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# Agreement in interpersonal perception as a predictor of group performance

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The present work deals with quantifying group characteristics. Specifically, dyadic measures of interpersonal perceptions were used to forecast group performance. Forty-six groups of students, 24 of four and 22 of five people, were studied in a real educational assignment context and marks were gathered as an indicator of group performance. Our results show that dyadic measures of interpersonal perceptions account for final marks. By means of linear regression analysis, 85% and 85.6% of group performance, respectively, was explained for group sizes equal to four and five. Results found in the scientific literature based on the individualistic approach are no larger than 18%. The results of the present study support the utility of dyadic approaches for predicting group performance in social contexts.

*Concordancia en percepción interpersonal como predictora del rendimiento grupal*. El presente trabajo trata sobre la cuantificación de las características grupales, concretamente, en este estudio se emplearon medidas diádicas de percepción interpersonal con el objetivo de predecir el rendimiento grupal en grupos académicos. Como indicadores del rendimiento grupal se tomaron las calificaciones del curso de 46 grupos de estudiantes, 24 de cuatro y 22 de cinco participantes. Mediante regresión lineal se obtuvo un porcentaje de varianza explicada del rendimiento grupal igual al 85% en grupos de cuatro participantes, mientras para los grupos de cinco miembros fue igual al 85,6%. Los resultados encontrados en la literatura científica basados en la perspectiva individual no son superiores al 18%. Los resultados del presente estudio apoyan la utilidad del enfoque diádico para predecir el rendimiento grupal en contextos sociales.

A great number of tasks or jobs (e.g., academic, business, medical) require people to interact in order to achieve outcomes or solve problems. Therefore, a common question addressed to many social researchers is how the configuration of group participants' characteristics should be to obtain an effective work group. The importance of this issue is illustrated by the amount of research into the relationship between group performance and a variety of variables. For example, the effect of time pressure on bargaining behaviour or the relationship between the difficulty of the task and the amount or rate of task performance (Kelly & McGrath, 1985). Another classical factor that has been studied is group size, although results regarding the effect of size on group performance have not been altogether consistent (Kozlowski & Bell, 2003). As a complement to these studies, personality traits related to group performance have been investigated for more than a hundred years and have shown to influence group performance (Mann, 1959; Peeters, van Tuijl, Rutte, & Reymen, 2006). All these studies have mainly followed an individualistic approach, that is, they have tried to identify the personal attributes of team members useful for predicting team efficiency. Furthermore, the most common approach to specify the appropriate operationalisation of team composition variables has been Steiner's typology (Steiner, 1972, cited in Bell, 2007). This strategy combines task type with several indices such as mean, variance, maximum, and minimum. In personality studies, mean and variance have traditionally been computed for operationalising team composition constructs (Barrick, Stewart, Neubert, & Mount, 1998). However, the study of group characteristics and environmental factors has been insufficient for understanding and predicting group performance. This is reflected by the low percentages of explained variability obtained by means of regression analyses (Hough, 1992; Peeters, Rutte, van Tuijl, & Reymen, 2008; Peeters et al., 2006). In fact, the highest percentage found was 18% using agreeableness as a job performance predictor (Neuman, Wagner, & Christiansen, 1999).

The present study is intended to explore whether by means of dyadic indices higher percentages of explained variance of group performance could be predicted since the individualistic approach pays no attention to social interactions between group members which may be significant factors when studying social phenomena. In this regard, it has been suggested that individual research methods, as mean, variance, minimum, and maximum, are not appropriate for studying influence and interdependent patterns (Bond, Horn, & Kenny, 1997). For instance, according to Barrick et al., (1998) the mean score of individual measures is potentially

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problematic since aggregation can mask important information. Furthermore, computing mean values of a specific trait implies working under the assumption that the amount of the characteristic possessed by each individual increases the collective pool of this characteristic, regardless of how it is distributed within the group (Halfhill, Sundstrom, Lahner, Calderone, & Nielsen, 2005). A possible solution for overcoming this drawback is computing indices based on discrepancy. However, considering the guidelines of Harrison and Klein (2007), the choice of an index to measure discrepancies should be made after a proper description of the kind of diversity to be measured (separation, disparity, or variety). A different approach focuses on the highest or lowest score of a personality trait that a group member obtains in a questionnaire, supposing that minimum and maximum values are suitable measurements to represent groups at global level. This approach assumes that a single individual may significantly affect a group and thus its main drawback is that outliers can considerably bias group measurements. O'Reilly, Cadwell, and Barnett (1989) proposed another measure of heterogeneity based on the Euclidean distance of attribute dissimilarity of an individual team member. This index has traditionally been computed in demographic studies (Elfenbein & O'Reilly, 2007; Tsui, Egan, & O'Reilly, 1992; Tsui & O'Reilly, 1989). It should be noted that the maximum value of this index depends on *n* and the range of attributes measured and thus suitable comparisons and interpretations are not possible. Blau (1977, cited in Jackson et al., 1991) proposed an index of heterogeneity for categorical variables that varies from 0 (if all group members possess a characteristic) to 1 (if all group members do not possess it). However, the maximum value of this index depends on the number of categories and many researchers deal with quantitative instead of nominal scale measures. Teachman's entropy index (originally developed by Shannon in 1948, cited in Harrison & Klein, 2007) has also been proposed for categorical variables. However, it shows the same problems as Blau's index and is further limited when the number of group members is lower than the number of categories. The coefficient of variation has also been used as a measure of heterogeneity. Moreover, these methods may not be suitable for studying group performance since they do not take into account social interactions when seeking to understand and predict team effectiveness. Hence, ignoring the social context in which people are embedded may be the major drawback of the individualistic approach. However, there are other methodological and analytical approaches which are founded on social interactions, that is, on dyadic analysis (Kenny, 1994; Kenny, Kashy, & Cook, 2006; Solanas, Salafranca, Riba, Sierra, & Leiva, 2006; Wasserman & Faust, 1994). In this regard, interaction between individuals in teams or workgroups could be analysed from a dyadic approach. The present study is intended to show an application of dyadic indices and explore their relationships with group performance in an academic context.

*The study of groups from a dyadic approach*

According to Kenny (1994), people's beliefs about others guide them in various ways, for example, by helping them to explain and predict other people's behaviour and orienting them in social interactions. The study of people's beliefs about others is called interpersonal perception and, in the context of social psychology, the study of interpersonal perception has been based on the Social Relations Model (*SRM*; Kenny & La Voie, 1984). Perceiver, target, and relationship effects can be estimated and an *analysis of variance* is applied to partition variance into components. Perceiver effect is the particular perception that a group member has of the rest group members in general. Target effect is how a specific member is viewed by others in general. Relationship effect measures how a specific member uniquely perceives another specific member. *SRM* allows social researchers to estimate dyadic and generalized reciprocity by means of correlation coefficient values, although there is no overall measurement for global social reciprocity defined as the difference between what is given and received in return. Generalized reciprocity is the correlation between perceiver and target effects and dyadic reciprocity is the correlation between relationship effects. Whether interpersonal perception could guide interaction (Kenny, 1994), asymmetries in interpersonal perception should not be ignored since departures from symmetry may be informative (Saito & Yadohisa, 2005). As regards, the interpersonal approach has been encouraged to understanding and improving team functioning, at least in personality studies, since people compatibility and complementary (i.e., similarity *versus* dissimilarity or symmetry *versus* asymmetry) have been recognised as theoretical dimensions that contribute to or interfere with team performance (Anderson & Tett, 2006; Tett & Burnett, 2003; Tett & Murphy, 2002). Hence, and according to our conjecture, asymmetrical interpersonal perceptions may be useful for understanding and predicting team performance. The present research aims to study whether asymmetry in interpersonal perceptions could significantly affect group performance in a real academic context and explore to what extent asymmetry in interpersonal perception could improve prediction results regarding group performance.

Although a number of researchers have already dealt with asymmetrical data in ethological studies, they have rarely been considered in social psychology research. For instance, several indices and tests have been developed to quantify linearity and other features in dominance relationships (de Vries, 1995; de Vries, Stevens, & Vervaecke, 2006; Kendall & Babington Smith, 1940; Landau, 1951), while other statistical methods have also been proposed to measure social reciprocity and interchange (Hemelrijk, 1990a, 1990b). Furthermore, the directional consistency index (van Hooff & Wensing, 1987), which is founded on absolute differences between what each member of a pair of individuals gives to others and what she/he receives from them in return, provides a measure of social reciprocity in which the magnitude of the behaviour is taken into account. Recently, another index, called the *skew-symmetry* index (Solanas et al., 2006), has been proposed to quantify the discrepancy between what is addressed to others and what is received in return, that is, asymmetry in social structures. The *directional consistency* and *skew-symmetry* indices could be useful for quantifying reciprocity and interchange in social psychology research and also for measuring the agreement between interpersonal perceptions. The *skew-symmetry* index can be partitioned in such a way that individuals who contribute more to the lack of reciprocity can be identified, while dyadic and generalized reciprocity can also be measured. Furthermore, statistical significance for both the *directional consistency* and *skew-symmetry* statistics can be obtained under any null hypothesis of social reciprocity, although only when frequency measurements are taken into account (Leiva, Solanas, & Salafranca, 2008b). Moreover, power of the statistical test for the skew-symmetry index has been estimated in order to choose the optimal experimental conditions (Leiva, Solanas, & Salafranca, 2008a).

As interpersonal perceptions may be a significant factor in predicting group performance the present research considers the relationship between this kind of social perception and group achievement. In order to explore this association, in the present research, an academic situation was considered to explore whether asymmetry in interpersonal perceptions is useful to predict academic performance in work groups. Interpersonal perceptions were measured by means of the *skew-symmetry* (Solanas et al., 2006) and *SRM* indices (Kenny, 1994). It should be stressed that the main aim of this study is methodological, that is, the research was carried out to study whether dyadic measures enable us to achieve better predictions of team performance than those obtained via the individualistic approach. These techniques will be illustrated in the next section.

*Skew-symmetry and SRM indices*

A fictitious example will be stated in order to illustrate the computation of the *skew-symmetry* index (Solanas et al., 2006). Imagine a group of four participants that has been working together and, after finishing, they are asked to rate each other about their perception on the item '*She/He fulfils the deadlines for finishing her/his work*' from *1*, never, to *6*, always, excluding self-evaluation. With these scores an interpersonal perception sociomatrix **X** (a matrix where rows and columns correspond to participants' scores as perceivers and targets, respectively) can be constructed. The main diagonal is equal to *0* since participants did not score themselves. This information could be represented as follows,

$$\mathbf{X}=\begin{pmatrix}0&6&5&4\\3&0&5&2\\1&3&0&5\\2&6&3&0\end{pmatrix}$$

As it is shown in sociomatrix **X**, the score that participant 1 gives to participant 2 (6) does not correspond with the score that participant 1 receives from participant 2 (3). Conceptually, the discrepancy between these values corresponds to asymmetry in their interpersonal perceptions about how *She/He fulfils the deadlines for finishing her/his work*. The sociomatrix **X** can be decomposed into its symmetrical and skew-symmetrical parts. That is,

$$\mathbf{X}=\frac{\mathbf{X}+\mathbf{X}'}{2}+\frac{\mathbf{X}-\mathbf{X}'}{2}=\mathbf{S}+\mathbf{K}$$

where **S** is a symmetric matrix (**S = S',** that is, a square matrix that is equal to its transpose), and **K** is a skew-symmetric matrix, (**K = –K'**, that is, a square matrix whose transpose is also its negative), respectively. The matrix **K** corresponds to the departures from symmetry and the elements of a skew-symmetric matrix can be understood as representing the lack of balance in reciprocity or concordance among interpersonal perceptions between pair of participants. According to the definition of a skew-symmetric matrix, its elements show the following property: $k_{ij} = -k_{ji}$. This property describes the departures from the symmetry represented by the matrix **S**. A symmetry matrix is defined as the average of the elements $x_{ij}$ and $x_{ji}$, which corresponds to the reciprocity balance, and then $s_{ij} = s_{ji}$. The previous mathematical expression enables us to decompose the sum of squares into two parts, one due to symmetry and the other representing asymmetry. The *skew-symmetry* index $\Phi$ is computed by taking into account the ratio between the sum of squared values due to skew-symmetry and the total sum of squared values. The computation is as follows:

$$\Phi=\frac{tr(\mathbf{K}'\mathbf{K})}{tr(\mathbf{X}'\mathbf{X})}=\frac{\sum_{i=1}^{n}\sum_{\substack{j=1\\j\neq i}}^{n}k_{ij}^2}{\sum_{i=1}^{n}\sum_{\substack{j=1\\j\neq i}}^{n}x_{ij}^2},\ tr(\mathbf{X}'\mathbf{X})>0;0\leq\Phi\leq.5$$

where $k_{ij}$ and $x_{ij}$ denote, respectively, the elements of the matrices **K** and **X** and $\Phi$ ranges from *0* to *.5*. If $\Phi = 0$, groups are symmetric with respect to the registered behaviour or interpersonal perception and if it is close to *.5* the group shows an appreciable asymmetry. In the example the computation is,

$$\mathbf{K}=\frac{\mathbf{X}-\mathbf{X}'}{2}=\left(\frac{\begin{pmatrix}0&6&5&4\\3&0&5&2\\1&3&0&5\\2&6&3&0\end{pmatrix}-\begin{pmatrix}0&3&1&2\\6&0&3&6\\5&5&0&3\\4&2&5&0\end{pmatrix}}{2}\right)=\begin{pmatrix}0&1.5&2&1\\-1.5&0&1&-2\\-2&-1&0&1\\-1&2&-1&0\end{pmatrix}$$

$$\Phi=\frac{\sum_{i=1}^{n}\sum_{\substack{j=1\\j\neq 1}}^{n}k_{ij}^2}{\sum_{i=1}^{n}\sum_{\substack{j=1\\j\neq 1}}^{n}x_{ij}^2}=\frac{2.25+4+1+2.25+1+4+4+1+1+1+4+1}{36+25+16+9+25+4+1+9+25+4+36+9}=\frac{26.5}{199}=.13$$

In this fictitious example $\Phi$ is moderately close to zero, showing that group participants' perception about *fulfilling the deadlines for finishing the work* is not completely symmetrical since there are discrepancies between the scores that individuals give and receive in return. SAS and R programs for computing the $\Phi$ index are available on request (Leiva et al., 2008b).

The *SRM* decomposes dyadic data into three effects: actor, partner, and relationship. In other formulations of the *SRM*, specifically in the context of interpersonal perceptions, the term «actor» is referred to as «perceiver» and the term «partner» is called «target». The actor effect measures the individual's tendency to direct an action, thought or feeling toward others. The partner effect quantifies the individual's tendency to be the target of an action, thought or feeling. The relationship effect represents the individual's specific tendency to direct an action, thought or feeling toward another individual. Following Kenny (1994), two measures of reciprocity could be obtained: generalized and dyadic. Generalized reciprocity (e.g., among interpersonal perceptions) is defined as a correlation between actor and partner effects: an individual's tendency of acting, thinking or feeling toward the group is correlated with the group tendency of acting, thinking or feeling toward the individual. For instance, a positive correlation means that if one thinks their mates are intelligent they also

think he/she is intelligent so the group is reciprocal toward this individual. Dyadic reciprocity among interpersonal perceptions is the correlation between the relationship effects among pairs of individuals. That is, the particular perception that an individual has of another is correlated with the particular perception of the other towards her/him.

Considering the drawbacks of the individualistic approach for the study of group composition, specifically when dealing with predictive purposes, the main purpose of the present research is to explore the percentage of explain variance of course qualifications by means of the abovementioned dyadic measures, $\Phi$ and *SRM* indices, applied to interpersonal perceptions in academic groups. Specifically, the present research is intended to study whether percentages of explained variability of course qualifications can be improved by means of dyadic measures in comparison with those found in other investigations. The present study is intended to test the following conjecture: dyadic measurements (of interpersonal perceptions) will account for higher percentages of group performance explained variance (group marks) than those found in the scientific literature that follow an individualistic approach.

## Method

### *Participants*

*206* undergraduate students formed *24* groups of four and *22* groups of five people. All participants were members of the same university (ESADE-Ramón Llull University), they come from Spain, and participated voluntarily. The mean percentage of men was *51%*. They were enrolled in *Economy and Sociology of Work* (65%) and *Marketing* courses (35%). *35%* of the groups were formed by the students, that is, they organised the group themselves and the rest by the teachers, that is, teachers assigned students to the groups. All group members had previous acquaintance.

### *Procedure*

The task they had to accomplish consisted in carrying out a specific project, related with the subjects, in groups of four or five people. They had ten weeks to submit a final report and defend it in an oral session. The oral presentation was scored from 0 to 10, considering substantive concepts, topics proposed, clarity, and communication skills. This mark represents a percentage (40%) of their final mark within each subject since they also carried out other (individual) activities during the semester (e. g., exams and short exercises) that were also taken into account and thus each student obtained her/his individual mark.

Three teachers conducted the *Marketing* subject and one teacher conducted the *Economy and Sociology of Work* subject, but each of them scored the projects of groups enrolled in their courses. All group members obtained the same mark, that is, the mark they obtained in the oral presentation was the same for all group members. In order to avoid a possible teacher effect (over or under scoring the projects) marks were transformed to *Z* scores. Data analyses were carried out using these Z scores. The project allowed students to interact with one another and generate interpersonal perceptions about the way their group partners have performed. According to Sundstrom, McIntyre, Halfhill, and Richards (2000), these teams can be considered as project groups or project teams since they carried out defined, specialised, time-limited projects and disbanded after finishing. Before the oral presentation, they were asked to fill in the interpersonal perception questionnaire. They were informed about the aim of the study emphasising that their results were independent from the evaluation of the reports. The questionnaire is explained in the following section.

### *Interpersonal Perception Questionnaire*

Following the methodology of other authors of this research tradition (Cook, 2005; Kenny, Mannetti, Pierro, Levi, & Kashy, 2002), an interpersonal perception questionnaire was developed (Appendix I). This questionnaire was designed to measure interpersonal perceptions between team members about the contribution and participation of their team mates. The scale was constructed by three experts in group research and consisted of *10* items scored on a Likert scale (from *1*, total disagreement, to *6*, total agreement) enabling us to gather information about the most significant features of team work (e.g., attendance at group meetings, assumption of responsibility, meeting deadlines). The scoring of the questionnaire follows a *round robin* design. That entails assigning scores to every group mate but avoid self scores. This kind of design allows shaping the information gathered in sociomatrices where rows and columns represent individuals of a group. Thus, for each group, ten sociomatrices (one for each item), that showed the interpersonal perception rates between members of the group, were obtained.

### *Data analysis*

As four teachers participated in the evaluation of the oral presentation, one in *Economy and Sociology of Work* and three in *Marketing*, the marks obtained were standardised in order to avoid possible teacher effects. To this end, the mean and standard deviation for each teacher's marks were calculated. Standardised marks were the dependent variable in the following analyses and they were considered a measure of performance. Using the scores of the interpersonal perception questionnaire, $\Phi$ and *SRM* indices were calculated separately for each item in each group. An R program was used to compute $\Phi$ values (Leiva et al., 2008b). WinSoReMo (http://www.davidakenny.net/srm/srmp.htm) was used to perform *SRM* analyses, that is, to compute *generalized* and *dyadic* indices. Two linear regression analyses were carried out for the different group sizes. This procedure allowed us to estimate percentages of explained variance of standardised marks and decide whether dyadic measures of agreement in interpersonal perception based on the questionnaire items were useful for predicting marks. Statistical analysis was separately carried out by group size for different reasons. Firstly, although as mentioned above scientific literature is not conclusive, group size has been recognised as related to some group processes. Secondly, the present study was exploratory in essence and hence we tried differences to be apparent. Finally, mixing group sizes in an only statistical analysis could have cancelled group size differences.

## Results

Table 1 shows the descriptive statistics for the $\Phi$ values calculated separately for the questionnaire items for groups of four and five people. In general, means and standard deviation values are larger in groups of four people than in groups of five. Thus, it

seems that asymmetry in interpersonal perception is more likely in groups of four than in groups of five people.

Table 2 and 3 show descriptive statistics of *SRM generalized* and *dyadic* indices, respectively, for different group sizes. As regards to generalized indices, negative mean values are most frequent in groups of four than in groups of five people and in the case of dyadic indices the vast majority of means are positive in both group sizes.

Regression analyses results suggest that agreement in interpersonal perception measurements can be used to predict group marks, although statistical model parameters should be estimated separately for n = 4 and n = 5 since the predictive indices are not the same for both cases. Two linear regression analyses were conducted for groups of four and five people following the stepwise method using $\Phi$ and *SRM generalized* and *dyadic* values as regressors and standardised marks as dependent variable. Stepwise method was applied in the regression analyses since $\Phi$ and *SRM* values correlated among them. This method selects and orders the regressors considering the highest percentage of explained variance they account for, that is, since no previous theory or study indicates which predictor variable should be entered and how should be the order, the method entered and ordered the predictors, from the highest to the lowest percentage of variance explained, excluding variables that are correlated among them. Correlations among $\Phi$ values and *SRM* indices are shown in tables 4 and 5.

The linear regression analysis for n = 4, showed a solution with five regressors ($\Phi_7$, $D_{10}$, $G_7$, $D_9$, and $D_8$), accounting for 85% of standardised marks' variance. Table 6 shows change in $R^2$ and the summary for the regression coefficients.

Table 7 shows the values of the slopes indicating a positive relationship between $\Phi_7$, $G_7$, $D_9$, and standardised marks and a negative relationship for $D_{10}$ and $D_8$. On one hand, $\Phi$ and *SRM* generalized values of item 7, *She/He shows initiative in solving the task problems,* and *SRM* dyadic values of item 9, *She/He analyses the information needed to carry out the task,* seem to correlate positively with standardised marks. On the other hand, SRM dyadic values of items 10 and 8, *She/He offers solutions to reach the objectives of the group* and *She/He communicates her/his ideas clearly*, are negatively correlated with standardized marks. As it is a stepwise regression, the interpretation of the slopes should be

*Table 1*
Descriptive statistics of $\Phi$ by group size, where n = 4 and n = 5 are group sizes and $\Phi_i$ represents the *asymmetry* values of each item

| | n= 4 | | | | | n= 5 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Max.** | **Min.** | **Range** | **Mean** | **SD** | **Max.** | **Min.** | **Range** |
| $\Phi_1$ | .023 | .020 | .066 | .000 | .066 | .020 | .019 | .059 | .001 | .058 |
| $\Phi_2$ | .030 | .030 | .123 | .000 | .123 | .015 | .011 | .043 | .004 | .039 |
| $\Phi_3$ | .028 | .034 | .113 | .000 | .113 | .018 | .017 | .058 | .001 | .057 |
| $\Phi_4$ | .024 | .022 | .071 | .000 | .071 | .020 | .013 | .048 | .001 | .047 |
| $\Phi_5$ | .029 | .028 | .108 | .001 | .107 | .025 | .019 | .074 | .006 | .068 |
| $\Phi_6$ | .044 | .036 | .130 | .000 | .130 | .029 | .020 | .068 | .005 | .063 |
| $\Phi_7$ | .035 | .031 | .114 | .001 | .113 | .031 | .024 | .109 | .008 | .101 |
| $\Phi_8$ | .024 | .022 | .071 | .000 | .071 | .025 | .014 | .056 | .001 | .055 |
| $\Phi_9$ | .027 | .027 | .094 | .000 | .094 | .022 | .014 | .053 | .005 | .048 |
| $\Phi_{10}$ | .035 | .028 | .108 | .002 | .106 | .024 | .015 | .052 | .004 | .048 |

*Table 2*
Descriptive statistics of *SRM generalized index* by group size, where n = 4 and n = 5 are group sizes and $G_i$ represents the generalized values of each item

| | n= 4 | | | | | n= 5 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Max.** | **Min.** | **Range** | **Mean** | **SD** | **Max.** | **Min.** | **Range** |
| $G_1$ | −.04 | .49 | .90 | −1.00 | 1.90 | .14 | .69 | 1.00 | −1.00 | 2.00 |
| $G_2$ | −.02 | .42 | 1.00 | −1.00 | 2.00 | .15 | .45 | 1.00 | −.83 | 1.83 |
| $G_3$ | −.06 | .37 | 1.00 | −1.00 | 2.00 | −.03 | .50 | 1.00 | −1.00 | 2.00 |
| $G_4$ | .10 | .44 | 1.00 | −1.00 | 2.00 | −.02 | .40 | 1.00 | −1.00 | 2.00 |
| $G_5$ | −.04 | .33 | .84 | −1.00 | 1.84 | −.02 | .62 | 1.00 | −1.00 | 2.00 |
| $G_6$ | −.05 | .55 | 1.00 | −1.00 | 2.00 | .12 | .45 | .99 | −1.00 | 1.99 |
| $G_7$ | .03 | .60 | 1.00 | −1.00 | 2.00 | −.08 | .58 | 1.00 | −1.00 | 2.00 |
| $G_8$ | .08 | .41 | 1.00 | −1.00 | 2.00 | .17 | .36 | 1.00 | −.42 | 1.42 |
| $G_9$ | −.07 | .45 | .81 | −1.00 | 1.81 | .05 | .39 | 1.00 | −1.00 | 2.00 |
| $G_{10}$ | −.07 | .47 | .95 | −1.00 | 1.95 | .06 | .54 | 1.00 | −1.00 | 2.00 |

done respecting the order of entry of the variables, that is, $\Phi_7$, $D_{10}$, $G_7$, $D_9$, and $D_8$. In this sense, it seems that group marks increase as asymmetry in interpersonal perceptions of showing initiative to solve task problems increases ($\Phi_7$). The next variables is $D_{10}$, showing that marks decreased as dyadic reciprocity in offering solutions to reach group' objectives increased. The following variable that enters is $G_7$ and shows that marks increased as generalized reciprocity in interpersonal perceptions of showing initiative to solve task problems increases. The next variable is $D_9$ which shows that marks increase as interpersonal perceptions about dyadic reciprocity in the analyses of the information needed to carry out the task increase. The last variable that enters in the regression model shows that marks decrease as interpersonal perceptions about the clearly communication of personal ideas ($D_8$) increase.

A different structure models the relationship between the variables for groups of five people. Table 8 shows a solution with five regressors ($\Phi_4$, $G_1$, $\Phi_2$, $\Phi_3$, and $D_2$) accounting for 85.6% of the standardised marks' variance.

The values of the slopes are shown in table 9. $G_1$ and $\Phi_2$ showed a positive relationship with standardised marks and $\Phi_4$, $\Phi_3$, and $D_2$ showed a negative relationship. That is, *SRM* generalized values of item 1, *She/He participates in all group meetings*, and the $\Phi$ values of item 2, *She/He assumes her/his responsibility in the task*, show a positive relationship with standardised marks whereas the $\Phi$ values of items 4 and 3, *She/He contributes to the development of planned activities* and *She/He fulfils the deadlines for finishing her/his work*, and the SRM dyadic values of item 2 show a negative relationship with standardised marks. As it has been mentioned before, the interpretation of the sign of the slopes requires respecting the order of entry, that is, $\Phi_4$, $G_1$, $\Phi_2$, $\Phi_3$, and $D_2$. The first variable that enters in the model indicates that group marks decrease as asymmetry in interpersonal perceptions about the contribution to the development of planned activities increased ($\Phi_4$). The next variable is $G_1$ showing that marks increased as generalized reciprocity in interpersonal perceptions of participating in all group meetings increases. The following variable is $\Phi_2$ and shows that group marks increase as asymmetry

*Table 3*
Descriptive statistics of *SRM dyadic index* by group size, where n = 4 and n = 5 are group sizes and $D_i$ represents the dyadic values of each item

| | n= 4 | | | | | n= 5 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Max.** | **Min.** | **Range** | **Mean** | **SD** | **Max.** | **Min.** | **Range** |
| $D_1$ | .08 | .48 | .91 | –.86 | 1.77 | .04 | .37 | .73 | –.76 | 1.49 |
| $D_2$ | .02 | .45 | .96 | –.68 | 1.64 | .01 | .31 | .48 | –.82 | 1.30 |
| $D_3$ | .10 | .34 | 1.00 | –.50 | 1.50 | –.01 | .31 | .68 | –.65 | 1.33 |
| $D_4$ | .18 | .38 | .80 | –.75 | 1.55 | .10 | .32 | .73 | –.54 | 1.27 |
| $D_5$ | .10 | .44 | .77 | –1.00 | 1.77 | .13 | .37 | .72 | –.51 | 1.23 |
| $D_6$ | .01 | .47 | .86 | –1.00 | 1.86 | .11 | .30 | .57 | –.64 | 1.21 |
| $D_7$ | –.14 | .51 | .98 | –1.00 | 1.98 | .09 | .35 | .67 | –.51 | 1.18 |
| $D_8$ | .01 | .48 | 1.00 | –1.00 | 2.00 | .09 | .35 | .63 | –.73 | 1.36 |
| $D_9$ | –.04 | .65 | 1.00 | –1.00 | 2.00 | –.03 | .27 | .60 | –.57 | 1.17 |
| $D_{10}$ | –.03 | .48 | .87 | –1.00 | 1.87 | –.04 | .31 | .43 | –.57 | 1.00 |

*Table 4*
Correlation coefficients among $\Phi$ values for groups of four and five people where n = 4 and n = 5 are group sizes and *asymmetry* values of the *i*-th item

| | n= 4 | | | | | | | | | n= 5 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\Phi_1$ | $\Phi_2$ | $\Phi_3$ | $\Phi_4$ | $\Phi_5$ | $\Phi_6$ | $\Phi_7$ | $\Phi_8$ | $\Phi_9$ | $\Phi_1$ | $\Phi_2$ | $\Phi_3$ | $\Phi_4$ | $\Phi_5$ | $\Phi_6$ | $\Phi_7$ | $\Phi_8$ | $\Phi_9$ |
| $\Phi_2$ | .840** | – | | | | | | | | .615** | – | | | | | | | |
| $\Phi_3$ | .730** | .852** | – | | | | | | | .353 | .714** | – | | | | | | |
| $\Phi_4$ | .768** | .855** | .872** | – | | | | | | .578** | .649** | .566** | – | | | | | |
| $\Phi_5$ | .636** | .682** | .768** | .775** | – | | | | | .078 | .471* | .459* | .572** | – | | | | |
| $\Phi_6$ | .569** | .716** | .573** | .722** | .523** | – | | | | .597** | .647** | .503* | .727** | .650** | – | | | |
| $\Phi_7$ | .613** | .747** | .698** | .736** | .718** | .783** | – | | | .111 | .359 | .326 | .606** | .832** | .468* | – | | |
| $\Phi_8$ | .353 | .663** | .669** | .617** | .469* | .471* | .376 | – | | .358 | .336 | .330 | .583** | .562** | .762** | .490* | – | |
| $\Phi_9$ | .761** | .912** | .819** | .790** | .680** | .727** | .837** | .551** | – | .418 | .330 | .303 | .465* | .391 | .564** | .272 | .623** | – |
| $\Phi_{10}$ | .555** | .742** | .635** | .665** | .570** | .852** | .806** | .415* | .826** | .254 | .481* | .451* | .624** | .471* | .511* | .432* | .549** | .409 |

* significant at .05; ** significant at .01

*Table 5*
Correlation coefficients among SRM generalized and dyadic values where n = 4 and n = 5 are group sizes, $G_i$ represents *SRM generalized* values, and $D_i$ represents *SRM dyadic* values of the *i*-th item

| | n = 4 | | | | | | | | | n = 5 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $G_1$ | $G_2$ | $G_3$ | $G_4$ | $G_5$ | $G_6$ | $G_7$ | $G_8$ | $G_9$ | $G_1$ | $G_2$ | $G_3$ | $G_4$ | $G_5$ | $G_6$ | $G_7$ | $G_8$ | $G_9$ |
| $G_2$ | −.254 | - | | | | | | | | .093 | - | | | | | | | |
| $G_3$ | .003 | .379 | - | | | | | | | −.025 | .382 | - | | | | | | |
| $G_4$ | −.243 | .537** | .354 | - | | | | | | −.042 | .232 | −.009 | - | | | | | |
| $G_5$ | .239 | .476* | −.024 | .335 | - | | | | | .495* | .095 | .023 | .247 | - | | | | |
| $G_6$ | .144 | .367 | .162 | −.123 | .307 | - | | | | −.162 | .215 | .262 | .410 | .208 | - | | | |
| $G_7$ | −.083 | .607** | .192 | .537** | .569** | .223 | - | | | −.023 | .020 | .099 | .146 | .357 | .241 | - | | |
| $G_8$ | −.020 | −.359 | −.251 | −.126 | −.169 | −.355 | .048 | - | | −.389 | .203 | .254 | .479* | .016 | .520* | .265 | - | |
| $G_9$ | .343 | .289 | .442* | .222 | .193 | .179 | .345 | −.015 | - | −.070 | .195 | .428* | .032 | −.027 | .225 | .402 | .457* | - |
| $G_{10}$ | .291 | .544** | .358 | .261 | .400 | .366 | .435* | −.067 | .567** | .167 | .239 | −.001 | .195 | .327 | .261 | .088 | .420 | .265 |
| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | $D_5$ | $D_6$ | $D_7$ | $D_8$ | $D_9$ | $D_1$ | $D_2$ | $D_3$ | $D_4$ | $D_5$ | $D_6$ | $D_7$ | $D_8$ | $D_9$ |
| $D_2$ | .384 | - | | | | | | | | .252 | - | | | | | | | |
| $D_3$ | −.100 | .077 | - | | | | | | | −.270 | .214 | - | | | | | | |
| $D_4$ | .313 | −.078 | .375 | - | | | | | | .446* | .334 | .021 | - | | | | | |
| $D_5$ | .094 | −.262 | .049 | .334 | - | | | | | .281 | −.204 | −.328 | −.033 | - | | | | |
| $D_6$ | .100 | .535(**) | −.037 | −.197 | −.228 | - | | | | .127 | .049 | .019 | −.115 | .270 | - | | | |
| $D_7$ | .195 | .495(*) | .289 | .182 | .090 | .602(**) | - | | | −.362 | .111 | .368 | −.246 | −.175 | .133 | - | | |
| $D_8$ | .153 | .191 | .021 | .010 | −.019 | −.034 | .003 | - | | −.172 | .183 | .331 | .121 | −.197 | −.039 | .334 | - | |
| $D_9$ | .367 | .250 | .175 | .199 | −.210 | .041 | .004 | .541(**) | - | .082 | .316 | .358 | −.113 | .061 | .122 | .236 | .362 | - |
| $D_{10}$ | .119 | .319 | .353 | .581(**) | .245 | .125 | .626(**) | .251 | .190 | −.123 | .148 | −.043 | −.036 | .404 | .372 | .158 | .067 | .193 |

* significant at .05; ** significant at .01

in interpersonal perceptions of assuming responsibilities about the task increases. The next variable that enters shows that group marks decrease as asymmetry in interpersonal perceptions about fulfilling the deadlines for finishing work increases ($\Phi_3$). Finally, the last variable that enters in the model, $D_2$, indicates that marks decrease as dyadic reciprocity about of assuming responsibilities about the task increases.

*Table 6*
Regression analysis summary of four-participant groups where $\Phi_i$, $G_i$, and $D_i$ represent *asymmetry* and *SRM generalized* and *dyadic* values of the *i*−th item, respectively

| Model | $R^2$ | Corrected $R^2$ | SE | $\Delta R^2$ | F change | Sig. F change |
|---|---|---|---|---|---|---|
| 1 | .219 | .184 | .858 | .219 | 6.176 | .021 |
| 2 | .460 | .408 | .730 | .241 | 9.349 | .006 |
| 3 | .687 | .641 | .569 | .228 | 14.570 | .001 |
| 4 | .758 | .707 | .514 | .071 | 5.538 | .030 |
| 5 | .850 | .808 | .416 | .092 | 11.025 | .004 |

1 Predictors: (Constant). $\Phi_7$.
2 Predictors: (Constant). $\Phi_7$. $D_{10}$.
3 Predictors: (Constant). $\Phi_7$. $D_{10}$. $G_7$.
4 Predictors: (Constant). $\Phi_7$. $D_{10}$. $G_7$. $D_9$.
5 Predictors: (Constant). $\Phi_7$. $D_{10}$. $G_7$. $D_9$. $D_8$

Other $\Phi$ or *SRM* indices did not entered in the model since the tolerance was practically set to *0* in order to prevent the undesirable effects of multicollinearity.

## Discussion

As regards the conjecture of the present study, the $\Phi$ and *SRM* indices lead to large degrees of explained variance of team performance when using linear regression analysis. Comparing

*Table 7*
Parameter estimates for the regression model with five regressors for predicting marks of four−participant groups where $\Phi_i$, $G_i$, and $D_i$ represent *asymmetry* and *SRM generalized* and *dyadic* values of the *i*−th item, respectively

| Regressor | b | SE | t |
|---|---|---|---|
| *Intercept* | −.687 | .147 | −4.690** |
| $\Phi_7$ | 20.456 | 3.247 | 6.301** |
| $D_{10}$ | −1.100 | .193 | −5.692** |
| $G_7$ | .756 | .163 | 4.631** |
| $D_9$ | .693 | .164 | 4.236** |
| $D_8$ | −.738 | .222 | −3.320* |

* significant at .05; ** significant at .01

the results of the present study with those found in the literature, obtained by means of the individualistic approach, the dyadic approach seems to be useful for prediction purposes. Note that percentages of explained variance in the scientific literature are slightly larger than 18% and are commonly lower than 10% when personality attributes are used to predict team performance (see Hough, 1992), whereas percentages of explained variance of 85% have been obtained in the present study. This work shows an application of dyadic indices to predict group performance in a specific context founded on the quantification of the degree of asymmetry in interpersonal perceptions. These results support the conjecture of the usefulness of dyadic approach to quantify group characteristics with predictive purposes. Furthermore, the results of the present study show asymmetry in interpersonal perceptions about team mates' contribution and perhaps asymmetry in this kind of social perception could be gathering the unequal contribution to the group task. In this sense, observational studies carried out in a laboratory context would contribute with empirical behavioural data to contrast whether groups with more or less participation result in a more or less symmetrical perceptions.

Although the dyadic approach should be considered in future research that seeks to identify the relevant factors which explain and predict team performance, it is necessary to provide a theoretical explanation as to why the dyadic approach improves prediction accuracy. Maybe the most significant reason is that the dyadic approach takes relationships into account, that is, a team's performance is not independent of interpersonal perceptions between pairs of group members. Hence, the dyadic approach assumes that the social environment in which participants are embedded may be an important factor for explaining group performance. However, we are not advocating that measurements of participants' attributes be omitted from group studies, since both individual characteristics and relational factors are important factors when explaining and predicting team performance. However, individual characteristics could be considered and quantified from a dyadic approach using non traditional indices as mean or variance. In this sense, new dyadic indices could be proposed considering the most common questionnaires or techniques employed to gather data from groups. Nevertheless, the scores reported by these instruments (e.g., the NEO-PI-R) should be used under a dyadic quantitative methodology instead of aggregating all group members' trait scores.

Although the dyadic approach seems to be a promising methodology, most social research is based on the individualistic approach. There would seem to be two reasons for this fact. Firstly, dyadic analysis is often more time-consuming than the individualistic approach. It is not always feasible for social experimenters, whether in laboratories or natural settings, to collect data for long periods of time, although they can often gather data for one or two hours per participant in a study. Secondly, most social research on team performance focuses on psychological processes and attributes rather than on environmental and relational factors associated with group achievement. In this regard, it seems that individual research methods are not appropriate for studying influence and interdependent patterns (Bond et al., 1997).

The present study considers a real academic setting and, therefore, our results may be of interest for practical purposes. At all events, it should be stressed that this research was not designed to provide applied strategies for forming academic groups. In fact, the present study was only concerned with providing some research evidence as how dyadic methods can allow social researchers to improve groups' performance predictions. However, conceptual background is required to theoretically understand why dyadic founded measures are related to global group processes. Unfortunately, although some statistical methods have been developed to analyse dyadic processes, there is a lack of theoretical foundations. That is, dyadic methods have been proposed as helpful tools that can be used to understand perception and behaviour, although they are not themselves a theory of interpersonal perception (Kenny, 1994). Hence, dyadic methods are only specific analytical strategies to study interdependencies.

A key conclusion of this study is that social research requires specific indices to measure agreement in interpersonal perception, at least for Likert response scales. The index used here to quantify agreement in interpersonal perception assumes that frequency data are gathered. The most important drawback of applying the $\Phi$ index in this research is that extremely low values are obtained. Note that although the empirical range of obtained values did not cover a significant part of the possible values, the index is able to distinguish between those groups in which there was greater lack of agreement in interpersonal perception. However, a more suitable index for quantifying agreement in interpersonal perception should be developed for those cases in which Likert response scales are used. Another limitation of the present study deals with the control of group members' acquaintance, that is, cumulative experience that groups gather and has an influence in group performance jointly

*Table 8*
Regression analysis summary of five–participant groups where $\Phi_i$, $G_i$, and $D_i$ represent *asymmetry* and *SRM generalized* and *dyadic* values of the *i*–th item, respectively

| Model | $R^2$ | Corrected $R^2$ | SE | $\Delta R^2$ | F Change | Sig. F Change |
|---|---|---|---|---|---|---|
| 1 | .457 | .430 | .776 | .457 | 16.842 | .001 |
| 2 | .601 | .559 | .682 | .144 | 6.856 | .017 |
| 3 | .685 | .632 | .623 | .084 | 4.773 | .042 |
| 4 | .776 | .724 | .540 | .092 | 6.973 | .017 |
| 5 | .856 | .810 | .447 | .079 | 8.772 | .009 |

1 Predictors: (Constant). $\Phi_4$.
2 Predictors: (Constant). $\Phi_4$. $G_1$.
3 Predictors: (Constant). $\Phi_4$. $G_1$. $\Phi_2$.
4 Predictors: (Constant). $\Phi_4$. $G_1$. $\Phi_2$. $\Phi_3$.
5 Predictors: (Constant). $\Phi_4$. $G_1$. $\Phi_2$. $\Phi_3$. $D_2$

*Table 9*
Parameter estimates for the regression model with five regressors for predicting marks of five–participant groups where $\Phi_i$, $G_i$, and $D_i$ represent *asymmetry* and *SRM generalized* and *dyadic* values of the *i*–th item respectively

| Regressor | b | SE | t |
|---|---|---|---|
| *Intercept* | .958 | .193 | 4.958** |
| $\Phi_4$ | –81.615 | 10.595 | –7.703** |
| $G_1$ | .831 | .154 | 5.407** |
| $\Phi_2$ | 67.057 | 14.916 | 4.496** |
| $\Phi_3$ | –28.939 | 8.627 | –3.354* |
| $D_2$ | –.952 | .321 | –2.962* |

* significant at .05; ** significant at .01

with certain kinds of changes imposed in the groups (Hollingshead, McGrath, & O'Connor, 1993). It seems that task type or the kind of work group (face-to-face and computer mediated) are not the only factors that have an influence on task performance. Previous experience is an important aspect that should be considered for both researchers and applied psychologists. Longitudinal group studies could be of interest to consider the work group experience as a significant variable. In natural contexts groups should work over time and managers could anticipate the differential performance as time passes. Another aspect that should be considered in future studies deals with the structural properties of work groups. It seems that specific kinds of network structures as hierarchical, core-periphery, and structural holes of leaders significantly affect group performance (Cummings & Cross, 2003). Furthermore, Sparrowe, Linden, Wayne, and Kraimer (2001) found a negative relationship between hindrance network density and group performance; therefore, uncooperative behaviours should be considered in future studies since they seem to have the same influence as cooperative behaviours regarding group performance prediction. Additionally, the kind of decentralisation of leadership also has an influence on team performance (Mehra, Smith, Dixon, & Robertson, 2006). Percentages of team performance variance explained in these studies range from 10% to 31% and therefore social network analyses seem to be a promising approach to describe, understand, and predict group dynamics. Finally, the present research was concerned with studying a natural setting and hence many variables were not controlled.

To sum up, the present work summarises the more frequently individualistic methods applied to quantify group characteristics and shows how dyadic measurements of interpersonal perceptions can be used as a new dimension to improve the prediction of team performance. In a more general sense, the dyadic approach is proposed to achieve a better understanding and forecasting of group outcomes.

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APPENDIX I
Interpersonal perception questionnaire

| ITEM | Partner 1 | … | … | … | Partner n |
|---|---|---|---|---|---|
| 1. She/He participates in all group meetings. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |
| 2. She/He assumes her/his responsibility in the task. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |
| 3. She/He fulfils the deadlines for finishing her/his work. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |
| 4. She/He contributes to the development of planned activities. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |
| 5. She/He makes suggestions to promote achievement. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |
| 6. She/He gathers information to do the task. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |
| 7. She/He shows initiative in solving the task problems. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |
| 8. She/He communicates her/his ideas clearly. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |
| 9. She/He analyses the information needed to carry out the task. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |
| 10. She/He offers solutions to reach the objectives of the group. | 1 2 3 4 5 6 | | | | 1 2 3 4 5 6 |

## References


Anderson, M.G., & Tett, R.P. (2006, May). *Who prefers to work with whom? Trait activation in classroom teams*. Paper presented at the 21st Annual Conference of the Society for Industrial and Organizational Psychology, Dallas, TX.

Barrick, M.R., Stewart, G.L., Neubert, M.J., & Mount M.K. (1998). Relating member ability and personality to work-team processes and team effectiveness. *Journal of Applied Psychology, 83,* 377-391.

Bell, S.T. (2007). Deep-level composition variables as predictors of team performance: A meta-analysis. *Journal of Applied Psychology*, *92*, 595-615.

Bond, C.F. Jr., Horn E.M., & Kenny, D.A. (1997). A model for triadic relations. *Psychological Methods, 2,* 79-94.

Cook, W.L. (2005). The SRM approach to family assessment: An introduction and case example. *European Journal of Psychological Assessment, 21,* 216-225.

Cummings, J.N., & Cross, R. (2003). Structural properties of work groups and their consequences for performance. *Social Networks, 25,* 197-210.

de Vries, H. (1995). An improved test of linearity in dominance hierarchies containing unknown or tied relationships. *Animal Behaviour*, *50*, 1375-1389.

de Vries, H., Stevens, J.M.G., & Vervaecke, H. (2006). Measuring and testing the steepness of dominance hierarchies. *Animal Behaviour*, *71*, 585-592.

Elfenbein, H.A., & O'Reilly, C.A., III (2007). Fitting in: The effects of relational demography and person-culture fit on group process and performance. *Group & Organization Management*, *32*, 109-142.

Halfhill, T., Sundstrom, E., Lahner, J., Calderone, W., & Nielsen, T.M. (2005). Group personality composition and group effectiveness: An integrative review of empirical research. *Small Group Research*, *36,* 83-105.

Harrison, D.A., & Klein, K.J. (2007). What's the difference? Diversity constructs as separation, variety, or disparity in organizations. *Academy of Management Review*, *32*, 1199-1228.

Hemelrijk, C.K. (1990a). A matrix partial correlation test used in investigations of reciprocity and other social interaction patterns at group level. *Journal of Theoretical Biology*, *143*, 405-420.

Hemelrijk, C.K. (1990b). Models of, and tests for, reciprocity, unidirectionality and other social interaction patterns at a group level. *Animal Behaviour*, *39*, 1013-1029.

Hollingshead, A.B., McGrath, J.E., & O'Connor, K.M. (1993). Group task performance and communication technology: A longitudinal study of computer-mediated versus face-to-face work groups. *Small Group Research, 24,* 307-333.

Hough, L.M. (1992). The 'big five' personality variables-construct confusion: Description versus prediction. *Human Performance, 5*, 139-154.

Jackson, S.E., Brett, J.F., Sessa, V.I., Cooper, D.M., Julin, J.A., & Peyronnin, K. (1991). Some differences make a difference: Individual dissimilarity and group heterogeneity as correlates of recruitment, promotions and turnover. *Journal of Applied Psychology, 76,* 675-689.

Kelly, J.R., & McGrath, J.E. (1985). Effects of time limits and task types on task performance and interaction of four-person groups. *Journal of Personality and Social Psychology, 49,* 395-407.

Kendall, M.G., & Babington Smith, B. (1940). On the method of paired comparisons. *Biometrika, 31*, 324-345.

Kenny, D.A. (1994). *Interpersonal perception. A social relations analysis*. The Guilford Press: New York.

Kenny, D.A., Kashy, D.A., & Cook, W.L. (2006). *Dyadic data analysis*. New York: Guilford.

Kenny, D.A., & La Voie, L.J. (1984). The social relations model. In L. Berkovitz (Ed.): *Advances in experimental psychology* (vol. 18, pp. 142-182). San Diego, CA: Academic Press.

Kenny, D. A., Mannetti, L., Pierro, A., Levi, S., & Kashy, D. A. (2002). The statistical analysis of data from small groups. *Journal of Personality and Social Psychology, 83,* 126-137.

Kozlowski, S.W.J., & Bell, B.S. (2003). Work groups and teams in organizations. In W.C. Borman & D.R. Ilgen (Eds.): *Handbook of psychology: Industrial and organizational psychology* (vol. 12, pp. 333-375). New York: Wiley.

Landau, H.G. (1951). On dominance relations and the structure of animal societies: I. Effect of inherent characteristics. *Bulletin of Mathematical Biophysics, 13,* 1-19.

Leiva, D., Solanas, A., & Salafranca, Ll. (2008a). An overall statistic for testing symmetry in social interactions. *Psicothema, 20,* 951-957.

Leiva, D., Solanas, A., & Salafranca, Ll. (2008b). Testing reciprocity in social interactions: A comparison between the directional consistency and skew-symmetry statistics. *Behavior Research Methods, 40,* 626-634.

Mann, R.D. (1959). A review of the relationships between personality and performance in small groups. *Psychological Bulletin, 56,* 241-270.

Mehra, A., Smith, B.R., Dixon, A.L., & Robertson, B. (2006). Distributed leadership in teams: The network of leadership perceptions and team performance. *The Leadership Quarterly, 17,* 232-245.

Neuman, G.A., Wagner, S.H., & Christiansen, N. D. (1999). The relationship between work-team personality composition and the job performance of teams. *Group Organization Management, 24,* 28-45.

O'Reilly, C.A., III, Cadwell, D.F., & Barnett, W.P. (1989). Work group demography, social integration and turnover. *Administrative Science Quarterly, 34*, 21-37.

Peeters, M.A.G., Rutte, C.G., van Tuijl, H.F.J.M., & Reymen, I.M.M.J. (2008). Designing in teams: Does personality matter? *Small Group Research*, *39*, 438-467.

Peeters, M.A.G., van Tuijl, H.F.J.M., Rutte, C.G., & Reymen, I.M.M.J. (2006). Personality and team performance: A meta-analysis. *European Journal of Personality, 20*, 377-396.

Solanas, A., Salafranca, Ll., Riba, C., Sierra, V., & Leiva, D. (2006). Quantifying social asymmetric structures. *Behavior Research Methods*, *38*, 390-399.

Sparrowe, R.T., Liden, R.C., Wayne, S.J., & Kraimer, M.L. (2001). Social networks and the performance of individuals and groups. *Academy of Management Journal, 44,* 316-325.

Sundstrom, E., McIntyre, M., Halfhill, T., & Richards, H. (2000). Work groups: From the Hawthorne Studies to work teams of the 1990s and beyond. *Group Dynamics: Theory, Research and Practice*, *4*, 44-67.

Saito, T., & Yadohisa, H. (2005). *Data analysis of asymmetric structures*. Marcel Dekker: New York.

Tett, R.P., & Burnett, D.D. (2003). A personality trait-based interactionist model of job performance. *Journal of Applied Psychology*, *88*, 500-517.

Tett, R.P., & Murphy, P.J. (2002). Personality and situations in coworker preference: Similarity and complementary in worker compatibility. *Journal of Business and Psychology, 17*, 223-241.

Tsui, A.S., Egan, T.D., & O'Reilly, C.A., III (1992). Being different: Relational demography and organizational attachment. *Administrative Science Quarterly*, *37*, 549-579.

Tsui, A.S., & O'Reilly, C.A., III (1989). Beyond simple demographic effects: The importance of relational demography in superior-subordinate dyads. *Academy of Management Journal*, *32*, 402-423.

van Hooff, J.A.R.A.M., & Wensing, J.A.B. (1987). Dominance and its behavioral measures in a captive wolf pack. In H.W. Frank (Ed.): *Man and wolf* (pp. 219-252). Dordrecht: Junk Publishers.

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge: Cambridge University Press.