABIC = 2920.54 \). There was no significant effect of the person fit actor term in the Person Fit Actor Model, \( b = 0.141, t(529) = 1.25, p = .213, SABIC = 2921.17 \), or the person fit partner term in the Person Fit Partner Model, \( b = 0.130, t(330) = 1.30, p = .194, SABIC = 2920.77 \). Next, the Us against Them Model was tested. This model would be the best fitting model if actors felt more similar to their partners when they were closer to being the only two of their gender in the group. This was not the case, as there was no statistically significant effect of the Us against Them term in this model, \( b = 0.186, t(568) = 1.36, p = .174, SABIC = 2919.34 \). The last model, the Dyadic Model, contains only the actor gender, partner gender and dyadic similarity terms. That is, no terms involving the others are included in this model. As expected, the dyadic similarity term was again statistically significant in this model, \( b = 0.113, t(773) = 2.41, p = .016 \). Furthermore, the Dyadic Model is the best model according to the SABIC which was 2916.93 for this model. The Dyad Model is also a better fitting model than the Empty Model by the SABIC.

In summary, the best fitting model was a model that only contained terms that involve the two members of the dyad and none of the other group members.
Table 3

The GAPIM-D Effects for Gender Composition on Dyadic Perceptions of Similarity

<table>
<thead>
<tr>
<th></th>
<th>$b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor Gender</td>
<td>-0.062</td>
</tr>
<tr>
<td>Partner Gender</td>
<td>-0.008</td>
</tr>
<tr>
<td>Others Gender</td>
<td>0.172*</td>
</tr>
<tr>
<td>Dyadic Similarity</td>
<td>0.120*</td>
</tr>
<tr>
<td>Actor Similarity</td>
<td>0.020</td>
</tr>
<tr>
<td>Partner Similarity</td>
<td>0.003</td>
</tr>
<tr>
<td>Others Similarity</td>
<td>0.038</td>
</tr>
</tbody>
</table>

*Note. * $p < .05$, ** $p < .01$. Women were coded at -1 and men were coded as 1.*
Table 4

Comparison of GAPIM-D Submodels for the Effects of Gender Composition on Dyadic Perceptions of Similarity

<table>
<thead>
<tr>
<th>Model</th>
<th>Parameters&lt;sup&gt;a&lt;/sup&gt;</th>
<th>SABIC&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Deviance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Model</td>
<td>0</td>
<td>2923.30</td>
<td>2923.3</td>
</tr>
<tr>
<td>Complete Model</td>
<td>7</td>
<td>2917.18</td>
<td>2911.5</td>
</tr>
<tr>
<td>Diversity (I)</td>
<td>4</td>
<td>2920.54</td>
<td>2917.3</td>
</tr>
<tr>
<td>Person Fit Actor (II)</td>
<td>6</td>
<td>2921.17</td>
<td>2916.3</td>
</tr>
<tr>
<td>Person Fit Partner (III)</td>
<td>6</td>
<td>2920.77</td>
<td>2915.9</td>
</tr>
<tr>
<td>Us against Them (IV)</td>
<td>4</td>
<td>2919.34</td>
<td>2916.1</td>
</tr>
<tr>
<td>Dyad Model (V)</td>
<td>3</td>
<td>2916.93</td>
<td>2914.5</td>
</tr>
</tbody>
</table>

Note. <sup>a</sup> Number of fixed effect parameters not including the intercept. <sup>b</sup> Smaller values indicate better model fit.
Appendix C

SAS syntax for creating GAPIM-D variables, the matrix for constraints on the random effects, and for estimating the effects the GAPIM-D.

```sas
data dataset;
  set mydata;

  /***Syntax for GAPIM-D variables/***
  actgen
  prtgen
  grpgen
  dydsimgen
  actsimgen
  prtsimgen
  grpsimgen

  run;

data g5;
input parm row col value;
datalines;
1 1 1 1
1 2 2 1
1 3 3 1
1 4 4 1
1 5 5 1
2 6 6 1
2 7 7 1
2 8 8 1
2 9 9 1
2 10 10 1
3 1 6 1
3 2 7 1
3 3 8 1
3 4 9 1
3 5 10 1
4 11 11 1
;

Proc mixed data=dataset covtest method=ml;
  CLASS dyad groupid;
  model simrev= actgen prtgen grpgen dydsimgen actsimgen prtsimgen grpsimgen/s ddfm=SATTERTH notest;
  random a1 a2 a3 a4 a5 a6 p1 p2 p3 p4 p5 p6 intercept/g sub=groupid
    type=lin(4) ldata=g5;
  repeated /type=cs sub=dyad (groupid);
run;
```