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WORKGROUP INTERDEPENDENCE ASSESSMENT: GROUP-REFERENT SCALES AND SOCIAL NETWORK ANALYSIS

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The article intends to draw attention to methodological issues identified in literature when assessing group interdependence relations at the workplace. The development of two different methodologies for assessing intragroup interdependence — a group-referent scale and a social network analysis instrument — is described. First, a workgroup interdependence scale was subjected to exploratory factor analysis and three interdependence dimensions (task, outcome, and functional interdependence) were identified. Subsequently, a number of social network analysis measures (density, centralization, reciprocity, fragmentation) were calculated and association between these variables and the different workgroup interdependence dimensions means were analyzed. Data were collected from 78 teams of different organizations. The results suggest that social network measures are moderately correlated to workgroup interdependence dimensions means and, depending on the form of interdependence considered, social network variables are differentially related to the data collected by the intragroup interdependence scale. Methodological and conceptual implications for team interdependence research are discussed.

Key words: Workgroup interdependence; Social network analysis; Group-referent scales; Teams; Sociograms.

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The existence of workgroups or teams in the workplace is nowadays a consensual and recognized reality. Moreover, interdependence has always been recognized as one of the fundamental characteristics for the existence and functioning of workgroups or teams (e.g., Cartwright & Zander, 1968; Guzzo & Dickson, 1996; McGrath, 1984; Savoie & Beaudin, 1995; Wheelan, 1999). In the present study, intragroup interdependence at the workplace is conceptualized as a group characteristic defined by the way members are related or rely on each other when executing team work.

Fundamentally, the current study aims to present two different methodologies for assessing intragroup interdependence relations at the workplace: a group-referent scale and a social network analysis instrument. We began by describing the development of a workgroup interdependence scale where three dimensions were identified after an exploratory factor analysis: task, outcome, and functional interdependence. In fact, team interdependence is commonly analyzed through self-perception of group members using interval scales, after individual scores have been

aggregated to team-level when an acceptable level of intragroup agreement is obtained. Due to some methodological problems concerning interdependence study at group-level of analysis, identified in literature when using consensus and referent-shift models (Chan, 1998), social network analysis is presented and discussed as an alternative methodology. Therefore, the process of development of a social network questionnaire to assess the same three workgroup interdependence dimensions (i.e., task, outcome, and functional interdependence) is described in detail.

This study has also the exploratory purpose of analyzing the association between social network analysis measures (i.e., density, centralization, reciprocity, fragmentation) and the workgroup interdependence dimensions means obtained when using a group-referent interval scale. From the answers to a set of research questions, the results obtained open a privileged space for the discussion of methodological and conceptual issues that researchers should consider when studying team interdependence. Particularly, this study contributes toward clarifying some of the limitations of using interval self-report scales with individual score aggregation to team level and highlights the contributions that the social network measures can bring to the study of workgroup interdependence.

Intragroup Interdependence at the Workplace: Task, Outcome, and Functional Interdependence

Some authors distinguish between workgroups and teams, based on the idea that teams are more interdependent than workgroups (e.g., Savoie & Beaudin, 1995; Wheelan, 1999). In the current article, both concepts are used interchangeably in accordance with other authors (e.g., Allen & Hecht, 2004; Cohen & Bailey, 1997; Guzzo & Dickson, 1996). In general, team interdependence appears conceptually associated to work conditions, and the two most studied variables are task and outcome interdependence. In the literature, autonomous groups and self-management teams are defined as highly interdependent groups (e.g., Cordery, 1996; Polley & Van Dyne, 1994; Sexton, 1994; Ulich & Weber, 1996). In addition to task and outcome interdependence, a third type of workgroup interdependence is also present in those definitions and was conceptualized in this article as functional interdependence. The three dimensions of workgroup interdependence considered in this study are described below.

Task and Outcome Interdependence

Task interdependence refers to the exchange of resources, materials, information, and knowledge between group members in order to attain group goals (van der Vegt & van de Vliert, 2002) or when multiple individuals are required to complete group work (Wageman, 2001). Outcome interdependence is usually referred to both common work-related goals, rewards, and feedback which are related to group performance (van der Vegt & van de Vliert, 2002). When a group is outcome interdependent, individual success is seen as group success and individual rewards and outcomes depend on group effectiveness (Wageman, 1995; Wageman & Baker, 1997). Task and outcome interdependence can be conceived as structural features of the group, but also as having a behavioral dimension (Wageman, 2001; Wageman & Baker, 1997). In this perspec-

tive, it is important to distinguish between the context elements (e.g., technology) that are given to the groups and the way group members share materials and results, exchange information and knowledge and depend on each other in the work process. Both task and outcome interdependence in workgroups are empirically related to positive outcomes. Particularly, task interdependence is positively associated to group performance (e.g., Campion, Medsker, & Higgs, 1993; Campion, Papper, & Medsker, 1996), group satisfaction (e.g., Campion et al., 1993,1996; Shaw, Duffy, & Stark, 2000; van der Vegt, Emans, & van de Vliert, 2000), and work and team commitment (e.g., Shaw et al., 2000). In an experimental study conducted in a laboratorial setting, Comeau and Griffith (2005) established that both task and outcome interdependence lead to organizational citizenship behaviors. Despite these positive results, other studies also found differentiated task and outcome interdependence effects on group effectiveness (e.g., Shaw et al., 2000; van der Vegt, Emans, & van de Vliert, 2001). Finally, the importance on group effectiveness of congruence between task and outcome interdependence (i.e., when both task and outcome interdependence are high or low) was established in several empirical studies (e.g., Saavedra, Earley, & van Dyne, 1993; Savoie & Beaudin, 1995; van der Vegt et al., 2000; Wageman, 1995), leading to a theory-based prescriptive framework (e.g., van der Vegt & van de Vliert, 2002; van Vijfeijken, Kleingeld, van Tuijl, Algera, & Thierry, 2002, 2006).

Functional Interdependence

The concept of functional interdependence arises in the context of some well-known and relevant constructs in workgroup studies frequently appearing as autonomous group features, polyvalent skills and multifunctionality (e.g., Ulich & Weber, 1996), functional flexibility (e.g., Cordery, 1989), and multiskilling (e.g., Cordery, 1989, 1996; Sexton, 1994). Based on the definitions of this set of concepts, functional interdependence can be conceptualized as an integrative form of group interdependence related to knowledge of functions, roles, tasks, duties, requirements, and responsibilities of colleagues at work and to the capacity and ability to perform each other's tasks when necessary. According to some reviewed articles (e.g., Dunphy & Bryant, 1996; van den Beukel & Molleman, 2002), multifunctionality, under some group conditions (e.g., high task interdependence, effective utilization of skills), is related to positive processes and results for the group, such as increased performance and job satisfaction.

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Task and outcome interdependence can both be conceptualized as categorical or continuous variables. For example, Thompson (1967) distinguishes three interdependence categories in increasing order of the interaction and coordination needed among group members to accomplish work: pooled, sequential, and reciprocal interdependence. Later, van de Ven, Delbecq, and Koenig (1976) added a fourth type of interdependence to the model, team interdependence. This typology of task interdependence is mostly used in experimental designs, where the interdependence variable is manipulated in order to create different teamwork structures (e.g., Comeau & Griffith, 2005; Saavedra et al., 1993; Wageman & Baker, 1997). Nevertheless, in non-experimental studies task interdependence in workgroups is generally operationalized as a continuous variable,

which is assessed by Likert-type scales (e.g., Campion et al., 1993; van der Vegt, Emans, & van de Vliert, 1999; van der Vegt et al., 2001).

Outcome interdependence can also be operationalized as a categorical variable, as in the classical theory of cooperation and completion by Deutsch (1949), which distinguishes three different interdependence structures: positive interdependence of individual goals (or cooperation), negative interdependence of individual goals (or competition), and independence of individual goals. In experimental studies, outcome interdependence is often defined as a categorical variable that is manipulated to produce competitive and cooperative structures of group work (e.g., Beersma et al., 2003; Rosenbaum et al., 1980; Saavedra et al., 1993; Wageman & Baker, 1997). On the other hand, outcome interdependence is also studied in correlational studies as a continuous variable and assessed by scales through respondents' perception (e.g., Campion et al., 1993; van der Vegt et al., 1999, 2000).

Functional interdependence-related variables could be assessed in the same way as continuous variables (e.g., Campion et al., 1993; van der Vegt & van de Vliert, 2005) or as a group structural or compositional characteristic which can be externally controlled, for example through cross-functional and functional team design (e.g., Uhl-Bien & Graen, 1998; Yeh & Chou, 2005) or team cross-training (e.g., Cannon-Bowers, Salas, Blickensderfer, & Bowers, 1998; Volpe, Bowers, Cannon-Bowers, Salas, & Spector, 1996).

Based on the typology of compositional models presented by Chan (1998), the consensus and referent-shift models are the most frequently used in team interdependence in the empirical literature reviewed. In both perspectives, group work-related interdependence is analyzed through group members' self-perception using interval scales, where the individual scores are aggregated to team level if an acceptable level of intragroup agreement is achieved. In the direct consensus model, individual-level perceptual responses regarding the extent to which each team member considers him/herself to be interdependent of others are combined in a central tendency index (e.g., mean) to represent team interdependence. In referent-shift consensus models, the referent of scale item content changes from the "self" to "the team as a whole," and team interdependence is now represented by group members' consensus about the extent to which team members are interdependent of each other. In Table 1, some item examples of workgroup interdependence measures are provided to illustrate these two composition models.

TABLE 1
Consensus and referent-shift models (Chan, 1998)
and workgroup interdependence dimensions: Examples of items

	Consensus model	Referent-shift model
Task interdependence	"I have to work closely with my team members to do my work properly" (Van der Vegt et al., 2001)	"Within my team, jobs performed by team members are related to one another" (Campion et al., 1993)
Outcome interdependence	"My work goals come directly from the goals of my team" (Campion et al., 1993)	"Group members are informed about the goals they should attain as a group" (Van der Vegt et al., 2000)
Functional interdependence	"I have other skills than my team members" (Van der Vegt & van de Vliert, 2005)	"It is easy for the members of my team to fill in for one another" (Campion et al., 1993)

The use of these measures can lead to methodological problems concerning the interpretation of results of team-level analysis (Bliese, 2000; Cole, Bedeian, Hirschfeld, & Vogel, 2011; Kozlowski & Klein, 2000). In this context, social network analysis methodology can bring important contributions to the study of group interdependence relations.

Workgroups and Social Network Analysis

Interdependence among members of workgroups is defined by the existing interpersonal relations and can therefore be represented as a social network. Social network analysis is currently one of the most used and preferred approaches in the social sciences to understand and describe the social structure of groups, organizations, and communities. Its development has almost a century of history, involving various authors, perspectives, and disciplines. In particular, this period overlaps with the history of the study of groups (Katz, Lazer, Arrow, & Contractor, 2004) and the organizational context seems to be present right from the beginning in the development of the social network approach (Kilduff & Tsai, 2003). During the last decades, a growing academic interest in the methodology of social network analysis has been evident (Knoke & Yang, 2008). However, this methodology is not a very common approach for the study of teams in organizational contexts, as attested by Henttonen's (2010) review of empirical studies published between 1958 and 2008, where workgroups were conceptualized as social networks. Data were collected in organizational contexts in only 12 out of a total of 32 studies considered in this literature review, with the majority of the studies developed in laboratory or academic settings.

Based on the literature (e.g., Knoke & Yang, 2008; Wasserman & Faust, 1994), in social network analysis the following levels can be distinguished: individual/node, dyad, triad, subgroups, and the group or network as a whole. In the present study, the complete-network level of analysis is considered and the social system is examined as a unit, based on the links between all actors. The social network data is graphically represented through network graphics or diagrams (i.e., sociograms) where actors are represented as points and relationships among the actors as lines in two-dimensional space (Kilduff & Tsai, 2003). For the characterization of social networks in organizations, these authors refer and distinguish the concepts of density, centralization, reachability, and balance. Density is defined by the number of connections which exist between the network actors compared to the maximum possible number of connections that could be present. We may consider that a team is highly dense when most members 1) provide work-related information to the majority of colleagues (task interdependence), 2) have related objectives, rewards, and feedback (outcome interdependence), and 3) know what each colleague is doing in their work and are capable of substituting him/her if necessary (functional interdependence). Centralization refers to the degree to which the network is centralized around one or a few actors. A team can be considered centralized 1) when most members rely on only one or few members in order to adequately complete their work (task interdependence), 2) when individual objectives, feedback, and rewards depend on a very small group of team members (outcome interdependence), and 3) when only a few people know what each colleague is doing in their work and what are his/her responsibilities (functional interdependence). The centralization index has two components: indegree centralization (e.g., the number of people who rely on each team member/actor in order to complete his work) and outdegree centralization (e.g., the number of people each team member/actor relies on in order to complete his work). Reachability is related to the number of

people reached by each actor through all possible steps and can be measured by fragmentation degree, defined by the proportion of pairs of actors that are unreachable from each other. In a high-reachability team, information, relations, or knowledge may diffuse more rapidly, reaching the majority of team members through a reduced number of intermediaries. Finally, balance of a network is an indicator of the degree of structuring that can be assessed by reciprocity (i.e., proportion of dyads) and transitivity (i.e., proportion of triads) measures. The reciprocity degree in a team depends on the proportion of pairs of members with reciprocal (or symmetric) relations (e.g., one particular member gives information to a colleague and also receives information from him/her). As will be seen subsequently, these four indicators are considered in the selection of social network measures used in this empirical study.

Borgatti and Li (2009) and Borgatti, Mehra, Brass, and Labianca (2009) present a framework of relationship types which intends to organize and clarify the conceptual and theoretical information which has been flourishing in social network analysis literature. Based on this typology, a relation between two people can be continuous, if it is stable and it exists continuously (e.g., having similarities with someone else in terms of an attribute or location, having an affective or kinship relation with others, knowing something about other people, or having influence over someone) or discrete, if it only occurs over a limited time or space (e.g., give information, have a conversation, or help someone else). Task and outcome interdependence relations are discrete because they occur in the work context and are dependent on the teamwork circumstances. In particular, task interdependence ties are defined as flow ties because they involve the transmission of information and resources; outcome interdependence is well defined as an interaction tie because it implies that some team members may influence the goals, the rewards, and performance of their colleagues. Finally, functional interdependence ties are considered as a continuous social relation because they are present between a pair of team members whenever they are aware of each other's responsibilities, role, and tasks.

Research Questions

Based on the literature review and considering the complete network (i.e., the workgroup/team) as the unit of analysis, the following general research questions are presented.

1) Which of the social network measures (density, centralization, reciprocity, and fragmentation) is closely related to workgroup interdependence when assessed by group-level scales?

2) Is there any difference in the pattern of results between the different forms of workgroup interdependence?

3) What contributions do social network measures bring to the study of workgroup interdependence?

Method

Participants

At an individual level of analysis, a total of 477 employees (40.3% female and 59.7% male) of 97 management and administrative teams, from several different Portuguese companies distribut-

ed by services, commerce, and industry sectors, participated in this study. Ages ranged from 20 to 67 years. Most employees (73.7%) were between 30 and 50 years old, 13.0% were younger than 30 years old, and 13.3% were older than 50 years old. Regarding their education level, 1.4% had less than the basic schooling (i.e., nine years of education), 30.7% had between nine and twelve years of education, 58.3% were graduated, and 9.6% had a postgraduate degree. Average organizational tenure was 10.70 years (SD = 8.34) and average team tenure was 4.93 years (SD = 4.65).

At group-level analysis, 78 teams belonging to 36 different Portuguese organizations from the individual-level sample were considered. Nineteen teams were not considered for the reason that some team members did not respond to all the social network analysis questions and only teams where all the answers were available and valid were included in this group-level sample. The represented areas of organizations were: industry (27.8%), information and communication technology services (19.4%), hospital institutions (22.2%), other services (11.2%), commerce (11.1%), and transport and distribution (8.3%). All of the teams included in the study had no common members and executed tasks with considerable autonomy and responsibility in decision-making. The size of the teams ranged from three to ten members (M = 5.33; SD = 1.91). Only teams where all the social network analysis answers were available and valid were considered.

Boundary specification is a central issue in network analysis (Knoke & Yang, 2008; Wasserman & Faust, 1994). In the definition of social network boundaries, a set of conditions were taken into account. The workgroups involved in the study all included members who were formally and internally recognized as part of the team, based on criteria such as direct and regular interaction between the group members and the sharing of common goals. Only teams with a minimum of three and a maximum of ten people were considered. In the present research, the delineation of boundaries for each of the teams was based on information given by the organization representative and confirmed by the members of the groups. Thus, the limits of the social networks were defined prior to data collection.

Measures

Workgroup interdependence scale. The workgroup interdependence scale was developed following these core steps: 1) a wide literature review; 2) the selection and adaptation of an item pool; 3) an item review by experts; 4) using a pretest scale among a set of team members from two different organizations to analyze both item comprehensibility and context relevance; 5) the item test scored on a 7-point scale from 1 (*never*) to 7 (*always*); 6) an exploratory factor analysis (EFA). Task and outcome interdependence items were adapted from task, feedback, and reward interdependence subscales of a Work Group Characteristics Measure (Campion et al., 1993, 1996). First, the nine items were translated into Portuguese and subsequently back-translated to English. Then, some of the items were adjusted so as to consistently refer to the team ("In my team, we . . ."), providing the means for the group-level interpretation of results according to a composition model which "describes phenomena that are essentially the same as they emerge upward across levels" (Kozlowski & Klein, 2000, p. 16). Six more items were added to the nine items adapted from Campion et al. (1993) to account for the functional interdependence dimension, defined as the mutual dependence between group members and related to the possibility of being capable or available to perform each other's tasks and functions (two of these items were adapted from Campion et al.'s (1993) scale and were selected from the flexibility subscale).

Based on the theoretical framework, the three extracted factors were expected to correlate to some extent. Thus, an EFA with oblique rotation was run with the 15-item version. The Kaiser-Mayer-Olkin (KMO) index was .88, and Bartlett's sphericity test was significant, $\chi^2(105) = 3593.13$, $p < .001$, indicating the adequacy of this data for factor analytic procedures. As theoretically expected, a three-factor solution was suggested by application of the scree-test criterion. Based on statistical criteria (Stevens, 2009), we decided to eliminate one item ("Jobs performed by team members are related to one another") because it had identical and relatively low loadings in task and outcome interdependence dimensions (i.e., .33 and .41, respectively). This item was conceptualized by Campion et al. (1993, 1996) as being part of task interdependence. The final 14-item version of the measure explained 56.55% of the total variance and comprised three factors: Factor 1 (functional interdependence) included six items (eigenvalue = 4.70); Factor 2 (outcome interdependence) included six items (eigenvalue = 2.46); and Factor 3 (task interdependence) comprised two items (eigenvalue = .76). Factor loadings and item communalities, after the exploratory factor analysis with oblimin rotation, are presented in Table 2. Functional interdependence and outcome interdependence subscales have good internal consistency, with Cronbach's alpha coefficients of .92 and .94, respectively. Only the task interdependence subscale shows an interitem correlation coefficient of .53.

TABLE 2
Factor analysis loadings and communalities on the workgroup interdependence scale three-factor solution after oblimin rotation ($N = 477$)

		Factor 1	Factor 2	Factor 3	h^2
Factor 1: Functional interdependence					
In my team. . .					
12.	. . . we have technical expertise for role and job rotation as members of the same team	.90	–.07	.04	.77
10.	. . . we are able to replace each other in our tasks within the team	.88	–.08	–.02	.72
13.	. . . we are able to assume the duties and responsibilities of our teammates	.88	–.03	–.01	.75
15.	. . . when one member has work overload, his work can be well done by colleagues	.78	.00	.01	.62
14.	. . . when someone is missing at work, the other group members have the knowledge to perform their tasks	.77	.10	–.06	.67
11.	. . . we know the work of other group members	.57	.13	.02	.40
Factor 2: Outcome interdependence					
In my team. . .					
04.	. . . our individual goals come directly from the team's objectives	–.04	.73	–.01	.51
06.	. . . the tasks we perform are determined by the objectives of the team	–.03	.72	–.03	.49
07.	. . . the information about how well we are doing our job comes mainly from information about how well the work of the whole team is doing	.00	.71	.06	.54

(table 2 continues)

Table 2 (continued)

		Factor 1	Factor 2	Factor 3	h^2
05.	. . . our activities of a normal working day are determined by the team's goals for that day	.00	.70	.06	.53
08.	. . . the evaluation of our individual performance is strongly influenced by the quality of the whole team performance	.02	.68	.08	.51
09.	. . . the rewards received by the individual work (as salary or promotions) are determined in large part by contributions of each team member	.08	.55	–.07	.31
Factor 3: Task interdependence					
In my team. . .					
01.	. . . we are not able to accomplish our tasks without information from other team members	.01	–.06	.74	.52
02.	. . . team members depend on each other for information or materials needed to perform their tasks	–.01	.11	.71	.57

Note. h^2 = communalities after factor extraction.

In order to test the multidimensionality of workgroup interdependence scale at team level (N = 78), a confirmatory factor analysis was conducted using maximum likelihood procedure. The team scores were obtained by aggregating the individual scores (i.e., computing the group mean) on each of the items within the teams. Concerning overall model fit analyses and after adding covariances between the workgroup interdependence factors and between two error pairs which were content related (i.e., items 4 and 6 of outcome interdependence subscale and items 11 and 12 of functional interdependence subscale), the results indicated a good model fit at group-level analysis, $\chi^2(72) = 87.68$, $p = .101$; $\chi^2/df = 1.22$; CFI = .98; GFI = .87; RMSEA = .05, $p = .43$.

Social network analysis questionnaire. Considering the entire social network as a unit, the information about every relation among all the actors of each team was used. For the construction of the social network analysis questionnaire, the following steps were considered: 1) to characterize the existent relation between group members, content analysis of workgroup interdependence items (whose construction was based on the literature) was conducted before EFA had been calculated; 2) identification of relationship type involved, based on the typology presented by Borgatti and Li (2009, p. 7) and Borgatti et al. (2009, p. 894); 3) formulation of six social network analysis questions. In Table 3, highlights of these three phases of the construction of the social network analysis questions are presented.

Team members' responses were given on a 7-point scale from 1 (*never*) to 7 (*always*) regarding the six items assessing the frequency of each dyadic workgroup interdependence tie. For outcome and functional interdependence dimensions, before calculating network measures for each team, we computed the average of the individual scores of the items of each interdependence dimension. Therefore, the six network items presented in Table 3 resulted in only three distinct social networks, one for each interdependence dimension. For each group directed and dichotomous

TABLE 3
Phases of the construction of the social network analysis questions

Interdependence dimension	Item examples	Relation	Relation type	Social network analysis questions
Task	Team members depend on each other for information or materials needed to perform their tasks	Transmission of information and materials	Flows	1. I provide *colleague X* information and materials necessary for carrying out his/her work
Outcome	Our individual goals come directly from the team's objectives	Influence on objectives' definition	Interaction	2. The goals I have in my work determine the work objectives of *colleague X*
	The evaluation of our individual performance is strongly influenced by the quality of the whole team performance	Influence on performance	Interaction	3. My performance influences the results of *colleague X*'s performance
	The rewards received by the individual work (as salary or promotions) are determined in large part by contributions of each team member	Influence on rewards	Interaction	4. The work I do influences the rewards that *colleague X* receives
Functional	We have technical expertise for role and job rotation as members of the same team	Knowledge about others' work and function	Social relations	5. I know what *colleague X* is doing at work and what functions he/she performs
	When someone is missing at work, the other group members have the knowledge to perform their tasks			6. I can replace *colleague X* on his/her responsibilities and tasks if necessary

(0 = *absence of tie*; 1 = *presence of tie*) data were considered, given that each tie was present when the individual score was equal or higher than 4 (*sometimes*).

Team social network data were analyzed using routines available in the UCINET 6 computer program (Borgatti, Everett, & Freeman, 2002). The social network data is introduced into a sociomatrix or adjacency matrix which is represented by a square array of numerical elements arranged in rows and columns and has the following characteristics (Knoke & Yang, 2008): 1) the group members appear in the same order across the rows and the columns and each cell displays information about the relation between each pair of actors (i.e., members of the same team); 2) the numerical value in a cell measures a specific relation between the respective pair of actors designated by the respective row and column; and 3) the values of the matrix main diagonal are not significant and are not considered during data analysis.

In Table 4, social network measures calculated at group-level in the current study are described and examples of sociograms (i.e., diagrams of social network data) are displayed (Figures 1 to 4). Following several authors' recommendations (e.g., Hanneman & Riddle, 2005; Kilduff & Tsai, 2003; Knoke & Yang, 2008; Wasserman & Faust, 1994), to assess each of the social network characteristics of density, centralization, reachability, and balance, described previously, five social network measures were calculated. The diagrams were provided by NetDraw 2.111, a network visualization software (Borgatti, 2002) and graphically represent the interdependence relations on four teams which participated in the study. For each of the four network measures presented, one team, showing contrasting values in different interdependence dimensions, was selected.

Procedure

All the questionnaires were administrated at the same time to each participant in the work setting, in the presence of one of the researchers or an organization or team representative to whom complete and rigorous instructions had been given concerning instrument administration to ensure the standardization of data collection conditions. Network research in organizations entails some important ethical issues, clearly identified and discussed (e.g., Borgatti & Molina, 2005), related to response anonymity, confidentiality, consent form, or missing data. Therefore, informed consent was required from team members, organization representatives, and researchers alike to allow study participation. All measures were anonymously self-reported by subjects and the strict confidentiality of their responses was assured. Each individual answered each of the six items regarding every other colleague. To complete the social network questionnaire, a codification system was created to guarantee identity protection of respondents. A letter was assigned to each team member before questionnaire completion and only participants knew the correspondence between each person and the code. The social network questionnaire already had the letters which replaced any personal identification above the questions. Each participant had to report the frequency of each relationship considering that each of these letters represented a certain team colleague. The column relative to his own letter had to be left blank. The data recognition collection procedure has several advantages in relation to the free-recall method, where cognitive biases tend to occur more often due to factors such as network size (e.g., Brewer & Webster, 1999) or respondent cognitive skills (e.g., Stiller & Dunbar, 2007).

TABLE 4
Description and exemplification of complete network measures calculated in the study

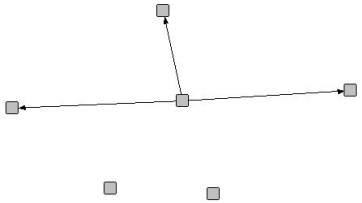
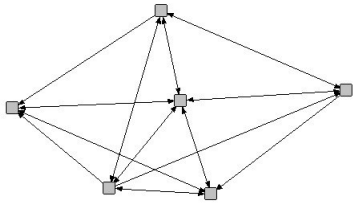
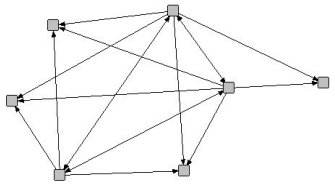
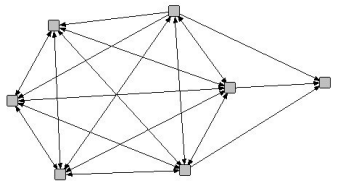
Complete network measures and index description	Examples of sociograms of workgroups/teams with discrepant values in different interdependence social networks
Density Network density = Ratio of the number of adjacencies that are present divided by the number of pairs of actors in the network	(a) Outcome interdependence ties  Density = .10 (b) Task interdependence ties  Density = .73
Balance Reciprocity (dyad method) = Ratio of the number of pairs with a reciprocated tie between them divided by the number of pairs with any adjacent tie	(a) Outcome interdependence ties  Reciprocity = .21 (b) Functional interdependence ties  Reciprocity = .72

FIGURE 1
Sociograms of Team A.

FIGURE 2
Sociograms of Team B.

(table 4 continues)

Table 4 (continued)

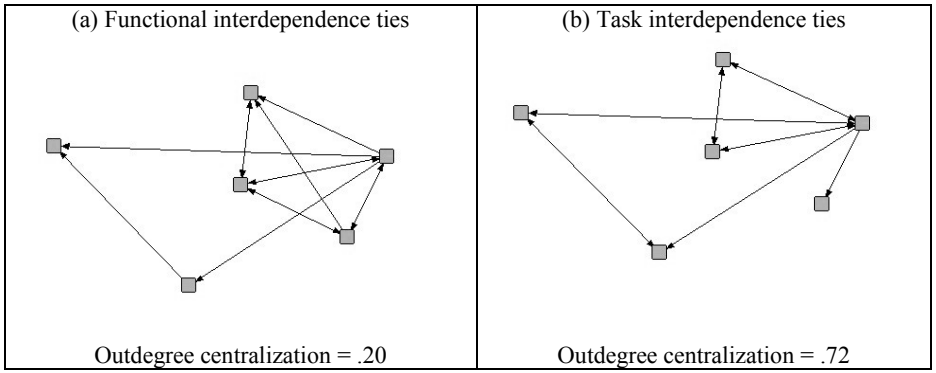
Complete network measures and index description	Examples of sociograms of workgroups/teams with discrepant values in different interdependence social networks
Centralization Degree (*) centralization (Freeman, 1979) = Ratio of the sum of degree differences between the most central actor and all other actors by the maximum possible (i.e., the value reached by a star graph)	

FIGURE 3
Sociograms of Team C.

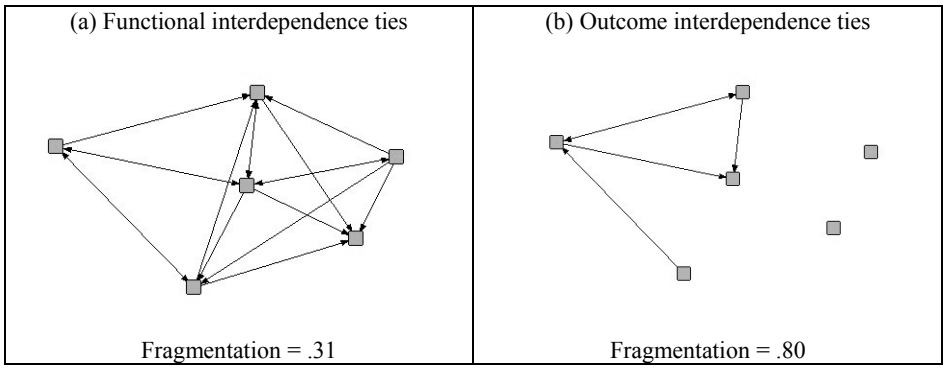
Reachability Distance-weighted fragmentation – ^{D}F (Borgatti, 2003, 2006) = Proportion of pairs of actors that are unreachable from each other considering the reciprocal distance between each pair	

FIGURE 4
Sociograms of Team D.

Note. (*) = Degree – number of connections that an actor has in a network; Indegree – relative to ties that are received from other network actors; Outdegree – relative to ties that are given to each of the other network actors.

RESULTS

Through histogram analysis, we concluded that normality of social network analysis data was not assured for all the variables. As a result, nonparametric correlation (Spearman rank order correlation, rho) tests were conducted at group-level. Within each team, individual scores where aggregated to the group-level. To justify this procedure three indices were calculated. In order to assess within-group interrater agreement, an average deviation index (AD_M; Burke & Dunlap, 2002; Burke, Finkelstein, & Dusig, 1999) was computed. AD_M is one of the most commonly used interrater agreement indicators to estimate agreement in the metric of the original scale of the items and is a function of each judge's deviation from the mean rating taken over judges (LeBreton & Senter, 2008). In this study, the practical value of within-group agreement is adopted as reference value (i.e., $c/6$, where c is the number of response categories) to which the observed values are compared. An empirical value which does not exceed $c/6$ implies sufficient within-group agreement. As an alternative, Burke and Dunlap (2002) suggest the estimation of critical values. LeBreton and Senter, however, recognize that additional research is needed to outline the critical values "when judges' ratings may have been influenced by various response biases" (p. 837). When discussing the methodological issues concerning interrater reliability and interrater agreement, LeBreton and Senter describe the practical value of AD_M as a reliable and useful indicator often used to justify aggregating lower-level data (which should be presented along with interrater consistency indicators, as ICC1 and ICC2). Then, according to the guidelines of Bliese (2000), James (1982), and LeBreton and Senter (2008), two intraclass coefficient indices, ICC1 and ICC2, were also considered to assess the reliability between individual estimates of the group mean and the estimate of the reliability of all group means in a certain variable, respectively. Table 5 presents the intragroup agreement results obtained for each variable, first considering all the teams that participated in this study ($N = 78$) and then, only the teams whose values of AD_M were below/equal 1.17, the cut-off value considered for a 7-point scale. Taking into account several authors' criteria for cut-off values (Bliese, 2000; Burke & Dunlap, 2002; James, 1982; LeBreton & Senter, 2008) we concluded that results were indicative of an acceptable agreement and relative consistency that justifies individual score aggregation at team level.

TABLE 5
Intragroup agreement indices

	Complete sample ($N = 78$)				Teams with $AD_M \leq 1.17$		
	AD_M (Mean)	ICC1	ICC2	Teams with $AD_M > 1.17$ N (%)	AD_M (Mean)	ICC1	ICC2
Functional interdependence	.76	.37	.75	6 (7.69%)	.73	.42	.79
Outcome interdependence	.87	.32	.71	11 (11.54%)	.81	.35	.74
Task Interdependence	.86	.20	.57	15 (19.23%)	.73	.25	.63

Note. AD_M = average deviation index; ICC = intraclass correlation coefficient.

As expected, all the indices became more suitable after the elimination of teams whose AD_M values were higher than the limit of 1.17. None of the groups had AD_M higher than 1.17 in all the three interdependence variables and the dimension with a higher proportion of teams in this condition was task (19.23%; N = 15), followed by outcome (11.54%; N = 11) and, finally, functional interdependence (7.69%; N = 6).

Only the teams with acceptable within-group agreement were considered in the forthcoming analysis. Overall perception concerning workgroup interdependence was assessed through workgroup interdependence dimensions and group mean scores were calculated for each team. Social network methodology requires that all the group members' responses are available (Wasserman & Faust, 1994) and for all the 78 one-mode social networks a set of five variables was calculated: density, reciprocity, indegree centralization, outdegree centralization, and fragmentation. These variables have already been described in Table 4.

Table 6 exhibits the means, standard deviations, and intercorrelation matrix for the functional, outcome, and task interdependence variables, considering only the teams with acceptable values of intragroup agreement (i.e., $AD_M \leq 1.17$).

TABLE 6
Workgroup interdependence (functional, outcome, and task):
Descriptive statistics and nonparametric correlations

	M	*SD*	1	2	3	4	5
1. Functional interdependence (FI)	5.06	0.78					
2. Density of FI	.69	0.21	.53***				
3. Reciprocity of FI	.60	0.24	.38**	.80***			
4. Outdegree centralization of FI	.34	0.22	–.50***	–.83***	–.71***		
5. Indegree centralization of FI	.21	0.15	–.32***	–.42***	–.58***	.51***	
6. Fragmentation of FI	.22	0.19	–.49***	–.98***	–.83***	.83***	.44***
1. Outcome interdependence (OI)	4.84	0.67					
2. Density of OI	.38	0.24	.48***				
3. Reciprocity of OI	.37	0.34	.17	.70***			
4. Outdegree centralization of OI	.56	0.28	.15	–.05	–.30*		
5. Indegree centralization of OI	.26	0.20	–.21	–.23	–.15	–.04	
6. Fragmentation of OI	.56	0.26	–.46***	–.97***	–.77**	.05	.21
1. Task interdependence (TI)	4.32	0.70					
2. Density of TI	.60	0.24	.42**				
3. Reciprocity of TI	.49	0.29	.27*	.80***			
4. Outdegree centralization of TI	.45	0.27	–.35**	–.78***	–.68***		
5. Indegree centralization of TI	.26	0.19	–.35**	–.36**	–.36**	.15	
6. Fragmentation of TI	.32	0.23	–.38**	–.96***	–.85***	.75***	.31*

Note. N = 72 (functional interdependence), N = 67 (outcome interdependence), N = 63 (task interdependence).
* $p < .05$. ** $p < .01$. *** $p < .001$.

Considering the overall results presented in Table 6, the correlations between the interdependence subscale mean and density scores are significant and positive for functional, outcome,

and task types of interdependence relations (r_s = .53, p < .001; r_s = .48, p < .001; r_s = .42, p = .001, respectively). Similar results were obtained for correlations between the interdependence subscale mean and reciprocity scores for functional (r_s = .38, p = .001) and task (r_s = .27, p = .033) dimensions. However, the relationship between the outcome interdependence subscale mean and reciprocity scores does not reach statistical significance (p = .16). The correlations between the interdependence subscale mean and fragmentation scores are negatively significant for functional, outcome, and task dimensions (r_s = –.49, p < .001; r_s = –.46, p < .001; r_s = –.38, p = .002, respectively). With regard to the outdegree and indegree centralization index, the pattern of correlations is not identical for all the three interdependence dimensions. For functional interdependence, both centralization indices correlate significantly and negatively with the respective subscale mean (r_s = –.50, p < .001 for outdegree centralization and r_s = –.32, p = .006 for indegree centralization). Similarly, the task interdependence subscale mean is significantly and negatively associated with outdegree (r_s = –.35, p = .005) and indegree (r_s = –.35, p = .002) centralization. With respect to the outcome interdependence subscale and the centralization indices, none of the degree centralization variables are significantly related to the outcome interdependence subscale mean (p > .09). In general, the strength of the correlations is higher in the functional interdependence results.

Discussion and Conclusions

Initially, obtained results are discussed in response to the research questions. Then, main implications, limitations, and further investigation suggestions are presented.

Which of the social network measures (density, centralization, fragmentation, and reciprocity) is more related to workgroup interdependence when assessed by group-level scales? In general, density and fragmentation are measures that are most related to the workgroup interdependence subscale means, signifying that number of ties and reachability are the social network (i.e., team) characteristics more associated with group-consensus scale responses. Social network density is positively, but only moderately, correlated to all the three interdependence subscale means; fragmentation, assessed by the distance-weighted fragmentation index, is negatively and also moderately associated to the functional, outcome, and task interdependence dimension means. In fact, all these correlation magnitudes are between .38 and .53, indicating that although the subscale means and each one of the two social network analysis measures (i.e., density and fragmentation) shared some of their variance, each variable also contained unique aspects of social relations in workgroups related to functional, outcome, or task interdependence relationships, even considering the random and systematic measurement errors. So, the main question that remains without a clear answer regards what is in fact assessed through a self-report questionnaire about workgroup interdependence. Recently, Brashears and Quintane (2015) found that people's social network information is mainly encoded and recalled as triads, but not as individual dyads. Similarly, the schemata used to process social information could explain to some extent the moderated and weak correlations obtained between social network analysis measures and workgroup interdependence subscale means. Respondents, when facing the interdependence scale items, might have had as referent not the entire team at the same time, but only some of the relationships which are cognitively available in that moment (for instance, because those ties are perceived as balanced or particularly intense or frequent).

Is there any difference in the pattern of results between the different forms of workgroup interdependence? The results show that social network analysis measures are significantly associated to each of the three workgroup interdependence variable means considered in this study. Nevertheless, we can identify some differences in the correlation matrix between functional, outcome, and task forms of interdependence. These differences can be explained by the different nature of relationships that characterize these types of workgroup interactions. Outcome interdependence social networks are, on average, more fragmented and outdegree centralized (.56 for both measures), when compared to task (.32 and .45, respectively) and functional (.22 and .34, respectively) interdependence social networks. Functional interdependence social networks are, on average, more dense (.69) and reciprocal (.60) in their ties, followed by task interdependence (density = .60; reciprocity = .49) and finally, outcome interdependence social networks (density = .38; reciprocity = .37). These results could be explained by the fact that the last type of relationship implies a more formal and externally influenced form of interdependence, related to the group rewards management and performance evaluation system within a team. When the relationship type is a social relation, like functional interdependence, which involves sharing knowledge, abilities, and competences, reciprocity may exist because of the more informal and spontaneous nature of this relationship that is expected to be less structure dependent or externally determined. These social network characteristics might possibly explain the fact that in functional and task interdependence assessment, there are significant negative correlations between the subscale mean and degree centralization measures considered in the study and, contrastingly, the outcome interdependence subscale mean is not associated to both indegree and outdegree centralization. The possibility of nonlinear relationships should also be considered. Curiously, the highest percentage of teams whose AD_M agreement index was above the cut-off point is in relation to task interdependence (i.e., almost 20% of the teams) and not to outcome interdependence, whether outcome interdependence social networks are, on average, the most fragmented and centralized or not. In respect to the functional interdependence dimension, results are more consistent: only 7.19% of the teams have nonacceptable within-group agreement values and the respective social networks are, in fact, denser and more balanced and less fragmented and centralized. This proportion could also be used as an indicator of the appropriateness of aggregating individual data to unit level in the operationalization of certain constructs. But, what proportion is high enough to exclude this methodological approach? Social network analysis methodology prevents the exclusion of groups because of this criterion and makes the use of all available data possible.

What contributions could social network measures bring to the study of workgroup interdependence? Although the social network analysis methodology allows for the study of the relational structure of a group, a traditional scale at group-level would have the advantage of being a more pragmatic measurement tool, easier to administer in work-related contexts for team research, diagnosis, and intervention purposes. Nevertheless, this option could entail some associated methodological problems, for example, the presence of unbalanced ties and subgroups or isolated members in the same team. These network characteristics may influence the perception of the whole group, invalidating the compositional hypothesis of emerging group-level phenomenon. The discussion about composition models is of particular interest in organizational research, which usually comprises functional relationships among constructs at diverse levels of analysis (Chan, 1998; Kozlowski & Klein, 2000). In the current study, the composition model assumed is,

according to Chan, the referent-shift consensus model, where "lower-level units being composed by consensus are conceptually distinct though derived from the original individual-level units" (p. 236). This assumption is adopted when the researcher's objective is to identify how each team member perceives the group opinion of the interdependence relations that characterize the workgroup and whether or not there is a consensus present within each team regarding those individual perceptions. This was the procedure used in this study to justify the aggregation of individuals' collective perceptions to group-level of analysis, considering workgroup interdependence as a shared unit characteristic. However, in light of the results the validity of this conceptual and methodological perspective when applied to work-related interpersonal relations within teams may be questionable, since it is probable that the lower-level characteristics diverge within the group, influencing the individual perceptions of this group property in a distinct manner. Some authors (e.g., Campion et al., 1993; van der Vegt et al., 1999, 2000) did not find sufficient within-group agreement in individual responses on at least one type of team interdependence, suggesting that team members experienced different degrees of interdependence. In most of these cases, authors opted to study task interdependence at individual level of analysis without data aggregation at group-level.

Despite the consensus and consistency within teams observed through the intragroup agreement index, social network analysis measures, like density or fragmentation, could be a more accurate methodology for assessing interdependence relationships in workgroups. Social network analysis measures are calculated taking into account every dyadic tie within the same unit, rather than a global perception of unit functioning. In addition, any validated and consistent scale that assesses a particular type of interpersonal relationship in a certain unit should be considered as a reliable source for the developed social network analysis questions. The option of studying workgroup interdependence through social network analysis could be better understood in the framework of the compilation models, rather than through the composition approach, which conceptualizes constructs as configural unit properties that "characterize patterns, distribution, and/or variability among members' contributions to the unit-level phenomenon" (Kozlowski & Klein, 2000, p. 31). Thus social network analysis measures represent patterns of relationships and not shared properties within a group that result from agreement or consensus among team members. Cole et al. (2011) present some methodological and statistical constraints inherent to the reliance of means of individual-level scores to represent group constructs, since this central tendency measure does not consider the variability of data and only groups with high within-group agreement are suitable to be represented by the average of the individual data. Consequently, the authors proposed the application of dispersion measures (i.e., within-group variance) at group-level for assessing variability among team members as more meaningful than the group mean to operationalize higher-level constructs. Once again, social network measures appear to be a valid alternative as degree density and centralization provide different information about group-level characteristics associated with both central tendency and dispersion indices, respectively.

Limitations and Suggestions for Further Research

One possible limitation of the study concerns the common method variance of the measures considering that all of them were self-reported by team members at the same moment. Secondly, dispositional factors of subjects that could influence results were not assessed or con-

trolled in the study. For example, the influence of individual variables in the perception of social relations by name recognition technique is known, as is the respondent's mood (e.g., Hlebec & Ferligoj, 2001). Also, the measure of within-group agreement could lead to a biased agreement estimate. Recently, Bossenz, Kunina-Habenicht, and Kunter (2014) found that AD_M tends to overestimate agreement in small groups and propose an adjusted AD_M which takes group size into account. Moreover, the authors encourage more research regarding measures of agreement within groups. Finally, despite the acceptableness of the psychometric qualities of the workgroup interdependence scale developed in the study, the task interdependence subscale only comprises two items, which could lead to some methodological problems. Thus, more studies are desirable in order to test the validity and reliability of the workgroup interdependence scale.

Further research is required to more thoroughly analyze the validity of group-level scales in assessing interaction patterns in a certain unit and to contribute to a better understanding of what we are truly assessing when we ask team members to characterize the interpersonal relations of their group considering the group as an entity. In fact, it would be reasonably expected by researchers that team members have an accurate and relative consensual perception of the group based on a global assessment of interpersonal relations. In fact, interdependence assessment is seen by researchers as an important subject when studying other types of relationships, such as family interdependence (e.g., Lanz, Scabini, Tagliabue, & Morgano, 2015) or workgroup emotional ties (e.g., Alves, Lourenço, & Miguez, 2013). In work contexts, individual perceptions of group properties could differ due to team structure, particularly when teams are viewed by their members as a centralized or fragmented unit, which occurs with more probability in formal and less mutual ties that are externally defined by organization management or team leadership. The effect of individual position in the network (e.g., the degree which an actor is more or less central or connected) on the perception of group relations is also an interesting feature to be considered in further studies. Moreover, the perception of large groups might be more susceptible to cognitive errors due to the existence of subgroups that become the reference of the subjects' answers, rather than the whole-group. Comparing data collected by self-report measures with objective indicators of the workgroup interdependence structure could also bring some light to the study of validity of those group-level instruments. Moreover, it would be worthwhile studying the extent to which both group-level aggregated means and social network measures have a significant effect on valid group criteria. Finally, it could also be relevant to study the cognitive schemata used by respondents when they process the scale item information requiring a global estimation about intragroup social relations.

As a concluding remark, we believe that workgroup interdependence could be conceptualized as a meaningful characteristic or process in the workplace, but due to methodological issues similar to those described in this article, it is fundamental that operationalization of this variable to the group-level of analysis be adequately clarified and justified in order to guarantee its validity. The results raised the question about what is the referent used by respondents when they answer on a traditional workgroup interdependence scale. Furthermore, social network analysis methodology seems to be an accurate and valid alternative option to study work interdependence in the workplace which could avoid some of the problems related to group-referent consensus procedures and the theoretical interpretation of multilevel results.

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REFERENCES

Allen, J. A., & Hecht, T. D. (2004). The "romance of teams": Toward an understanding of its psychological underpinnings and implications. *Journal of Occupational and Organizational Psychology*, *77*, 439-461. doi:10.1348/0963179042596469

Alves, M., Lourenço, P. R., & Miguez, J. (2013). How to measure socioemotional ties in workgroups? Validation of workgroup socioaffective interdependence scale. *Procedia – Social and Behavioral Sciences*, *84*, 1084-1089. doi:10.1016/j.sbspro.2013.06.704

Beersma, B., Hollenbeck, J. R., Humphrey, S. E., Moon, H., Conlon, D. E., & Ilgen, D. (2003). Cooperation, competition, and team performance: Toward a contingency approach. *Academy of Management Journal*, *46*, 572-590. doi:10.2307/30040650

Bliese, P. D. (2000). Within-group agreement, non-independence and reliability: Implications for data aggregation and analysis. In K. J. Klein & S. W. J. Kozlowski (Eds.), *Multilevel theory, research and methods in organizations: Foundations, extensions and new directions* (pp. 349-381). San Francisco, CA: Jossey-Bass.

Borgatti, S. P. (2002). *NetDraw: Graph visualization software*. Harvard, MA: Analytic Technologies.

Borgatti, S. P. (2003). The key player problem. In R. Breiger, K. Carley, & P. Pattison (Eds.), *Dynamic social network modeling and analysis: Workshop summary and papers* (pp. 241-252). Washington, DC: The National Academies Press.

Borgatti, S. P. (2006). Identifying sets of key players in a social network. *Computational & Mathematical Organization Theory*, *12*, 21-34. doi:10.1007/s10588-006-7084-x

Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). *UCINET for Windows: Software for social network analysis*. Harvard, MA: Analytic Technologies.

Borgatti, S. P., & Li, X. (2009). On social network analysis in a supply chain context. *Journal of Supply Chain Management*, *45*, 5-22. doi:10.1111/j.1745-493X.2009.03166.x

Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network analysis in the social sciences. *Science*, *323*, 892-895. doi:10.1126/science.1165821

Borgatti, S. P., & Molina, J.-L. (2005). Toward ethical guidelines for network research in organizations. *Social Networks*, *27*, 107-117. doi:10.1016/j.socnet.2005.01.004

Bossenz, H., Kunina-Habenicht, O., & Kunter, M. (2014). Estimating within-group agreement in small groups: A proposed adjustement for the average deviation index. *European Journal of Work and Organizational Psychology*, *23*, 456-468. doi:10.1080/1359432X.2012.748189

Brashears, M. E., & Quintane, E. (2015). The microstructures of network recall: How social networks are encoded and represented in human memory. *Social Networks*, *41*, 113-126. doi:10.1016/j.socnet.2014. 11.003

Brewer, D. D., & Webster, C. M. (1999). Forgetting of friends and its effects on measuring friendship networks. *Social Networks*, *21*, 361-373. doi:10.1016/S0378-8733(99)00018-0

Burke, M. J., & Dunlap, W. P. (2002). Estimating interrater agreement with the average deviation index: A user's guide. *Organizational Research Methods*, *5*, 159-172. doi:10.1177/1094428102005002002

Burke, M. J., Finkelstein, L. M., & Dusig, M. S. (1999). On average deviation indices for estimating interrater agreement. *Organizational Research Methods*, *2*, 49-68. doi:10.1177/109442819921004

Campion, M. A., Medsker, G. J., & Higgs, A. C. (1993). Relations between work group characteristics and effectiveness: Implications for designing effective work groups. *Personnel Psychology*, *46*, 823-850. doi:10.1111/j.1744-6570.1993.tb01571.x

Campion, M. A., Papper, E. M., & Medsker, G. J. (1996). Relations between work group characteristics and effectiveness: A replication and extension. *Personnel Psychology*, *49*, 429-452. doi:10.1111/j.1744-6570.1996.tb01806.x

Cannon-Bowers, J. A., Salas, E., Blickensderfer, E., & Bowers, C. A. (1998). The impact of cross-training and workload on team functioning: A replication and extension of initial findings. *Human Factors*, *40*, 92-101. doi:10.1518/001872098779480550

Cartwright, D., & Zander, A. (Eds.). (1968). *Group dynamics: Research and theory*. New York, NY: Harper & Row.

Chan, D. (1998). Functional relations among constructs in the same content domain at different levels of analysis: A typology of composition models. *Journal of Applied Psychology*, *88*, 234-246. doi:10.1037/0021-9010.83.2.234

Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management*, *23*, 239-290. doi:10.1177/ 014920639702300303

Cole, M. S., Bedeian, A. G., Hirschfeld, R. R., & Vogel, B. (2011). Dispersion-composition models in multilevel research: A data-analytic framework. *Organizational Research Methods*, *14*, 718-734. doi: 10.1177/1094428110389078

Comeau, D. J., & Griffith, R. L. (2005). Structural interdependence, personality, and organizational citizenship behavior. *Personnel Review*, *34*, 310-330. doi:10.1108/00483480510591453

Cordery, J. L. (1989). Multi-skilling: A discussion of proposed benefits of new approaches to labour flexibility within enterprises. *Personnel Review*, *18*, 13-22. doi:10.1108/EUM0000000000772

Cordery, J. L. (1996). Autonomous work groups and quality circles. In M. A. West (Ed.), *Handbook of work group psychology* (pp. 225-246). Chichester, UK: John Wiley & Sons.

Deutsch, M. (1949). A theory of co-operation and competition. *Human Relations*, *2*, 129-152. doi:10.1177/001872674900200204

Dunphy, D., & Bryant, B. (1996). Teams: Panaceas or prescriptions for improved performance? *Human Relations*, *49*, 677-699. doi:10.1177/001872679604900507

Freeman, L. C. (1979). Centrality in social networks: Conceptual clarification. *Social Networks*, *1*, 215-239. doi:10.1016/0378-8733(78)90021-7

Guzzo, R. A., & Dickson, M. W. (1996). Teams in organizations: Recent research on performance and effectiveness. *Annual Review of Psychology*, *47*, 307-338. doi:10.1146/annurev.psych.47.1.307

Hanneman, R. A., & Riddle, M. (2005). *Introduction to social network methods.* Riverside, CA: University of California.

Henttonen, K. (2010). Exploring social networks on the team level: A review of the empirical literature. *Journal of Engineering and Technology Management*, *27*, 74-109. doi:10.1016/j.jengtecman. 2010. 03.005

Hlebec, V., & Ferligoj, A. (2001). Respondent mood and the instability of survey network instruments. *Social Networks*, *23*, 125-139. doi:10.1016/S0378-8733(01)00037-5

James, L. R. (1982). Aggregation bias in estimates of perceptual agreement. *Journal of Applied Psychology*, *67*, 219-229. doi:10.1037/0021-9010.67.2.219

Katz, N., Lazer, D., Arrow, H., & Contractor, N. (2004). Network and small groups. *Small Group Research*, *35*, 307-332. doi:10.1177/1046496404264941

Kilduff, M., & Tsai, W. (2003). *Social networks and organizations*. London, UK: Sage Publications.

Knoke, D., & Yang, S. (2008). *Social networks analysis* (2nd ed.). Thousands Oaks, CA: Sage Publications.

Kozlowski, S. W. J., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal and emergent processes. In K. J. Klein & S. W. J. Kozlowski (Eds.), *Multilevel theory, research and methods in organizations: Foundations, extensions and new directions* (pp. 3-90). San Francisco, CA: Jossey-Bass.

Lanz, M., Scabini, E., Tagliabue, S., & Morgano, A. (2015). How should family interdependence be studied? The methodological issues of non-independence. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *22*, 169-180. doi:10.4473/TPM22.2.1

LeBreton, J. M., & Senter, J. L. (2008). Answers to 20 questions about interrater reliability and interrater agreement. *Organizational Research Methods*, *11*, 815-852. doi:10.1177/1094428106296642

McGrath, J. E. (1984). *Groups: Interaction and performance*. Upper Saddle River, NJ: Prentice-Hall.

Polley, D., & Van Dyne, L. (1994). The limits and liabilities of self-managing work teams. In M. M. Beyerlein & D. A. Johnson (Eds.), *Advances in interdisciplinary studies of work teams: Vol 1. Theories of self-managing work teams* (pp. 1-38). Greenwich, UK: JAI Press.

Rosenbaum, M. E., Moore, D. L., Cotton, J. L., Cook, M. S., Hieser, R. A., Shovar, M. N., & Gray, M. J. (1980). Group productivity and process: Pure and mixed reward structures and task interdependence. *Journal of Personality and Social Psychology*, *39*(4), 626-642.

Saavedra, R., Earley, P. C., & van Dyne, L. (1993). Complex interdependence in task-performing groups. *Journal of Applied Psychology*, *78*, 61-72. doi:10.1037/0021-9010.78.1.61

Savoie, A., & Beaudin, G. (1995). Les équipes de travail: Que faut-il en connaître? [The work team: What do we need to know about?]. *Psychologie du Travail et des Organisations*, *1*(2-3), 116-137.

Sexton, C. (1994). Self-managed work teams: TQM technology at the employee level. *Journal of Organizational Change Management*, *7*, 45-52. doi:10.1108/09534819410056122

Shaw, J. D., Duffy, M. K., & Stark, E. M. (2000). Interdependence and preference for work group: Main and congruence effects on the satisfaction and performance of group members. *Journal of Management*, *26*, 259-279. doi:10.1177/014920630002600205

Stevens, J. (2009). *Applied multivariate statistics for the social sciences* (5th ed.). New York, NY: Routledge.

Stiller, J., & Dunbar, R. I. M. (2007). Perspective-taking and memory capacity predict network size. *Social Networks*, *29*, 93-104. doi:10.1016/j.socnet.2006.04.001

Thompson, J. D. (1967). *Organizations in action*. New York, NY: McGraw-Hill.

Uhl-Bien, M., & Graen, G. B. (1998). Individual self-management: Analysis of professionals' self-managing activities in functional and cross-functional work teams. *Academy of Management Journal*, *41*, 340-350. doi:10.2307/256912

Ulich, E., & Weber, W. G. (1996). Dimensions, criteria and evaluation of work group autonomy. In M. A. West (Ed.), *Handbook of work group psychology* (pp. 247-282). Chichester, UK: John Wiley & Sons.

van de Ven, A. H., Delbecq, A. L., & Koenig, R. (1976). Determinants of coordination modes within organizations. *American Sociological Review*, *41*, 322-338. doi:10.2307/2094477

van den Beukel, A. L., & Molleman, E. (2002). Too little, too much: Downsides of multifunctionality in team-based work. *Personnel Review*, *31*, 482-494. doi:10.1108/00483480210430382

van der Vegt, G. S., Emans, B. J. M., & van de Vliert, E. (1999). Effects of interdependencies in project teams. *The Journal of Social Psychology*, *139*, 202-214. doi:10.1080/00224549909598374

van der Vegt, G. S., Emans, B. J. M., & van de Vliert, E. (2000). Team members' affective responses to intragroup interdependence and job complexity. *Journal of Management*, *26*, 633-655. doi:10.1177/014920630002600403

van der Vegt, G. S., Emans, B. J. M., & van de Vliert, E. (2001). Patterns of interdependence in work teams: A two-level investigation of the relations with job and team satisfaction. *Personnel Psychology*, *54*, 51-69. doi:10.1111/j.1744-6570.2001.tb00085.x

van der Vegt, G. S., & van de Vliert, E. (2002). Intragroup interdependence and effectiveness: Review and proposed directions for theory and practice. *Journal of Managerial Psychology*, *17*, 50-68. doi:10.1108/02683940210415924

van der Vegt, G. S., & van de Vliert, E. (2005). Effects of perceived skill dissimilarity and task interdependence on helping in work teams. *Journal of Management*, *31*, 73-89. doi:10.1177/ 014920 6304 271382

van Vijfeijken, H., Kleingeld, A., van Tuijl, H., Algera, J. A., & Thierry, H. (2002). Task complexity and task, goal, and reward interdependence in group performance management: A prescriptive model. *European Journal of Work and Organizational Psychology*, *11*, 363-383. doi:10.1080/ 135943 2024 4000193

van Vijfeijken, H., Kleingeld, A., van Tuijl, H., Algera, J. A., & Thierry, H. (2006). Interdependence and fit in team performance management. *Personnel Review*, *35*, 98-117. doi:10.1108/00483480610636812

Volpe, C. E., Cannon-Bowers, J. A., Salas, E., & Spector, P. E. (1996). The impact of cross-training on team functioning: An empirical investigation. *Human Factors*, *38*, 87-100. doi:10.1518 /001872096 778940741

Wageman, R. (1995). Interdependence and group effectiveness. *Administrative Science Quarterly*, *40*, 145-180. doi:10.2307/2393703

Wageman, R. (2001). The meaning of interdependence. In M. E. Turner (Ed.), *Groups at work: Theory and research* (pp. 197-217). Mahwah, NJ: Lawrence Erlbaum Associates.

Wageman, R., & Baker, G. (1997). Incentives and cooperation: The joint effects of task and reward interdependence on group performance. *Journal of Organizational Behavior*, *18*, 139-158. doi:10.1002/(SICI)1099-1379(199703)18:2%3C139::AID-JOB791%3E3.0.CO;2-R

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

Wheelan, S. A. (1999). *Creating effective teams: A guide for members and leaders*. London, UK: Sage Publications.

Yeh, Y., & Chou, H. (2005). Team composition and learning behaviors in cross-functional teams. *Social Behavior and Personality*, *33*, 391-402. doi:10.2224/sbp.2005.33.4.391