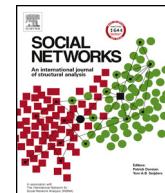




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## Social influence and discourse similarity networks in workgroups

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### ABSTRACT

Adopting a socio-semantic perspective, this study aims to verify the relation between social influence and discourse similarity networks in workgroups and explore its modification over time. Data consist of video transcripts of 45 3-h group meetings and weekly sociometric questionnaires. Relation between tie strength, actor centrality within the influence network, and shared elements of discourse between group members are examined over time. Observed correlations support the hypothesis of a relation between social influence and discourse similarity. Changes over time suggest a similarity threshold above which the relation between similarity and influence is reversed.

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## 1. Introduction

Social influence and related phenomena, such as leadership and social power, are intrinsic to any human organising process. Social influence has been conceived as a relational process for which interpersonal influence happening at the level of the dyad constitutes a building block (Carter et al., 2015; Friedkin and Johnsen, 2011; Simpson et al., 2015). In workgroups, social influence affects how groups make decision, conduct their work, or shape their understanding of the task and the environment, and more (Johnson et al., 2015; Melamed and Savage, 2016; Pavitt, 2014; Westaby et al., 2016). Interactions and communication are central to social influence (Guastello, 2007; Moscovici, 1988), and discourse is a key component of both. Here, discourse is understood as "a general term that applies to either written or spoken language that is used for some communicative purpose" (Ellis, 1999, p. 81).

The study presented in this paper offers a novel perspective on the interplay between social influence and discourse in workgroups by exploring the relation between social influence networks and discourse similarity networks, a type of network in which relationships between people are established on shared elements of discourse (words, expressions, concepts, topics, etc.). Based on verbal interactions between workgroup members over time, the study offers empirical support for the relation between social relationships and discourse similarity at the dyadic and group levels and

confirms the relevance of performing that type of joint analysis to better understand communication phenomena such as interpersonal influence. Our results also highlight the pertinence to consider strength and reciprocity of social ties in the study of discourse similarity. Finally, the longitudinal aspect of the study suggests non-linear co-evolution between the two networks and the presence of a "similarity threshold" above which greater similarity is associated with less influence, a result that could explain some aspects of the evolution of workgroups through time.

## 2. Structural and discursive approaches to social influence

The study of social influence can be grouped into two broad and generally distinct approaches: (a) a structural approach that understands social influence through relationships between individuals and (b) a discursive approach that identifies influence within the discourse of social actors. In what follows, we present a brief overview of both and argue that each approach must be taken into account to better understand social influence in workgroups.

### 2.1. A structural approach

The structural approach focuses on the relational aspect of social influence and related concepts, such as leadership and social power. At the dyadic level, the relational proximity perspective theorises that the mere presence of a tie allows for information exchange and shared influence (Rice, 1993). However, numerous studies, starting with Coleman et al. (1957), have found evidence that tie strength must be considered in the study of influence, particularly

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given the relational intensity and reciprocity it implies (Aral and Walker, 2014; Bond et al., 2012). At the group or organisation level, social influence is seen as intertwined with members' relationship networks and, most importantly, the structures and patterns they create (Carter et al., 2015; Friedkin, 1993; Friedkin and Johnsen, 2011; Saint-Charles and Mongeau, 2009). According to Brass and Krackhardt (2012, p. 355), "the structure of social networks strongly affects the extent to which personal attributes, cognition, and behaviour result in power in organisations". Methodologically speaking, most studies using this approach employ sociometric questionnaires to gather data on influence relationships or other types of relationships, including friendship, advice, and support.

Network centrality seeks to measure "the prominence or importance of the actors in a social network" (Wasserman and Faust, 1994, p. 170). Degree centrality based on the number of an individual's incoming and outgoing ties is thought to be related to influence because central people have easier access to resources (Brass and Labianca, 1999). Many studies have shown that actors' degree centrality within networks is linked to their overall influence within the group or the organisation, such influence being measured through actors' perceptions of the most influential individuals in their group or organisation or using a variety of performance measures. Beginning with the earliest laboratory studies on communication patterns in task-oriented groups (Bavelas, 1950; Leavitt, 1951), this link has been demonstrated in a variety of contexts, including issue resolution in small organisations (Friedkin, 1993); multicultural teams (Salk and Brannen, 2000); the role of CEOs in mergers and acquisitions (El-Khatib et al., 2015); decision-making in Initial Public Offerings (Owen-Smith et al., 2015); innovation (Ibarra, 1993a); organisational strategies (Boje and Whetten, 1981); online discussion groups (Huffaker, 2010); and more. Nonetheless, the process through which an individual assumes a central position in a network is not yet fully understood.

Researchers have also explored how centrality combines with other factors also correlated with social influence, including formal status (Astley and Sachdeva, 1984); gender and ethnicity (Ibarra, 1993b); political skills (Treadway et al., 2013); trust (Sparrowe and Liden, 2005); and use of strategies, cognitive and communicative abilities, emotional abilities, and performance (Brass, 1985; Brass and Burkhardt, 1993; Emery, 2012; Krackhardt, 1990; Zuchowski, 1987).

These kinds of studies are frequently criticised for focusing on the metaphor of "ties as conduits" (Borgatti and Foster, 2003), which neglects what circulates through the conduits – notably, discourse (Labianca and Brass, 2006; Monge and Contractor, 2003). In light of this critique, the next section examines studies that have explored the relation between discourse and influence.

## 2.2. A discursive approach

Beginning with the rhetorical tradition (Craig, 1999) and continuing through a growing contemporary interest in discourse in organisational studies (Barberio and Monti, 2014), discourse has always been seen as an important means of influence and power. What has been coined "the linguistic turn of the 20th century" (Rorty, 1967) has spurred the emergence of many distinctive, but complementary, fields of study focused on "discourse" (Barberio and Monti, 2014; Oswick et al., 2010). The various usages of the term "discourse" resulting from the field's expansion (Alvesson and Karreman, 2000; Fairclough, 2003; Jian, 2008) have produced a broad concept whose core meaning is that of language used by humans for communication.

The interplay between discourse and influence has been the subject of a significant number of studies, many of which focused on how discourse affects or supports the influence of dominant groups or individuals. Discourse is seen both as inextricably linked

with power and an essential tool of manipulation (Aman, 2009; Fairclough, 1989; Van Dijk, 1989; van Dijk, 2006; Wang, 2006). These studies favour predominantly qualitative methods, including variants of discourse analysis (critical, historical, Foucauldian); narrative and metaphor analysis; linguistic analysis, rhetoric, and interaction; and conversation analysis. Q methodology, a combination of discourse and content analysis, and other mixed methods have also been used (Balogun et al., 2014; Clare et al., 2013; Dijk, 2012; Holmes, 2009; Kotwal and Power, 2015; McKenna, 2016).

The diversity of topics and settings in this literature is itself testimony to the scientific and social importance of the relation between discourse and influence. For example, Hardy and Maguire (2016) have questioned the way discourse on risk is intertwined with power issues within organisations. Duval et al. (2015) have shed light on the framing influence of forms imposed on grant applicants (primarily NGOs) by a granting agency for international development. Others have explored (dominant) public policy discourse and debates over issues such as wetland management (Clare et al., 2013). Another research trend is concerned with the "discourse of strategy", which examines discourse from the perspective of "strategy as practice" (Balogun et al., 2014, p. 176). Other scholars have explored how discourse contributes to the creation or reproduction of status, gender, and other social inequalities, as well as how resistance to dominant discourses is expressed in the workplace, education, public policy, medicine, the media, and sports (Bergvall and Remlinger, 1996; Codo, 2011; Edley and Wetherell, 1997; Ezeifeka and Osakwe, 2013; Kilby and Horowitz, 2013; Mayes, 2010; Menz and Al-Roubaie, 2008; Prego-Vazquez, 2007; Toft, 2014; Zanoni and Janssens, 2015).

Organisational studies addressing managers' influence and leadership abound (Day and Antonakis, 2012), and more recent theorisations have also considered leaders' discourses (Fairhurst and Connaughton, 2014; Fairhurst and Cooren, 2009). Transformational and neocharismatic theories (Jordan, 2005; Meda, 2005), which argue that a leader's influence depends on the ability to frame the situation so as to inspire members, are representative of this literature (Antonakis et al., 2004). This research trend is more concerned with "what makes a good leader" than with exposing power issues hidden in the discourse.

In small group settings, the "dominant discourse" focus is also less prevalent. For example, researchers have examined how discourse influences interactional dynamics during meetings; how chairpersons guide meetings toward specific topics, and how decisions are made (Asmuß and Svennevig, 2009; Barske, 2009; Clifton, 2009; Holmes, 2009; Lazzaro-Salazar et al., 2015). Micro-analytical approaches based on discourse, linguistic, or conversation analysis have frequently been used to explore these issues.

The exploration of conflicts, disagreements, and clique formation as loci of influence has also revealed sequential discourse phenomena in the construction of alliances (Kangasharju, 2002). Nielsen (2009, p. 23) investigated "how interpretational work supports organisational goals and values" in business meetings. Specifically, she shows how this interpretative work is accomplished through employees' acquisition of organisational language. Inequality and power issues between stakeholders in the context of deliberative small groups or "democracy meetings" have also attracted attention (Lazzaro-Salazar et al., 2015; Vargas et al., 2016). With regard to leadership, Choi and Schnurr (2014) have used discourse analysis to explore different members' performance of leadership in a leaderless team.

This overview leaves little doubt as to the importance of the interplay between social influence and discourse but, as Krinsky (2010, p. 627) observes, this research trend has tended to neglect relational contexts, including "the relations between the things speakers say", and treat discourse as static rather than dynamic. In the same vein, Brummans et al. (2008) note that studies on

conflict framing are “unable to explain the intricate communication processes through which people make sense of a situation”.

Approaches focused on the co-construction of meaning have developed a more dialogical interpretation of the influence process (Choi and Schnurr, 2014; Fairhurst and Connaughton, 2014) that sheds light on the relational and constructed aspects of meaning through discourse in cases, for instance, where influential individuals are seen as acting as intermediaries between various representations of the situation (Barge, 1989, 1996; Barge and Hirokawa, 1989; Thayer, 1988). Fairhurst and Connaughton (2014) have shown in their literature review a number of studies looking at relationships and interactions with regards mostly to leadership as an influence-oriented language. Their review highlights the important role discourse and social interactions play in influence and also show that the structural aspect remains neglected in those studies.

### 3. Linking social networks and discourse similarity

A socio-semantic perspective for the joint study of social networks and discourse similarity appears as a promising path to bring together the structural and the discursive. Scholars have travelled this path, although not with regard to influence.

Homophily, the tendency for people to form relationships with similar others, is a well-established social phenomenon (Carley, 1991; Curry and Dunbar, 2013; McPherson and Smith-Lovin, 1987; McPherson et al., 2001). As stated by Curry and Dunbar (2013, p. 337): “Individuals who are similar with regard to race, ethnicity, sex, age, religion, education, occupation, social class, attitudes, opinions, and beliefs are more likely to associate with one another than would be expected by chance”. In view of this, semantic homophily is to be expected (Roth and Cointet, 2010). As well, using similarity to highlight common elements of different discourses has been suggested by researchers interested in identifying groups of individuals sharing semantic universes (Roussiau and Bonardi, 2001). Thereby, researchers have developed models and measures of similarity of discourse between individual interconnected in a social network to explain various individual, social and cultural phenomena.

For instance, Carley (1986a, 1991) has modelled the relation between social interactions and cognitive structures within small organisations. Her model focuses on how information exchanged through the structure of social interactions affects individuals' cognitive structure and how both structures combine to create group cohesion, consensus, and stability. In short, the more members share the same information the more the group becomes cohesive, capable of consensus and stable through time. In their study of risk perception, Scherer and Cho (2003) confirmed the importance social networks in building “groups or communities of like-minded” individuals. Cointet and Roth have studied the coevolution of the social and semantic networks of scientists (Roth, 2008) and bloggers (Cointet and Roth, 2009) and highlighted their similarities and differences (Roth and Cointet, 2010). For example, although degree centrality in the social network is correlated with centrality in the actors-concepts network both networks exhibit different patterns in the way both measures are linked. In their study of a community-based protest, Teo and Loosemore (2011) noted that social networks play a critical role in the transmission of ideas, information, beliefs, and perceptions. They observed that shared experiences through relationship networks helped create shared cultural meanings and interpretations. Danowski (2013) has shown that between 2007 and 2011, “semantic-based division networks are becoming more decoupled from the formal membership-based networks” in his study of the divisions of the International Communication Association. Basov et al. (2017) and Basov and Brennecke (in press) have explored instrumental, expressive and interaction

networks of small self-run creative organisations and their links to shared meaning as a way to bring together the social and the cultural. The complementarity between social networks and discourse similarity have also given rise to several studies of social media and networks of co-citation and co-publication – trends that both benefit from the increasing availability of large datasets (Roth, 2013).

### 4. Workgroups over time

A workgroup is understood here in a similar way as Cohen and Bailey (1997): it is an ensemble of individuals mutually interacting in their tasks and sharing responsibility for the outcomes. Group members consider themselves and are being considered by others as a social entity embedded in larger social systems. Workgroups like social networks are dynamic and change over time (Arrow et al., 2004; Faust, 2011; Mongeau and Saint-Charles, 2011).

Many of the numerous group development models proposed that groups evolve through various stages (Braaten, 1974; Dunphy, 1968; Mills, 1967; Schutz, 1958; St-Arnaud, 1978; Tuckman, 1965; Tuckman and Jensen, 1977; Wheelan, 1994). Although linear models have been criticised for neglecting the roles of organisational time, task types, and environmental uncertainty (Chang, 2006; Hare, 2003; McGrath, 1991; Poole and DeSanctis, 1990), their validity is supported by research, particularly for zero-history, leaderless, and fixed-duration groups (Braaten, 1974; Dunphy, 1968; Mills, 1967; Wheelan, 2009).

Linear progressive models have identified from three to nine stages leading to group maturity, at which point group members become more focused on task accomplishment. Three main stages are common to all models (Chidambaram and Bostrom, 1996; Wheelan, 2009). Borrowing from the terminology initially proposed by Tuckman (1965), we call these common stages *forming*, *storming*, and *norming*. The *forming* stage, as its name implies, refers to the period during which the group is formed and members are in observation and testing mode. This is followed by *storming*, during which disagreements are voiced and conflicts appear. Resolving these conflicts leads to the establishment of norms and group stabilisation, or *norming*. These stages have fuzzy boundaries (McGrath et al., 2000); groups may linger in one stage without necessarily moving on to the next. For example, the *forming* stage may take longer in zero-history groups because members do not already know one another and may need more time understand the group's goals (Chidambaram and Bostrom, 1996).

With regard to the content of exchanges between group members, studies have shown a significant increase in exchange prototypicality and homogeneity over time (Postmes et al., 2005); this is consistent with a linear progressive model. Johnson et al. (2015) observed that the emergence of alternative opinions early in group development may lead to task conflicts, which suggests an explanation for the group moving into the *storming* stage. These results may imply co-evolution between group members' exchanges and the relationships they develop, thus adding more incentive to study both relationships and discourse between members.

### 5. Hypothesis

The various research trends identified above have established the importance of discourse and relationships for social influence in groups and organisations, as well as the need to study them together. We have also presented the relevance of discourse similarity networks to reveal relationships between individuals. Therefore, our general hypothesis posits a positive association between influence networks and discourse similarity networks in workgroups. To test this association, we propose four specific

hypotheses, one at the dyadic level (interpersonal influence) and the others at the group level.

As we have seen, interpersonal (dyadic) influence is considered one of the building blocks of social influence and the intensity and reciprocity of the dyadic tie affect this influence. Thus, we hypothesise that the stronger the dyadic tie, the more similar the discourse.

**Hypothesis 1.** Discourse similarity and influence tie strength between two individuals are positively related.

At the group level, our hypotheses are based on degree centrality in the influence network and are consistent with what is presented in the literature cited above. In order to take into account the strength of ties, we used both valued degree centrality and dichotomised matrices. It is expected that the most central individuals in the influence network will be those sharing the largest number of elements of discourse with the largest number of members; these individuals will therefore be central in the discourse similarity networks.

**Hypothesis 2.** The similarity of a group member's discourse to that of all other group members is positively related to his or her valued degree centrality in the influence network.

Because it affects dyadic interpersonal influence, we hypothesise that tie strength will also be of importance at the group level.

**Hypothesis 3.** The positive relation between degree centrality and discourse similarity for strong influence ties is stronger than the relation between weak influence ties and discourse similarity.

Our fourth hypothesis is based on the three stages of group development presented above. We expect that these stages will be reflected in the interplay between the influence network and discourse similarity networks. Although we expect a consistent positive correlation between discourse similarity and valued centrality in the influence network, we assume that this correlation will be weaker during the second stage (*storming*) given that this stage is characterised by disagreements and conflicts. The assumption here is that the words used by members advocating different opinions should be distinct.

**Hypothesis 4.** The positive relation between valued degree centrality and discourse similarity will be weaker during the second stage of group development.

## 6. Method

The overall method consists of correlating data from sociometric questionnaires on influence ties within workgroups with discourse similarity networks created from group members' discussion during meetings.

### 6.1. Sample

Data for this study were collected from a sample of 34 French-speaking students (29 women and 5 men in their early twenties) enrolled in an undergraduate communication programme. Students were randomly divided into five groups of six to eight relatively homogeneous individuals in terms of ethnic origin, gender, educational background, and age. These groups can be considered zero-history, leaderless, and of fixed duration. Students were at the beginning of their undergraduate programme, had not met one another before, and no formal structure existed within their group. These groups were asked to work together on a task worth 40% of their total course mark; the mark was collective. The task was to produce an academic paper and present it to their classmates at the end of the session. The task was therefore real and implied significant consequences for group members (the course

**Table 1**  
Categorisation of reciprocal ties.

| Tie strength | Reciprocity                                  | Strength value combination |
|--------------|--|----------------------------|
| 1            | Weak reciprocal (co-presence influence ties) | 1-1                        |
| 2            | Non-reciprocal (all influence ties)          | 1-2, 2-1, 1-3 1-3, 3-1     |
| 3            | Reciprocal (strong influence ties)           | 2-3, 2-2, 3-2, 3-3         |

is mandatory in the programme). Groups met for three hours per week nine times over ten consecutive weeks (with the exception of one week, when there was no meeting). All students were volunteers. For ethical reasons, a procedure was set up allowing any student to anonymously refuse to participate. This was possible because only half of the groups formed for the course were retained for the study. The study received Research Ethics Board approval from the authors' institution.

### 6.2. Data collection

Data on influence ties were collected through a sociometric questionnaire filled out by group members the day after each meeting ( $n=306$  without missing values, 34 members  $\times$  9 meetings; considering the inevitable absence of members at meetings over a period of nine weeks, the observed minimum is  $n=280$ ).

Data related to discourse similarity were collected from video transcripts of 45 3-h group meetings (9 meetings  $\times$  5 groups  $\times$  3 h) for a total of 135 h of video. Due to financial constraints, transcripts were limited to 30 min per meeting. In order to ensure that transcripts best reflected members' contributions, they were divided into three 10-minute periods per meeting: beginning, mid-meeting, and end-of-meeting. As a result, 22.5 h of video were transcribed for a total of 33,262 "texts", each of which corresponds to a speaking turn.

### 6.3. Influence tie strength

Self-declared tie strength was captured after each meeting by the following question: "In the last meeting, you were influenced by...." A complete list of group members was provided and followed by a 3-point Likert-type scale. Each member could use this scale to evaluate how much or how often he/she had been influenced by every other member during the meeting: 1 = very little or rarely influenced; 2 = somewhat or sometimes influenced, and 3 = greatly or often influenced.

We calculated the mean declared tie strength over the 9 meetings for each dyad within each group. The calculation was performed on oriented ties ( $n=1454$  valid), i.e. the Aline/Alexia dyad was considered distinct from the Alexia/Aline dyad, for example.

Strength ratings were categorised according to whether they were reciprocal or not. Given that the lowest rating "1" (weak influence ties) can be considered an expression of mere co-presence, reciprocal ratings of "1" have been separated from the others. When members of a dyad used the ratings 2 or 3 (influence and strong influence ties), the tie was considered reciprocal (see Table 1).

### 6.4. Centrality in influence network

As we have seen in the presentation of the structural approach, degree centrality has been consistently shown as correlated with various measures of influence. As such, we can confidently use centrality in the influence network as a proxy for influence. Valued degree centralities in influence networks within each group were calculated. Centrality was also calculated for dichotomised matrices for each strength rating and for combinations of 2 and

3 (influence  $\gg 2$ ). Because of the variation in group size, means of individual influence centralities were normalised.

### 6.5. Discourse similarity

Discourse similarity is often based on the use of similar words or expressions (Carley, 1993; Mongeau and Saint-Charles, 2014; Roth and Cointet, 2010) although it has been variously measured. For example, similarity can be derived from a topic analysis (Blei and Lafferty, 2009; Danowski, 2011; Maier et al., 2015), automatic and manual thematic coding (Cohen et al., 2005; Saint-Charles et al., 2014), semantic mapping (Holmberg and Hellsten, 2016; Leydesdorff and Hellsten, 2006), cognitive mapping (Carley, 1997), QAP correlation of individual semantic networks (Basov and Brennecke, in press; Danowski, 2013) or distributional semantics (Fabre and Lenci 2015; Harris, 1954).

In this study, discourse similarity is based on analysis of video transcripts of each group meeting. Text analysis and calculations used to create a discourse similarity index were performed using Sématos semantic analysis software (Plante et al., 2005).

A discourse similarity index was calculated based on an examination of the similarity of words and noun phrases present within the transcribed text. Similarity was established using a French semantic thesaurus of synonyms and semantic proximities (Plante et al., 2005) to group words and noun phrases in the dataset into semantic fields. A semantic field is a collection of words or noun phrases with semantic affinities within a given dataset. Carley (1993) and Roth and Cointet (2010) suggest a similar technique to group words and noun phrases representing the same idea to form "concept". For example, in a given set of texts, the semantic field "fight" may include the words "confrontation", "antagonism", "battle", "combat", "conflict", "opposition", and "rivalry" or noun phrases such as "sibling rivalry".

A two-mode matrix was created by the ties that link group members with the semantic fields they used. These ties are valued according to the number of times an individual employs a particular semantic field. Using the minimum value of all semantic fields shared by a dyad, this matrix is then converted to an actor x actor matrix. For example, if Aline uses the semantic field "fight" 10 times during the first meeting while Alexia uses it 20 times, the dyad is attributed 10 "points" for this semantic field. This operation is repeated for each shared semantic field and the total is then divided by the total "points" for each dyad. Given that some group members talk more or more often than others, frequency (number of utterances for each member) was normalised and total length of speech weighted using the number of bits in the text file.

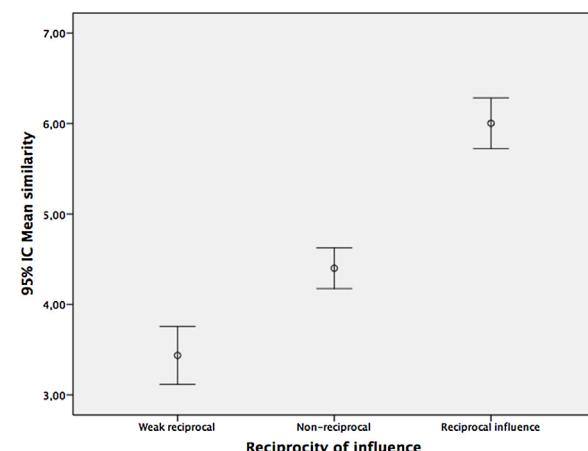
Valued centrality was then calculated for each meeting to produce an individual discourse similarity index. We also calculated the mean similarity index for each individual over the 9 meetings, as well as the average discourse similarity for dyads.

### 6.6. Group stages

In order to explore group development stages, we grouped observations into three periods. Because timing and moving from one stage to another may vary from group to group, we created three equal periods containing three meetings each (the first three, the middle three, and the last three).

## 7. Results

Hypothesis 1 which states that discourse similarity and influence tie strength are related at the dyadic level, is supported by the observed correlation between mean tie strength and average discourse similarity for dyads over the 9 meetings. The correlation,



**Fig. 1.** Mean discourse similarity according to reciprocity of influence tie strength.

**Table 2**  
Correlation coefficients between influence centrality and similarity index.

| Influence centrality                  | Correlation with individual mean similarity index (n = 34) | Correlation with similarity index (n = 306) |
|---------------------------------------|--|---|
| All ties (valued centrality)          | 0.49**   | 0.30**                                      |
| Strong influence (value 3)            | 0.57***  | 0.35**                                      |
| Influence (values 2 and 3)            | 0.40**   | 0.28**                                      |
| Influence (value 2)                   | 0.33   | 0.11  |
| Weak influence (value 1; co-presence) | -0.58***   | -0.34***                                    |

\*\*p < 0.01; \*\*\*p < 0.001 (two-tailed test).

which is significant but moderated ( $r = 0.42$ ;  $p = 0.000$ ;  $n = 200$ ), explains 17.8% of the observed variance.

This hypothesis is also supported by a significant difference in average discourse similarity depending on whether the influence is reciprocal, non-reciprocal, or expresses co-presence ( $df = 1451$ ;  $f = 58.677$ ;  $p < 0.000$ ). Fig. 1 shows the mean level of similarity for each category.

Hypothesis 2 which states that a group member's discourse similarity with that of all other group members is positively correlated with his or her valued degree centrality in the influence network, is supported by a positive but moderate correlation between mean valued degree centrality and mean similarity index ( $r = 0.49$ ;  $p < 0.003$ ;  $n = 34$ ) (Table 2).

To test whether the positive correlation between valued degree centrality and discourse similarity was greater for strong influence ties than for weak influence ties (Hypothesis 3), we calculated mean degree centrality for the dichotomised influence matrices and correlated these results with mean discourse similarity (Table 2). Results show that mean influence centrality is more strongly correlated with similarity index for stronger ties ( $r = 0.57$ ;  $p < 0.001$ ) than for ties of strength 2 ( $r = 0.33$ ;  $p = \text{n.s.}$ ). Moreover, moderate negative correlations were observed between mean discourse similarity and mean influence centrality ( $r = -0.58$ ;  $p < 0.001$ ) for co-presence (weak influence) ties. Table 2 also shows correlations calculated for all 306 observations of all 34 people during 9 meetings (rather than for the mean). Due to weekly variability, correlations are lower but similar to what is observed for the means. Strictly speaking, these results do not support Hypothesis 3, which hypothesises a weaker but still positive correlation. Nonetheless, although this result is not entirely consistent with the hypothesis, it is aligned with it and provides an unexpected nuance.

**Table 3**

Regression coefficients for similarity as dependent variable.

|         | Influence value                       | Beta (std error) |
|---------|---------------------------------------|------------------|
| Model 1 | Strong influence (value 3)            | 0.077 (0.012)*** |
| Model 2 | Strong influence (value 3)            | 0.053 (0.014)*** |
|         | Weak influence (value 1; co-presence) | 0.0413 (0.012)** |

Unstandardised coefficients (std error). \*\*p &lt; 0.01; \*\*\*p &lt; 0.001; (two-tailed test).

Regression analysis shows that the best predictors of discourse similarity reside at the extremes of measured tie strengths (**Table 3**). It means that the more one has strong (3) ties with other members (model 1) or the more he or she one has strong ties and the less he or she has co-presence ties (model 2), the more he or she shares elements of discourse with other group members (or vice-versa).

We explored the existence of differences between low and high similarity indexes for valued influence centrality (without dichotomising). To do so, we divided valid observations into two equal groups of low and high similarity indexes. Correlations between discourse similarity and valued centrality in the influence network within each of these groups are relatively weak, but significant. In the subgroup of those whose discourse shows little similarity to that of all group members, there is a positive correlation with valued centrality ( $r=0.27$ ;  $p < 0.001$ ;  $n = 139$ ), while a negative correlation ( $r=-0.20$ ;  $p < 0.01$ ;  $n = 139$ ) is observed in the subgroup of those whose discourse is highly similar to that of all members. In other words, within the subgroup of low similarity, the more similar a member is to all group members, the higher his or her influence centrality, while the opposite is true for the high-similarity subgroup. This result suggests that there may be a threshold at which the relation between discourse similarity and influence centrality is reversed.

To test whether the correlation between centrality and discourse similarity weakened during the second stage of group development, as stated by Hypothesis 4, we calculated correlations between similarity indexes and centralities for each of the three periods: P1—first three meetings ( $n = 92$ ); P2—middle three meetings ( $n = 98$ ); and P3—last three meetings ( $n = 88$ ). Results show partial support for Hypothesis 4: for P1, similarity and centrality grow simultaneously ( $r=0.49$ ;  $p < 0.001$ ); for P2, there is no significant correlation and, for P3, the correlation is positive and significant, but low ( $r=0.29$ ;  $p < 0.005$ ).

In order to better understand this result and considering the possibility of a threshold at which the relation between similarity and influence reverses direction, we created five equal groups of percentile-based observations for each period. While maintaining a sufficient number of observations by groups, this division makes it possible to examine the potential emergence of a similarity threshold.

As expected, the relation is linear during P1 (**Fig. 2a**). For P2, the non-linear relation explains the absence of a significant correlation. Observations above the 80th similarity percentile indicate less influence (**Fig. 2b**). The correlation is linear below this percentile ( $r=0.41$ ;  $p < 0.001$ ;  $n = 60$ ) and similar to that of P1 ( $r=0.49$ ;  $p < 0.001$ ;  $n = 92$ ), but negative above this threshold ( $r=-0.45$ ;  $p < 0.005$ ;  $n = 38$ ). The difference between the mean similarity of these two groups is significant ( $p < 0.001$ ;  $f = 4.338$ ;  $dl = 37$ ). For P3, this low correlation can be attributed to the presence of two main groups, one with low similarity and influence, the other with higher similarity and influence. The mean difference between these groups is significant ( $p < 0.001$ ;  $dl = 87$ ;  $f = 108.09$ ) (**Fig. 2c**).

## 8. Discussion

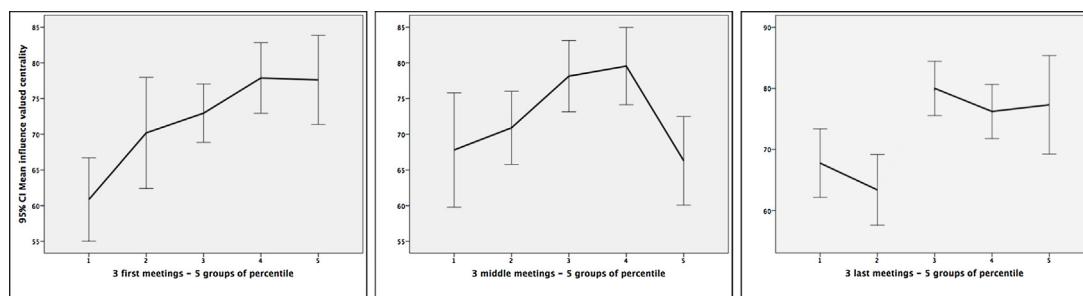
One of our study's primary contributions is to bring empirical support to the relation between social networks and discourse similarity. In that we comfort other studies that have obtained similar results in other contexts and with different ways of measuring discourse similarity ([Basov and Brennecke, in press](#); [Carley, 1986a, 1991](#); [Cointet and Roth, 2009](#); [Danowski, 2013](#); [Roth, 2008](#); [Roth and Cointet, 2010](#); [Scherer and Cho, 2003](#); [Teo and Loosemore, 2011](#)). Such encouraging results are an invitation to pursue this line of research.

To our knowledge, this is the first time that this type of longitudinal analysis has been realised in workgroups to better understand a communication phenomenon such as interpersonal influence. Also, from a methodological point of view, we are aware of no other study using a socio-semantic approach to analyse discourse similarity networks based on verbal interactions between group members<sup>1</sup> – a common data source for discourse analysis in qualitative methods ([Holmes, 2009](#)). Our study demonstrates the pertinence of quantitative analysis of verbal interactions as a way to uncover other aspects of the links between discourse and relationships.

A second contribution of this study lies in the importance given to tie strength ([Aral and Walker, 2014](#); [Bond et al., 2012](#)). Under a moderate correlation between valued centralities in influence networks and similarity indexes, distinct phenomena are hidden: the direction of the correlation is reversed between those with numerous strong influence ties ( $r=0.57$ ) and those with many co-presence (weak influence) ties ( $r=-0.58$ ). Combined with our result at the dyadic level, which shows the importance of strength and reciprocity for discourse similarity, this supports the need to consider tie strength in the study of social influence. More importantly, it opens new avenues to deepen our understanding of the factors in play when one reaches a central position in a workgroup influence network. Because our study was conducted with zero-history, leaderless, highly homogeneous groups with regard to age, gender and ethnicity, we know that neither pre-existing structure nor status differences were present. This may imply that semantic homophily ([Roth and Cointet, 2010](#)) played a role early in the group's life and contributed to the development of strong influence relationships between semantically similar group members, thereby "excluding" others in the process. Using the frequency of contacts as a proxy for tie strength, [Basov et al. \(2017\)](#) have obtained slightly different results. Indeed, they found that individuals with the highest frequency of contacts have a relatively low level of concepts sharing while those with less frequency of contacts have a tendency to bridge contain between subgroups. With regard to social influence, this may suggest the ones we interact with regularly are not necessarily the ones having the biggest influence on the evolution of our discourse.

Alternatively to the strength of tie explanation, individual characteristics associated with influence in the literature, such has a large repertoire of communication strategies ([Bass, 1990](#)), may have favoured the centrality of group members possessing such a repertoire and rendered their discourse more "adoptable". Conversely, given that "perceived listening effectiveness" has been shown to affect emerging leadership in workgroups ([Johnson and Bechler, 1998](#)), it may be that group members became more central in the influence network because they were using the words of others who, as a result, felt listened to.

<sup>1</sup> [Basov et al. \(2017\)](#) data includes verbal expressions of group members extracted from a mix of interviews and ethnographic observations of dyadic conversations combined with various "publications" made by members (posts, journal articles, prose and poetry), a different dataset than verbatim transcript of exchanges between members during work sessions.



**Fig. 2. a, b, c.** Influence valued centrality and five percentile groups of similarity indexes for three periods.

Our third and fourth contributions are based on a longitudinal exploratory analysis. Firstly, the results of this study show that the relation between influence network centralities and similarity indexes in workgroups changes through time in a non-linear manner that appears to follow the three main stages of group development. During the first stage, the positive correlation may be explained by the fact that those with the highest similarity may be perceived as more "prototypical" (Brown et al., 2004; Hogg et al., 2004) or transformational (Jordan, 2005; Meda, 2005) because the words and expressions used are similar to those employed by other group members. At the second stage, the analysis suggests a "similarity threshold" around the 80th percentile, above which greater similarity is associated with less influence. This constitutes our fourth contribution. This threshold could be paralleled to Cointet and Roth (2009) study of bloggers in which the most "influential" blogs seemed to be those with the larger readership – up to a point as "above a certain threshold, the increase in influence is flatter, although still relatively increasing" (p. 6). With regard to fixed duration workgroups, the supposed threshold appears during the midterm meetings, here understood as the second stage of group development marked by debates, confrontations, and decision-making regarding the task at hand. Influence and similarity are positively correlated below this threshold and negatively correlated above it. We propose that similarity must be high enough for people to be "in" the group, but low enough for their difference to stand out; original elements in their discourse distinguish them. In a debate, difference may be attractive (Robert and Mongeau, 2014). This assumption is also consistent with the expectancy violation theory proposed by Burgoon and Bacue (2009) in the study of non-verbal communication. This theory states that behaviours that deviate slightly from the norm attract attention. Our results suggest the potential generalisation of this theory to verbal communication. Alternatively, in her theory of stability in social group (Carley, 1991) postulates that a perfectly stable group would become unproductive for lack of new information to exchange. In view of this, the similarity threshold could be interpreted as a manifestation of a group autoregulation mechanism: above the similarity threshold members' attention should shift from similar elements to more dissimilar ones as too much similarity reduces the motivation to exchange information.

Finally, the division into two groups at the last stage may be interpreted as a phenomenon of exclusion of the less similar and less central members in the influence network. Indeed, one could postulate that during stage 2, the most central members in the influence network were those more actively participating in the debates – continuing the conversation until they reach a certain level of convergence that excludes others from the new, negotiated, discourse.

Let us reiterate that the relation between influence and discourse is not seen here in terms of linear causality. A different discourse in the early stages of a group's life could lead to having less influence, which could in turn help maintain a distinct discourse.

Conversely, holding a similar discourse could support the creation of strong influence ties, which may then help maintain discourse similarity.

## 9. Conclusion

The goal of our study was to verify the hypothesis of a relation between workgroup members' influence and their discourse similarity with that of other group members. To do so, we examined tie strength, actor centrality in influence network, and shared discourse elements in video transcripts of 45 3-h group meetings and weekly sociometric questionnaires. We also explored the evolution of the relation between influence centrality and discourse similarity over time.

Adopting a socio-semantic perspective, our study contributes in several ways to the joint application of structural and discursive approaches. Amongst the studies bringing together social networks and discourse similarity it is, to our knowledge, the only study to do this for verbal exchanges in workgroups, and with a focus on social influence from a longitudinal perspective.

Our results show that influence network centrality is correlated with discourse similarity network centrality (i.e. having a discourse that most resembles that of all group members). At both the dyadic and group levels, discourse similarity is higher for strong (and reciprocal) ties. These results also suggest that influence and discourse sharing co-evolve through time and group members' interactions. At the beginning of the group's life, the relation between influence and similarity is linear and positive, but at the midterm this relation becomes negative for those with the highest centrality in the discourse similarity network. In the final meetings, we noted the presence of two subgroups (one with high similarity and high centrality members and the other with low similarity and low influence); although difference between these subgroups is significant, difference within them is not. These changes through time have led us to postulate the existence of a similarity threshold below which similarity brings greater influence and above which originality and difference are required.

These findings are the result of capturing and analysing the verbal interactions of members in homogeneous, zero-history, leaderless, fixed-duration, bona fide groups over a sufficiently long period. The strength of this dataset is also a limitation: because these are student groups, there are not many groups in other organisations who share their characteristics<sup>2</sup> or who would be willing to have all of their meetings recorded. Because observations in our data vary considerably from one week to the next and from one group to another, longer periods and more groups would be required, but capturing and transcribing verbal interactions are time consuming and costly. Other means are therefore called for.

<sup>2</sup> Groups of "founders" may well have such characteristics, at least in terms of homogeneity and "leaderless".

Although one advantage of the socio-demographic homogeneity of our groups is that it limits the impact of variables such as status and gender, these are non-negligible in the process of social influence. For instance, studies taking gender into account show differences between men and women in terms of influence and according to communication style (Carli, 2001; Eagly et al., 2003). Gender may also influence the use of certain semantic fields. Carley (1986b) has shown that, over time, men adopt concepts first proposed by women. The groups studied here were predominantly composed of women; a comparative analysis based on gender was therefore not possible. As we have seen, studies linking centrality to influence have also demonstrated the impact of other variables, including communication strategies and political skills, personality, emotional abilities, and ethnicity. The variance explained by our results, which fluctuates between 16% and 34%, is notable considering the multitude of factors potentially at play. This confirms the relevance of studying the interplay between discourse and influence networks and also raises questions about the combined effect of multiple factors.

Regarding semantic data, our study is based on semantic fields automatically extracted by a text analysis software using a semantic thesaurus. Different ways to measure similarity could lead to different results. For instance, analyses more focused on meaning, such as thematic or topic categorisation, may narrow the results and make it possible to distinguish between, for example, using the same words to express agreement or disagreement. Such an analysis would also permit the exploration of shared cognitive frames. Another potential line of inquiry is the analysis of verbal strategies used by group members, given that leadership emergence has been linked to strategies like summarising, orienting group processes, and seeking evaluation (Barge, 1989).

To conclude, our results reveal a new avenue for closing the gap between ties as conduits and the flow of content (Borgatti and Foster, 2003) through the study of group similarity and open new perspectives for studying the emergence of social influence and leadership in workgroups.

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