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Thomas Ledermann[1] and David A. Kenny[2]

Abstract

When one gathers dyadic data, one is very often faced with the burdensome task of restructuring the data. For instance, the use of multiple regression analysis or structural equation modeling (SEM) requires one type of data structure, whereas multilevel modeling or multilevel SEM usually requires a different data structure. However, data are often entered in neither of these structures. In this article, we first describe the most typical dyadic data formats, what format the major data-analytic methods require, and then present a toolbox called restructure and describe dyadic data (RDDD) with programs that restructure dyadic data from one format into another. Moreover, the programs identify different types of dyadic variables and provide descriptive and inferential statistics that can be informative to dyadic researchers. The programs, written in R, provide a graphical user interface and are designed to work with minimal input information that is much less than standard restructuring procedures.

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There is a growing body of research that uses data gathered from both members of a dyad. A whole host of areas study dyads: marriage and dating partners, parent and child, co-workers, friends, supervisor and supervisee, and laboratory participants run in pairs. One example of the explosive growth in the number of articles using dyadic methods is that there are now over 600 articles that use the actor–partner interdependence model (APIM; Kenny, 1996) to study links between dyad members.

To analyze dyadic data, various data-analytic methods can be used (Kenny, Kashy, & Cook, 2006), including regression analysis, multilevel modeling (MLM), structural equation modeling (SEM), and multilevel SEM (MSEM). Each of these methods requires a specific data structure. MLM, for example, requires an individual or a pairwise data structure, whereas SEM usually requires a dyad data structure[1] (we provide details about these data structures below). We shall see that often the dyadic data are entered in a format that does not allow the particular analysis that the dyadic researcher intends to use.

This article describes programs for dyadic data analysis that are part of a toolbox called restructure and describe dyadic data (RDDD). These programs enable the restructuring of dyadic data into different formats and provide descriptive statistics, including means, standard deviations, minimum and maximum values, and correlations. The programs written in R (R Core Team, 2014) provide a graphical user interface and require a minimum of input information. To understand how to use these programs, we first provide the reader with some essential definitions of types of dyads, types of dyadic variables, and types of dyadic data structures.

Dyad members can be distinguishable or indistinguishable (Kenny et al., 2006). Two members of a dyad are said to be distinguishable if there is a categorical variable that can be used to distinguish the two members in a meaningful way, such as gender in heterosexual couples or generation in parent–child dyads. If there is a variable that uniquely distinguishes the two members of the dyad, that variable is called a *distinguishing variable*. Dyad members are said to be indistinguishable if there is no such variable that can be used to distinguish dyad members. Same-gender twins and homosexual couples are typical examples of indistinguishable members.

With dyadic data, there are three different types of variables, called *within-dyads*, *between-dyads*, and *mixed* variables (Kenny et al., 2006). The sum of the two scores of a within-dyads variable is the same value for every dyad. Examples of such variables that vary within but not between dyads are spouses' percentage of the total household income or the percentage of chores done by each spouse, assuming that the sum of the two percentages equals 100 for each dyad. For a between-dyads variable, both members of the dyad have the same score. Relationship duration and time spent together are typical examples of such variables that vary between but not within dyads. Mixed variables vary both within and between dyads. Examples are relationship satisfaction and personality variables.

Data from dyads are commonly organized in three different ways. The three data structures have been called *individual*, *dyad*, and *pairwise* structures (Kenny et al., 2006). Each of these data structures can be used for different analyses. In the individual structure, each record has the data for one dyad member, and for each variable, the two dyad members' measures are located in one variable. So, for instance, for the mixed

variable *satisfaction*, there would be one variable. If the variable is between dyads, then the two members would have the same score on the variable. In addition, a dyad identification variable is needed, which has one unique number or character for each member of the same dyad and so links the two members. If there were n dyads and q variables, there would be up to $2n$ cases and q variables in the individual structured data set. Table 1 illustrates an individual data structure with *dyad* as dyad identification variable and *person* as distinguishing variable. Although an individual structure is almost never used for dyadic data analysis, this structure is very often chosen when creating the data set. In addition, many publicly available dyadic data sets have an individual structure, such as the longitudinal study of generations (Bengtson, 2009), the 500 family study (Schneider & Waite, 2008), American couples (Blumstein & Schwartz, 1978), and preventing depression in couples facing job loss (Richard, Vinokur, Howe, & Caplan, 2004).

For a dyad structure, which is shown in Table 2 for the very same data as that for the individual data set in Table 1, each record has the information of both members of each dyad, and so the unit for this structure is the dyad, not the individual. With n dyads, q mixed and within-dyads variables, and p between-dyads variables (one possibly being the dyad identification variable), there would be n cases and $2q + p$ variables in the dyad data set. With this data structure, the variables measured in both members, the mixed and within-dyads variables, are entered twice. For instance, if the dyads were heterosexual couples, then the variable *satisfaction* would be in the data set twice, perhaps as Sat_H for husband's satisfaction and Sat_W for wife's satisfaction. Ordinarily, between-dyads variables would be entered just once. There are several publicly available data sets that use this format, including the Iowa Youth and Families Project (Conger et al., 2011) and the International Crisis Behavior Datasets (2010).

The pairwise structure, sometimes called *double entry*, is the most complex and least familiar format. It is shown in Table 3, again using the same data as before. For this structure, each record has the information about both members, which are denoted as the respondent (actor) and the partner of the respondent (partner of the actor). Indicated by the box, Table 3 contains exactly the same information as that for the individual data structure. Additionally, for the mixed and the within-dyads variables, the same variable is entered twice, once for the respondent and once for the partner. So if there is a variable *satisfaction* measured for both members, it might be coded as Sat_A and Sat_P, for the actor and partner, respectively. With n dyads, q mixed and within-dyads variables, and p between-dyads variables (one being the dyad identification variable), there would be $2n$ records and $2q + p$ variables in the pairwise data set. It is important to note that although both a dyad and a pairwise data structure have the same variable twice, for the dyad data structure the two variables refer to the two members (e.g., supervisor and supervisee), whereas for the pairwise data structure the variables refer to the respondent and his or her partner. So far as we know, no major publicly available data set is available in this type of format.

Different methods for dyadic data analyses require different data structures. Table 4 provides an overview for the many key dyadic analyses along with the required data structures. For many descriptive statistics, including means and standard deviations, each type of structure can be used. We note that any analysis that can be accomplished with an individual structure can also be accomplished by using a pairwise structure

Table 1. Example of an individual data structure.

Dyad	Person	Com	Sat	Dur
1	1	5	9	3
1	2	2	8	3
2	1	6	3	7
2	2	4	6	7
3	1	3	6	5
3	2	9	7	5

Note. Com = commitment; Sat = satisfaction; Dur = relationship duration.

Table 2. Example of a dyad data structure.

Dyad	Dur	Com_1	Sat_1	Com_2	Sat_2
1	3	5	9	2	8
2	7	6	3	4	6
3	5	3	6	9	7

Note. Com = commitment; Sat = satisfaction; Dur = relationship duration; 1 = Dyad Member 1; 2 = Dyad Member 2.

Table 3. Example of a pairwise data structure (box indicates an individual data structure shown in Table 1).

Dyad	Person	Dur	Com_A	Sat_A	Com_P	Sat_P
1	1	3	5	9	2	8
1	2	3	2	8	5	9
2	1	7	6	3	4	6
2	2	7	4	6	6	3
3	1	5	3	6	9	7
3	2	5	9	7	3	6

Note. Com = Commitment, Sat = Satisfaction, Dur = Relationship duration; A = Actor, P = Partner.

because a pairwise data set includes an individual structure (see the box in Table 4). To compare means and variances between distinguishable members, the use of the dyad structure is most straightforward. To analyze correlations, the dyad structure is most straightforward when dyad members are distinguishable, whereas in the indistinguishable case, the pairwise data structure is most straightforward, but the dyad structure can be used with SEM and the impositions of equality constraints (Olsen & Kenny, 2006). An often used measure for nonindependence is the intraclass correlation, which can be most easily obtained using an individual or a pairwise data structure (see Alferes & Kenny, 2009). For the analysis of associations between variables, two often-used methods of analysis are the APIM and the common fate model (CFM; Kenny & La Voie, 1985). The APIM can be analyzed by many statistical methods, including multiple regression and SEM, which require a dyad data structure, or MLM, which uses a pairwise

Table 4. Dyadic data analysis using different data structures.

	Individual	Dyad	Pairwise
Descriptive statistics	Yes	Yes	Yes
Correlations	No	Yes	Yes
ICC	Yes	No	Yes
APIM using MLM	No	No	Yes
APIM using SEM	No	Yes	No
APIM using MR	No	Yes	No
CFM using SEM	No	Yes	No
CFM using MSEM	Yes	No	Yes
MIM	No	Yes	No

Note. APIM = actor–partner interdependence model; CFM = common fate model; ICC = intraclass coefficient; MIM = mutual influence model; MLM = multilevel modeling; SEM = structural equation modeling; MR = multiple regression analysis; MSEM = multilevel SEM.

data structure. The CFM can be analyzed using SEM or MSEM (Ledermann & Kenny, 2012). SEM requires a dyad data structure, whereas MSEM requires an individual or a pairwise data structure. A third model is the mutual influence model (MIM; Kenny, 1996) that analyzes reciprocal effects between members. It requires the use of SEM and a dyad data structure. Because the APIM estimated by MLM is currently used in most analyses of associations between variables in dyadic research (Kenny & Kashy, 2014), researchers often face the task of creating a pairwise data set.

Typically, the format of the original data is of the either individual or dyad type. However, most often we need to restructure the data to put it in the proper format before we can analyze the data. Thus, data restructuring is a necessary but often a difficult task, especially when a pairwise data set is required. Most computer packages do have options to restructure data, but these methods are very often created for restructuring longitudinal data. However, the restructuring of dyadic data are very different, and the restructuring of an individual file into a pairwise file is very different from restructuring a dyad file into a pairwise file. We also know that some users use "cut-and-paste" methods to restructure dyadic data sets, which can easily lead to errors.[2] Thus, having a toolbox with programs that allows the user simply to go from one structure to another and distinguish between-dyads variables from mixed and within-dyads variables would be very useful. Additionally, none of the currently available methods provide any descriptive information, which our programs do provide. For instance, knowing which variables are mixed, between dyads, and within dyads can be very useful to a dyad researcher.

Programs to restructure dyadic data

There are three programs enabling the restructure of individual and dyad data sets and that are part of the toolbox RDDD. Each program produces two files, one with the restructured data set and the other with information about the variables in the data set. Two of the programs also provide extensive descriptive statistics. These two programs are ItoP, which changes an individual data set to a dyad data set, and ItoD, which changes

an individual to a dyad data set. The third program is DtoP, which changes a dyad to a pairwise or an individual data set.[3] All the programs provide a graphical user interface and can be downloaded from http://davidakenny.net/DyadR/RDDD.htm (to restructure the data directly without using the graphical interfaces, R code is available at http://thomasledermann.com/RDDD). The programs offer several options to the users and are relatively simple to use. Specifically, the programs identify variables that were measured for both members and variables that were measured for only one member and variables that are between-dyads variables. Currently, the programs can read a data set either in "sav" format (SPSS) or in "csv" format (comma separated text file). The restructured data and the text file are saved to locations that are designated by the user. The restructured data is saved as a "csv" file and the text output as a "txt" file. Although the programs are written in R and so R has to be installed on the computer, no knowledge of R is required for the user to run them but the installation of R and R packages. (Information on how to install the programs and R can be found on the website using the links above.) We now discuss each of the three programs, their data requirements, data input, and the output. Although the three programs are stand-alone programs, they are integrated into one single program called RDDD. Loading this program, users are first asked which of the three programs should be run and then enter the information required for the selected program.

ItoD

The program ItoD restructures an individual data set into a dyad data set and gives descriptive statistics for individuals and descriptive and inferential statistics for dyads.

Data requirements. The input data set is an individual data set that needs to contain a dyad identification variable and a distinguishing variable. If the name given for one of these variables is not in the input data set, the program gives a message and stops. There can be no more than two members per dyad, but some dyads may have the information from only one member. If any group has more than two members, the program gives a message and stops. All variables that are analyzed must be numeric variables; string variables are allowed but are not analyzed.

Inputs. The program ItoD produces the input screen contained in Figure 1 that displays the default values. The user tells the program the name and location of the data set as well as the names of the dyad identification and distinguishing variables in that data set. In addition, the user is asked for the suffixes that are to be added to the variables measured in both members to denote member A and member B. For instance, "_H" and "_W" might be added at the end to each mixed or within-dyads variables if husbands and wives were being studied. Alternatively, ".1" and ".2" could be used to distinguish the two members. The user can also provide an optional list of variables that are used as labels in the output text file. This list can include special characters and spaces, but the variables must be in the same order as the input data set. Additionally, the user designates the location and name of both the dyad data set and the text file to be created.
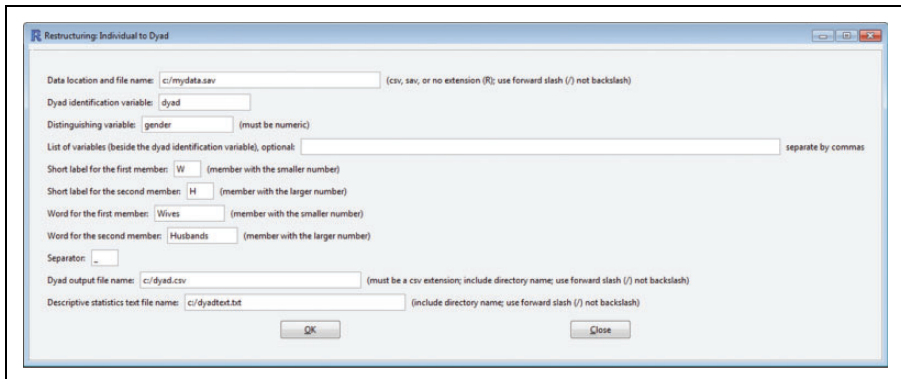
Figure 1. Graphical user interface for the ItoD program.

Output. The program creates two files. One is the restructured dyad data set which takes each mixed and within-dyads variable and adds a suffix for each of the two dyad members. Also included in the restructured data set are the between-dyads variables and the dyad identification variable (always the first variable in the restructured data set).

The second output file is a text file that provides the following descriptive information: the number of dyads and individuals of each type (both missing and list wise), whether each variable in the data set is between, within, or mixed, and which variables have no variance or fewer than five nonmissing cases. It also tells which variables might be used as distinguishing variables. Then for each variable, it provides the mean, standard deviation, minimum and maximum values, and the intraclass correlation across individuals. If there are missing data, it also gives the number of complete cases for that variable.

The program also produces both descriptive and inferential statistics for the dyad data set. For each mixed variable, the mean and standard deviation for each of the two members is provided and tests of the difference. Moreover, the Pearson correlation between the two members is given and tested for statistical significance. We present an example of the text file in Figure 2, which has one within-dyads variable (gender), one between-dyads, and five mixed variables.

ItoP

The ItoP restructures an individual data set into a pairwise data set and provides descriptive statistics of the variables in the data set.

Data requirements. As with the ItoD program, the input data set is an individual data set that has a dyad identification variable. Again, if the name given for the dyad identification variable is not in the input data set, the program gives a message and stops. Moreover, there can be no more than two members per dyad, but some dyads may not have information about the second member. If any group has more than two members,

Descriptive information for dyad dataset
The dataset c:/ai.sav has been transformed from an individual to a dyad dataset called c:/dyad.csv. The distinguishing variable is gender, and it has two levels, wives (−1) and husbands (1). There are 148 dyads and 296 individuals, 148 wives and 148 husbands. There are no missing data on any of the variables in the dataset.
There are 7 variables, 1 between-dyads variable, 1 within-dyads variable, and 5 mixed variables. The one between-dyads variable is years married, and the one within-dyads variable is gender. The within-dyads variable, gender, is a dichotomy and could be used as a distinguishing variable. The descriptive statistics for all the variables as individuals are contained in Table 1 and the descriptive and inferential statistics for the mixed variables are contained in Table 2.

Table 1: Descriptive statistics for individuals (all variables)

Variable	Mean	sd	Minimum	Maximum	Intraclass r
Years married	−0.000	7.707	−11.214	15.036	1.000
Gender	0.000	1.002	−1.000	1.000	−1.000
Self positivity	4.186	0.412	2.600	5.000	0.087
Other positivity	4.264	0.498	2.600	5.000	0.235
Satisfaction	3.605	0.496	1.167	4.000	0.618
Tension	2.431	0.687	1.000	4.000	0.319
Similar hobbies	0.078	0.646	−1.000	1.000	0.281

Table 2: Inferential and descriptive statistics for dyads (mixed variables)

| Variable | Mean | | | sd | | | | Pearson |
	Wives	Husbands	p	Wives	Husbands	p	r	p
Self positivity	4.291	4.082	<.001	0.409	0.390	.568	.157	.056
Other positivity	4.246	4.281	.490	0.523	0.474	.225	.234	.004
Satisfaction	3.591	3.618	.451	0.530	0.462	.034	.623	<.001
Tension	2.520	2.341	.006	0.709	0.655	.306	.340	<.001
Similar hobbies	0.189	−0.034	<.001	0.587	0.684	.052	.321	<.001

All calculations are based on 148 cases. Degrees of freedom for the test of mean difference are 147 and for the test of standard deviation difference and the test of the correlation are 146.

Figure 2. Text file example for ItoD.

the program gives a message and stops. All variables that are analyzed must be numeric variables; string variables are permitted but are not analyzed.

Inputs. The program ItoP produces the input screen contained in Figure 3 that displays the default values. The ItoP program asks for the location and name of the individual data set as well as the dyad identification variable and the suffixes for the actor and partner variables to be created. The default adds at the end the suffixes "_A" and "_P" to each mixed and within dyads variables. Alternatively, the user could choose to add, for example, ".1" and ".2" or "actor" and "partner." The user has also the option to provide a list of variable labels that is used in the text file. These variable labels can
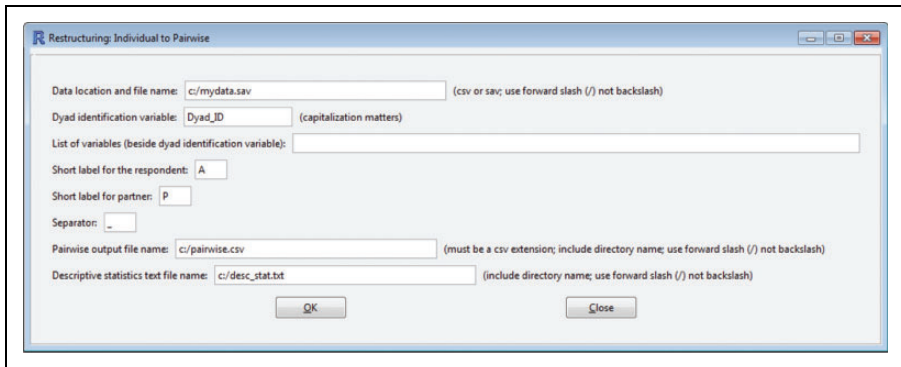
Figure 3. Graphical user interface for the ItoP program.

include special characters and spaces, but the variables must be in the same order as the input data set.

Output. The program creates two files. One is the restructured data set. That file takes each mixed and within-dyads variable and gives the actor and partner values for each person. Also included in the restructured data set are the between-dyads variables and the dyad identification variable (always the first variable in the new data set). Additionally, the program creates a within-dyads variable called *partnum*, which arbitrarily assigns a "1" to the first member of the dyad and a "2" to the second. For dyads in which there is information for only one member, a second record is created for the missing member. These new members have the dyad identification variable and values are imputed for any between- and within-dyads variable if the score on that variable is not missing for the other member. Missing scores for a mixed variable are not imputed. The program adds a new between-dyads variable called *Solo*, which denotes those cases for which only one of the two members is measured. The imputation of within- and between-dyads variables is also done for cases in which both members of the dyad are measured, and there is a within- or between-dyads variable for only one of the two members.

The program also creates a text file that provides the following descriptive information: the number of dyads and individuals and whether each variable in the data set is between, within, or mixed. It also informs what variables, if any, might be used as distinguishing variables. Then for each variable it gives the mean, standard deviation, minimum and maximum values, and the intraclass correlation. If there are missing data, it also gives the number of complete cases for that variable. The text file also notes what variables have no variance and have fewer than five cases.

DtoP

The program DtoP restructures a dyad data set into either a pairwise data set or an individual data set.
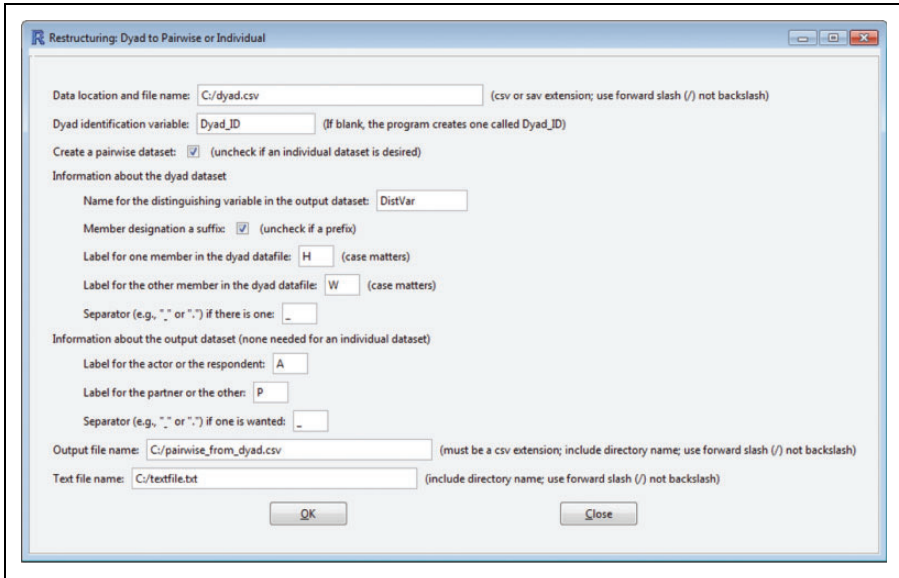
Figure 4. Graphical user interface for the DtoP program.

Data requirements. The input data set is a dyad data set. In this data set, there is information in the variable name for each mixed variable about the member to which the variable refers. That information about the member can either be at the end or the beginning of the stem of the variable name. Consistent with the requirements of most statistical programs, the first character of the variable name must be a letter, numbers or symbols are not permitted. In addition, the program can handle separators, such as points or slashes, between the stem of the variable name and the information of the dyad member. For instance, the program can handle the following examples of pairs of variable names: <X_female and X_male>, <sat.W and sat.H>, <wDepr and hDepr>, and <mom_x and dad_x>. It is permissible, that for some variables, only one of the two members has a value, for example, there might be a mom_pregnant variable but no dad_pregnant variable. If the stem of a mixed variable is the same as the variable name for a between-dyads variable (e.g., X_male and X) the program gives a message and stops.

Inputs. DtoP produces the input screen contained in Figure 4 that displays the default values. The program default assumes the restructured data set is pairwise, but the user can override this default and request an individual structure. The DtoP program asks whether the information about the dyad members is contained as a suffix or prefix in the variable names. For instance, the data set might have the variables Sat_M and Sat_F or M.Sat and F.Sat. Sometimes before running DtoP, the user may need to recode the mixed variables. So, for instance, if there were four variables in the data set and they were var001, var002, var003, and var004 where

      var001: husband satisfaction,
      var002: wife satisfaction,
      var003: husband commitment, and
      var004: wife commitment,

these variables would have to be recoded, perhaps as sat_H, sat_W, com_H, and com_W or alternatively as h.sat, w.sat, h.com, and w.com before running DtoP. For this example, gender would be the implicit distinguishing variable and users would provide this name on the graphical interface. As with ItoP, the program adds suffixes for the actor and partner variables. The default are "_A" and "_P," which are added to the stem of each mixed or within-dyads variable. However, the user can override these defaults and use something else, for example, ".1" and ".2." The program also asks the name of the implicit distinguishing variable (e.g., gender), and the user also has the option to restructure the dyad data set into an individual data set instead of a pairwise data set.

Output. DtoP creates the pairwise or individual data set and the text file. The pairwise data set has for each paired variable an actor and a partner variable. Additionally, the distinguishing variable is added using for the prefix or suffix the values from the dyad data set (e.g., H and W). If the distinguishing information is a string variable, an additional numeric distinguishing variable is added that has 1 for the first level and 2 for the second and the same name as the original variable plus "_numeric" as a suffix. Also a short text file is produced that describes the dyad data set and the new data set. However, unlike the other programs, it does not provide any descriptive or inferential statistics. Note though that if an individual data set were to be created, then the descriptive statistics could be obtained by restructuring it using ItoD or ItoP.

Restructuring longitudinal dyadic data

We now turn to the restructuring of multiwave dyadic data and the use of MLM, SEM, and MSEM, which all require a different data structure.

MLM analysis

MLM typically requires the data to be organized in what is called a *person-period data structure* (Singer & Willett, 2003) where each record has the information of one member at one time point. With n dyads and q mixed variables each measured in both members at t occasions, there would be $2nt$ cases and q mixed variables plus a dyad identification variable, a distinguishing variable, and a time variable in the data set. This structure permits the analysis of growth processes in dyads (Raudenbush, Brennan, & Barnett, 1995). The analysis of actor and partner effects in longitudinal data requires a *pairwise person-period* data set with $2nt$ cases and $2q$ mixed variables (see Kashy & Donnellan, 2012). Such a data set can be created using ItoP when the original data set is already of the type person-period. To do so, the dyad identification variable would be the unique time point, not dyad. So if there are 10 dyads and 3 time points, we might multiply the

dyad identification variable by 10 and then add the time point (1–3) to create a new "dyad" identification variable.

However, when the original data set has a dyad structure where each record has the information of both members and all measurement points (i.e., a data set with n cases and $2qt$ variables), the data can be restructured using DtoP and built-in procedures of standard statistical software programs for restructuring longitudinal data (e.g., the restructure data wizard in SPSS enables either the restructuring of selected variables into cases or the restructuring of selected cases into variables). In a dyad data set, each mixed variable name has the information of the member and the time point. The information of the member can be before or after the information of the measurement occasion. If this information is either a suffix or prefix, there are four possible combinations. For a variable *satisfaction* measured at three occasions in both members, the four possibilities are:

Sat_1M, Sat_2M, Sat_3M, Sat_1F, Sat_2F, Sat_3F;
Sat_M1, Sat_M2, Sat_M3, Sat_F1, Sat_F2, Sat_F3;
M1_Sat, M2_Sat, M3_Sat, F1_Sat, F2_Sat, F3_Sat; and
aM_Sat, bM_Sat, cM_Sat, aF_Sat, bF_Sat, cF_Sat.

It is important to note that most statistical software programs require that the first character to be a "string." Thus, a, b, and c (and not 1, 2, and 3) were used for the three time points in the last example. The restructuring can be done in two steps using our program and standard procedures. The order of the information determines whether one should use first DtoP or standard procedures for restructuring longitudinal data. DtoP would be used if the member information is the final suffix or the first prefix (first and third example, i.e., Sat_1M or M1_Sat) in order to create an individual data set with $2n$ cases and qt variables. This data set can then be turned into a person-period data set using standard procedures for restructuring longitudinal data. If the time information is the final suffix or the first prefix (second and fourth example, i.e., Sat_M1 or aM_Sat) the built-in procedure for restructuring longitudinal data would be used first and then DtoP to restructure the data into a person-period pairwise data set for MLM analysis.

SEM analysis

The use of SEM for longitudinal dyadic analysis requires a data set to be organized what can be called a *dyad person-level* data set, in which there would be n cases and $2qt$ mixed variables. If the original data format is of the form person-period a *dyad person-level* data set can be created using ItoD and built-in procedures for restructuring longitudinal data. The order in which the procedures are used determines whether the suffix in the *dyad person-level* data set begins with the information of the member or with the information of the time point. For example, using first ItoD and then the procedures for longitudinal data, the suffix in the final data set begins with the information of the member followed by the information of the time point.

MSEM analysis

MSEM can be used to analyze growth at the dyadic (group) level (Ledermann & Macho, 2014). The data structure is such that the information of each member is contained in a single record. With n dyads and q mixed variables measured t times, there would be $2n$ records and qt mixed variables (see Ledermann & Macho, 2014, for an example data set). If the original data structure is of the form dyad, DtoP can be used choosing the option to create an individual data set.

Limitations, extensions, and further directions

We have described a toolbox with programs for restructuring dyadic data and for calculating descriptive and inferential statistics. The graphical user interface and the minimum of input information required make the programs user friendly. We have also provided guidance to restructure longitudinal dyadic designs for the use of MLM, SEM, or MSEM. For data sets with many variables, the output with the descriptive statistics can become very large, and so it might be advisable to select a subset of variables before restructuring the data.

The programs are not without limitations. One limitation is that in some situations the restructuring of overtime dyadic data requires a sequential use of the programs described in this article and built-in procedures in standard software programs for restructuring longitudinal data. The use of both the programs for dyadic data and the procedures for longitudinal data enables the restructuring of almost any hierarchical organized data. Moreover, our own experience is that the built-in procedures in standard software statistic programs are handy for restructuring overtime data, and most researchers have almost no problems with the use of them. Another limitation is that the programs were also designed for the standard design: each person is paired with one partner. For both social relations and one-with-many designs (Kenny et al., 2006), we can use ItoP to create pairwise data sets, as long as the dyad identification variable refers to one pair of persons. A final limitation is that in the dyad data file the information about the members (e.g., M or F) needs to already be at the beginning or at the end of the names of the variables measured in both members. If not, the mixed variables need to renamed before running the program.

We envision that other toolboxes will be created. We would expect that very soon there would be one with programs to estimate the APIM, CFM, and MIM. A prototype is currently available at http://davidkenny.net/DyadR/DyadR.htm. Each of these programs would produce not only standard computer output but also text output describing the results. Because R is open source, we encourage other researchers to join us in building this toolbox for relationship researchers.

Notes

1. In the longitudinal analysis literature, the individual structure is sometimes referred to as a *long format* and the dyad structure is referred to as a *wide format*.
2. There are two SPSS macros that restructure individual to either pairwise or dyadic structures (http://davidakenny.net/kkc/c1/restructure.htm).
3. Restructuring from pairwise to individual and from pairwise to dyad is relatively trivial in that cases or variables just need to be deleted and variables need to be renamed.

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