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#### ***published in***

Communication Research  
2011

#### ***DOI (link to publisher)***

[10.1177/0093650210385225](https://doi.org/10.1177/0093650210385225)

#### ***document version***

Publisher's PDF, also known as Version of record

[Link to publication in VU Research Portal](#)

#### ***citation for published version (APA)***

Kleinnijenhuis, J., van den Hooff, B. J., Utz, S., Vermeulen, I. E., & Huysman, M. H. (2011). Social influence in networks of practice: An analysis of organizational communication content. *Communication Research*, 38(5), 587-612. <https://doi.org/10.1177/0093650210385225>

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*Communication Research* 2011 38: 587 originally published online 20 October 2010  
DOI: 10.1177/0093650210385225

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# Social Influence in Networks of Practice: An Analysis of Organizational Communication Content

Communication Research  
38(5) 587–612  
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DOI: 10.1177/0093650210385225  
http://crx.sagepub.com



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## Abstract

Networks of Practice (NoPs) facilitate knowledge sharing among geographically dispersed organization members. This research tests whether social influence in NoPs is reinforced by actors' embeddedness in practice (knowledge about informal content), organizational embeddedness (knowledge about formal organizational content), structural embeddedness (knowledge about who knows what), and relational embeddedness (knowledge about informal relationships). A full-fledged automated content analysis on all postings on four NoPs maintained by a multinational chemical company revealed four dimensions in communication content that largely coincide with the proposed embeddedness types. We measured social influence by assessing to what extent actors' use of uncommon language traits was adopted in the responses to the postings. Hypothesis testing revealed that network members who communicate about informal practice, and know who knows what, exert more social influence than others. The results suggest that network members' social influence is rooted in their utilitarian value for others, and not in their organizational or relational embeddedness.

## Keywords

organizational communication, networks of practice, content analysis, social influence, language style matching

## Introduction

Our globalizing economies increasingly confront organizations with the need to integrate geographically dispersed knowledge (Foss & Pedersen, 2004). From a practice-based

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perspective on knowledge, “networks of practice” (NoPs) facilitate the integration of such dispersed knowledge (Tagliaventi & Mattarelli, 2006). An NoP is a—usually online—communication network maintained by individuals who operate at different locations but share the same practice (Orlikowski, 2002; Sole & Edmondson, 2002).

NoPs are inherently emergent, self-organizing structures that thrive on the interaction between people acting within a particular shared context (Brown & Duguid, 2001; Vaast, 2004). Because of the self-organizing nature of NoPs, formal efforts to manage and stimulate knowledge sharing are often unsuccessful and frustrating (e.g., Alvesson, Kärreman, & Swan, 2002; Thompson, 2005). Therefore, the contribution of NoPs to knowledge integration does not so much depend on managerial activities in steering the network into certain directions but much more on the social influence enacted by network members themselves (Agterberg, Van den Hooff, Huysman, & Soekijad, 2010).

Agterberg et al. (2010) conclude that network members influence each other by focusing on both the *content* of the network and on the *connections* that make up the network. They do so by discussing both formal organizational aspects and more informal sociocultural aspects of the networks’ content and connections. By combining these two dimensions of communication content, four types of organizational discourse arise. Network members who show that they are more embedded in these four types of discourse may be more influential than others.

In this article, we discuss the issue of social influence in NoPs through a detailed analysis of the content of the communication within these networks. The article contributes both methodologically and theoretically to the literature on social influence in social networks by analyzing the actual content of organizational communication as a determinant of social influence. Where previous research has mainly focused on analyzing structural positions of network members through Social Network Analysis (e.g., Ibarra & Andrews, 1993; Leenders, 1996; Marsden & Friedkin, 1994), we focus on the relationships between originators of messages and respondents to these messages in communication networks. Our approach thus explicitly focuses on the *content* of actors’ communication, instead of on their structural positions in the network. We distinguish four different types of actors’ network embeddedness as factors that determine their social influence over others: embeddedness in practice, organizational embeddedness, structural embeddedness, and relational embeddedness. The central assumption is that actors’ influence on other network members will be stronger when their messages exhibit a higher degree of embeddedness. To our knowledge, this is a new perspective on the question of what determines actors’ social influence in networks.

Our automated content analysis-based approach builds on the argument that similarity in linguistic style between originators’ and respondents’ messages can be used as an indicator of social influence. A similar approach has recently been proposed by Gonzales, Hancock, and Pennebaker (2010), who showed experimentally that language style matching can predict social dynamics in small groups. We contribute to this promising new line of research by showing that automated content analysis can also predict dynamics in a real-world, large, and internationally dispersed organizational network. In the following Sections, we first outline our theoretical framework, which builds on recently developed

insights about actors' network embeddedness and its influence on knowledge sharing. Then, we discuss the methodological details of our content analysis in which we analyzed a large body of messages exchanged in four different electronic NoPs within a chemical multinational—labeled Chemco—in the period 2001-2006. Chemco is involved in technology development, production and marketing of polymers, chemicals and refining. The company implemented NoPs facilitated by electronic discussion forums to ensure that knowledge of members operating in different geographical locations and time zones is accessible to others. The forums serve to question, discuss, and establish common standards of good practice. Our content analysis offers an in-depth unobtrusive view on the actual communication flows between network members and yields interesting results concerning the influence that network members exert on each other and on the role of embeddedness in explaining the strength of this influence.

## Theory and Hypotheses

### *Social Influence*

Social influence is defined as “a change in a person’s cognition, attitude, or behavior, which has its origin in another person or group” (Raven, 1965, p. 371). So “when an actor adapts his behavior, attitude, or belief, to the behaviors, attitudes, or beliefs of other actors in the social system,” social influence has occurred (Leenders, 2002, p. 26). In line with our focus on actual communication behavior, we will analyze social influence in organizational discourse, that is, the exertion of authority by a speaker through the indirect and intangible pressure on the organizational audience to adhere to the speaker’s language use. Influence on organizational discourse can be measured by assessing whether unique aspects of the originator’s language can also be observed in the verbal conduct of organization members who respond to the originator’s message. Prior studies that applied measures of language style matching to investigate processes such as semantic contagion (Ross, 1992) or verbal mimicry (Gonzales et al., 2010) focused primarily on respondents’ (conscious or unconscious) motivations to match their communication style to that of others. Our approach, instead, focuses on mechanisms that make some originators more influential than others.

### *Determinants of Social Influence: Four Forms of Embeddedness*

Social influence may occur in many situations—in dyadic interactions, in small groups as well as in large networks, and in face-to-face (FTF) communication as well as in mediated communication. As a consequence, social influence processes have been studied from several different theoretical perspectives, including social identity theory, persuasion and attitude change, minority influence, group influence, and social network models.

A model that is particularly suitable to explain social influence in NoPs was formulated by Agterberg et al. (2010). As NoPs are characterized by their self-organizing nature, geographic dispersion of members, computer-mediated interactions, and large numbers of network members, social influence processes may differ from those in, for example,

**Table 1.** Four Forms of Embeddedness as Determinants of Social Influence

	Knowledge About Content	Knowledge About Connections
Knowledge about formal-structural aspects of the organization	Organizational embeddedness	Structural embeddedness
Knowledge about informal sociocultural aspects of the organization	Embeddedness in practice	Relational embeddedness

hierarchically structured work groups with frequent FTF interactions. In recognition of this potential difference, Agterberg et al. (2010) conducted a theory-building case study on 22 different NoPs. They triangulated data from interviews, observations, log files, and policy documents and arrived at a model specifically tailored to explain dynamics underlying communication in NoPs. Their explicit focus on NoPs is the key argument to test their model in the present research.

Based on the model presented by Agterberg et al. (2010), we argue that social influence in NoPs involves being well connected to, or “embedded in,” both the *content* of what is being discussed in a network (the knowledge being exchanged) and the *connections*, or the organization of the network (the structure and quality of ties between network members). Moreover, actors seem to be more influential when they convey knowledge about both *formal-structural* aspects of the organization (such as management goals and institutionalized knowledge), and the *informal sociocultural* aspects (the actual practices of, and interactions between, members of the organization). When both dimensions are combined, four types of embeddedness arise, as shown in Table 1.

Based on this two-dimensional conceptualization, we distinguish,

1. Embeddedness in practice: the extent to which an actor demonstrates knowledgeability and to have expertise in the daily practices of network members, contributing to practice-based learning (Brown & Duguid, 1991).
2. Organizational embeddedness: the extent to which an actor demonstrates knowledgeability about the formal organization and institutional knowledge contributing to organizational learning (Crossan, Lane, & White, 1999).
3. Structural embeddedness: the extent to which an actor demonstrates being connected to other network members and being familiar with their expertise, thus contributing to the transactive memory of the network (Rulke & Galaskiewicz, 2000).
4. Relational embeddedness: the extent to which an actor demonstrates being well connected to the social life of the organization, contributing to group identity, trust, and respect between network members (Borgatti & Cross, 2003).

As we will elaborate in more detail below, our general assumption is that for each form of embeddedness, a higher level of embeddedness will result in stronger social influence. In addition, we conjecture that these forms of embeddedness will emerge from the content

of the communication in a network. In other words, the actual terms used in the messages being exchanged by network members will indicate to what degree they are embedded in practice or in the formal organization and to what degree they are structurally or relationally embedded. Before we discuss this issue in more detail, we first review the assumed relationship between each of these forms of embeddedness and social influence.

*Embeddedness in practice.* French and Raven (1959) already considered established expertise as a determinant of social influence and power. The more an actor shows that he or she has expertise and experience concerning the relevant practice around which the network is created, or is embedded in this practice, the more he or she will be perceived as being influential (Lee, 2005; Thomas-Hunt, Ogden, & Neale, 2003). Expertise-based authority (Alvesson & Sveningsson, 2003; Jarvenpaa & Tanriverdi, 2003) provides actors with the ability to judge what kind of content is relevant to both the organization as a whole and the network members' individual practices. This is especially important in environments such as NoPs, where the essential motivation for members to participate is to learn about their common practice (Agterberg et al., 2010). Therefore, it can be expected that actors who are particularly knowledgeable about relevant practices are influential in NoPs.

*Hypothesis 1:* The higher the actors' embeddedness is in practice, the stronger their influence on others.

*Organizational embeddedness.* A position granting an actor formal authority can also be a determinant of his or her influence in the network. Alvesson and Kärreman (2001) noted for example that although the role of formal authority is usually downplayed in relation to knowledge management, visible and high-status individuals such as senior staff members might be able to positively influence knowledge sharing and relationship building in a community. Organizational embeddedness involves more than being connected to formal management, though. The concept also relates to the extent to which an actor knows about the issues that management deems important and the institutionalized knowledge base. An actor who shows that he or she is connected to formal management issues and who is able to connect practice-based learning within a network with institutionalized learning at the organizational level will be able to exert stronger influence (Berson, Nemanich, Waldman, Galvin, & Keller, 2006; Vera & Crossan, 2004).

*Hypothesis 2:* The higher the actors' organizational embeddedness, the stronger their influence on others.

*Structural embeddedness.* Structural embeddedness, as well as relational embeddedness (see section below), can be seen as more specific forms of social embeddedness (Granovetter, 1985; Gulati, 1998). The concept of social embeddedness refers to the extent to which links between network members have been routinized and stabilized due to ongoing social structures (Gulati, 1998, 1999).

The traditional definition of structural embeddedness pertains to the value of the number of connections that individual actors have. We extend this definition by adding the degree to which actors know who knows what, as this is an important characteristic of an actor's

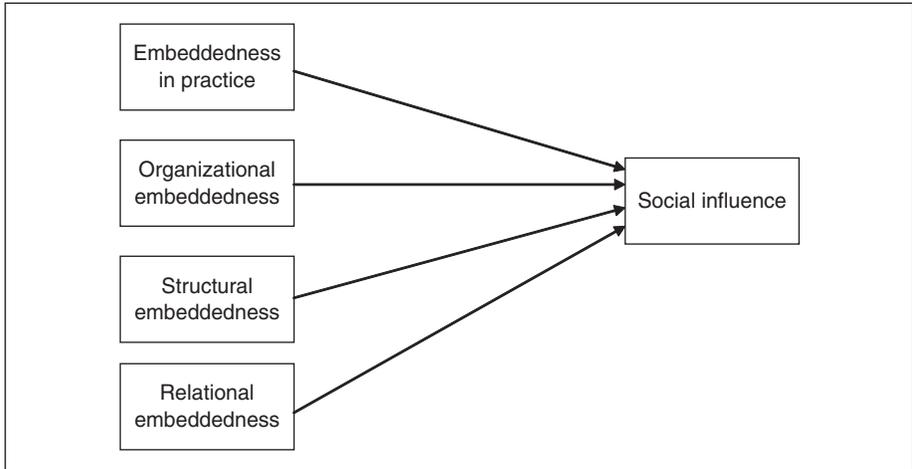
position in the network in terms of knowledge sharing (Denrell, Arvidsson, & Zander, 2004). Ahuja, Galletta, and Carley (2003) showed that individual centrality increases an actor's influence and status in the network. Connectedness influences information flows within the network and thus affects how social influence is exerted (Rulke & Galaskiewicz, 2000; Susskind, 2007). Network positions (in terms of centrality, proximity, etc.) are regarded as important determinants of social influence (Ibarra & Andrews, 1993), but awareness of, and access to, expertise are also crucial (Cornwell & Cornwell, 2008). An actor who conveys that he or she is connected with others and provides knowledge of who is who and who knows what can significantly contribute to the development of transactive memory (Hollingshead, 2000). Transactive memory systems—socially shared cognitions among group or organization members—are effective in reducing cognitive workload and coordination efforts and result in higher performance (Hollingshead, 2000). Recent research has shown that transactive memory systems are especially beneficial for dispersed teams, although they may be more difficult to coordinate (Oshri, van Fenema, & Kotlarsky, 2008; Sole & Edmondson, 2002). Structural embeddedness should be especially important to coordinate transactive memory systems in NoPs, which are characterized by their size and dispersion of the members. Structurally embedded actors may be perceived by others as mediators of access to useful knowledge and thus are likely to exert influence.

*Hypothesis 3:* The higher the actors' structural embeddedness, the stronger their influence on others.

*Relational embeddedness.* Relational embeddedness stresses the role of direct cohesive ties as a mechanism not only for gaining valuable information and knowledge but also for coming to shared understandings and emulation of behavior (compare Uzzi, 1997). The first evidence for the importance of cohesive ties in organizations was provided by Ibarra and Andrews (1993), who showed that it was not only systematic power based on network centrality that affected job-related attitudes but also localized social influence based on friendship network proximity. Borgatti and Cross (2003) reported that information seeking is not only determined by knowing the expertise of an actor (transactive memory) but also by relational conditions such as knowing the person as being helpful and trustworthy. Thus, informal relationships such as friendships among colleagues seem to play an important role. In line with this argument, Agterberg et al. (2010) found that interventions from actors who were perceived as trustworthy and "part of the group" (i.e., those with stronger ties within the network) were received much more positively than those from outsiders. This finding coincides with social identity theory (e.g., Ashfort & Mael, 1989), which predicts that prototypical in-group members are more influential than members of an out-group. Thus, actors who are involved in the group's informal social life, focusing on relational aspects and keeping the group together, are likely to be more influential (Ibarra & Andrews, 1993).

*Hypothesis 4:* The higher the actors' relational embeddedness, the stronger their influence on others.

All in all, this leads to the theoretical model presented in Figure 1.



**Figure 1.** Conceptual model

### *An Automated Content Analysis Approach Toward Measuring Social Influence*

In order to test our hypotheses, we take an alternative approach to much of the social network literature, by focusing on communication *content* instead of on communication links (Ahuja et al., 2003; Cross, Parker, Prusak, & Borgatti, 2001; Ibarra & Andrews, 1993; Monge & Contractor, 2003). We conducted a broad automated content analysis to examine all messages exchanged in four different electronic NoPs within the chemical multinational Chemco. Our analysis enabled us to assess whether social influence was exerted in communication exchanges between originators of, and respondents to, messages. In addition, the automated content analysis enabled us to measure whether the four proposed types of network embeddedness are reflected in real-life intraorganizational language use and to test whether the proposed relationships between embeddedness and influence arise.

Using automated content analysis to explain social processes in a group is a new and innovative approach. Gonzales et al. (2010) employed this method to predict cohesiveness and task performance of small groups that were either communicating FTF or through digital media. These authors focused on the role of *verbal mimicry*, measured by a linguistic style matching metric. We will follow a similar approach by also analyzing the extent to which respondents take over the linguistic style of the originator of a message. The main methodological difference is that Gonzales et al. (2010) analyzed the use of function words only and excluded content words in their analysis. Function words occur frequently and are context-independent: Examples are auxiliary verbs (e.g., to have), adverbs (e.g., often), personal pronouns (e.g., we, I), and quantifiers (e.g., many, few; Gonzales et al., 2010). As our concept of semantic contagion is broader, we will cover the complete language spectrum by means of 200 different language content indicators because we do not know in

advance on which combination of communication content features semantic contagion in NoPs rests.

## Method

To empirically test the conceptual model, we analyze messages exchanged in four NoPs maintained by Chemco, from 2001 to 2006. Our analysis compares the content of originators' postings with that of respondents' postings. Actor characteristics are derived from communication content as well. For example, actors' relational embeddedness is indicated by the occurrence of relationship terms (i.e., relationships, we, emotional states) in their postings. Organizational embeddedness, structural embeddedness, and embeddedness in practice are measured in similar, content-based, ways. Below we will describe how we measured our independent variables in more detail. Social influence, which is the dependent variable in the research model, is operationalized as a feature of the dyadic relationship between the content of originators' and respondents' messages. The extent to which originators' messages set the agenda or the tone for responses indicates the degree of social influence that the originators exert. That is, if responses closely follow subject matter, specific wordings or opinions prompted by an original message, the author of the original message should be seen as influential. A detailed overview of operational definitions follows below.

## Case Description

Chemco is a multinational corporation producing polypropylene and polyolefins products. With plants throughout the world, manufacturing activities in 20 countries and sales activities in more than 120 countries, the expertise of Chemco's 6,700 employees is highly distributed. Because of this dispersion and the highly knowledge-intensive character of the chemical industry, Chemco created 17 online NoPs to support knowledge sharing throughout the organization. These networks are organized around specific practice areas such as Polypropylene, Health and Safety, and Maintenance. The networks are intranet discussion forums where people can post their messages, reply to messages, and submit and store documents. Most postings on the networks relate to problems for which advice from the other members is sought. The networks were created to help members get connected to colleagues in similar practices around the world and keep them up to date about relevant events and developments at other Chemco sites.

Participation in the networks is voluntary and has an informal character. To gain membership, an online request has to be filled out which is to be approved by the network's management. In practice, such requests were always approved and members were allowed to join multiple networks. Every network has one or two moderators, typically high-level managers in the field, expected to stimulate discussion in the network, to organize the network, and to transfer interesting knowledge between the different networks. Chemco has furthermore set up several steering committees, generally consisting of two formal managers of the practice on which the network focuses, an IT manager, and a knowledge exchange

manager. These committees monitor the activities in the networks and have quarterly teleconferences on the activity within the networks over the previous periods.

For this research, Chemco granted us access to four networks: Maintenance, Health and Safety, Supply Chain, and Quality Management. Typical topics in the Maintenance network were fixing machine breakdowns, maintenance procedures for equipment, and requests for spare equipments. The Health and Safety network typically discussed safety incidents, safety guidelines, and health legislation. The Supply Chain network dealt with hauler issues, storage problems, and SAP-related problems. Quality Management dealt with the reporting of quality issues, incidents of low quality, and customer complaints. In these four networks, a total of 620 professionals and experts participated. The majority of these networks' members are mid-level or operational managers, for example local supply chain or maintenance managers. In addition, regional and global managers are active in the networks as well as some lower level employees, for example, some shipping office employees joined the supply chain network. In total, 8,119 messages were exchanged by the 620 participants (of whom 618 were individuals and two were group lists). There is a clear seasonal component in the discussion volume, with lows in the holiday weeks (July, August, late December) and growing activity afterwards, until the peaks of activity in May and November.

To verify whether we may analyze the four NoPs as one communication network, we conducted a core-periphery network analysis (Everett & Borgatti, 2005) as implemented in UCINET (Borgatti, Everett, & Freeman, 2002). A network exhibits a core-periphery structure if most participants do not interact with each other, but mostly with core participants, who, in turn, interact mainly with each other. A core-periphery structure is characteristic for decentralized communication networks with top-level consultations between heads of organizational units. The observation of a single core indicates that a communication network can be considered as a single, fluent network. If multiple cores were to be observed, we should regard the network as comprising several smaller networks. Network analysis shows that the four networks can be regarded as one large core-periphery network, with a core of 17 professionals only, and a periphery of 603 professionals, which amounts to a high concentration rate of 0.81. Responses of core professionals to other core professionals account for 53.1% of all postings, whereas 37.4% of all postings connect the core with the periphery. Only 9.5% of the postings are accounted for by interactions between the 603 peripheral professionals. Another indicator of the fluency of the four networks is that 105 out of the 620 professionals participated in more than one network. Message originators are fairly loyal to specific discussion forums, but respondents may operate in several networks simultaneously. As the empirical data suggest that the four networks considerably overlap in membership, we will consider them as one organizational network in the data analysis.

### *Content Analysis of Organizational Discourse*

Chemco made the full texts of the daily discussions in the four NoPs over the course of several years available for scientific research. This enabled us to perform a full-fledged,

unobtrusive content analysis (Krippendorff, 2004; Van Atteveldt, 2008) of the actual messages exchanged. Usually, research in organizational communication has to rely on retrospective self-reports in obtrusive interviews conducted with a sample of the participants (Yuan, Fulk, & Monge, 2007). We included the full texts of all postings in our analysis but not attached files or FTP sites and webpages referenced through hyperlinks. The average posting had a length of 56 words ( $SD = 82$  words, skewness = 4.5, median = 24 words).

Our content analysis follows a two-step approach. In the first, inductive step, we assess the occurrence, per message, of a very broad range of 200 linguistic indicators stemming from three generic sources. In this step, the aim is to determine whether the language used in the communication network diverges, as expected, into four factors coinciding with the four types of embeddedness that we propose. In the second, deductive step, we determine the extent to which the observed linguistic factors affect the social influence exerted by message originators on respondents.

As linguistic resources for our automated content analysis, we used *The General Inquirer* (Stone, Dunphy, Smith, & Ogilvie, D. M., 1966), *Roget's Thesaurus of English Words and Phrases* (Dutch, 1966), and the CELEX lexical database with regard to the Cobuild word form usage frequencies in current English (Baayen, Piepenbrock, & Gulikers, 1995). The former two are word categorization tools that combine into categories words with a similar meaning. *The General Inquirer* is sensitive to us–them distinctions as well as to a variety of power relationships that are relevant in politics, society, and business alike. We used all categories from *The General Inquirer* separately but combined several categories from Roget's thesaurus to tap aspects of textual content (e.g., success, failure, support, criticism) that predicted popular support for political parties (Kleinnijenhuis, Van Hoof, Oegema, & De Ridder, 2007) as well as corporate reputation (Meijer, 2004; Meijer & Kleinnijenhuis, 2006). The Cobuild word form frequencies were used to construct two measures of frequently used words in texts, that is, measures of text comprehensibility. Using the AMCAT environment for content analysis ([www.content-analysis.org](http://www.content-analysis.org) and [amcat.vu.nl](http://amcat.vu.nl), see Van Atteveldt, 2008), every posting in the NoPs was dissected into the frequencies of occurrence of each of the various categories from *The General Inquirer*, *Roget's Thesaurus*, and the Cobuild frequency dictionary, resulting in 200 indicators for each message.

## Operationalization

**Embeddedness.** First, we normalized word frequencies for each of the 200 linguistic indicators for long and short postings by relating the number of keywords representing a specific indicator to the total number of words in that posting in a percentage score. In order to understand the semantic structure in these networks, a factor analysis was conducted (principal components with varimax rotation) including all linguistic indicators. Human language use is typically a high-dimensional activity: To understand language at a level to pass, for example, the U.S. student entry test TOEFL, up to 300 dimensions are needed (Landauer & Dumais, 1997). Based on the scree test, we found that 5 independent (orthogonal) factors were clearly more important than the remaining 17 factors with eigenvalues larger than one. Table 2 lists the linguistic categories that load higher than 0.35 on the five factors. Inductive factor analysis, allowing for language traits loading nonuniquely

**Table 2.** Factor Loadings of Language Indicators on Embeddedness and Critical Analysis

	Relational	Organizational	Structural	In Practice	Critical Analysis
State verbs: mental or emotional states	0.64				
We	0.63				
Our	0.61				
Need	0.55				
Success/failure positive	0.55				
Overstatement, emphasis	0.54				
Solve: mental processes associated with problem solving	0.51				
Source negative	0.49				
Recognized words	0.48				
Quantity	0.47		0.39		
Relationships	0.42				
Rectitude (moral values)	0.40				
Verb	0.39	0.51			
QuestM	0.37				
Time/space	0.37		0.35		
Success/failure negative	0.36				
Source positive	0.36	0.35			
Weakness	0.35				
Yes/agreement		0.93			
Self—pronouns referring to singular self		0.88			
Power gain		0.85			
Power cooperation		0.85			
Exclamations, slang (e.g., nope)		0.81			
Sureness and firmness		0.69			
Affiliation		0.62			
Passive		0.57			
Form, format of transaction		0.56			
Similarity positive		0.47	0.53		
Adverb		0.42			
Verbs giving an interpretative explanation of an action		0.40		0.44	0.41
Female (women and social roles associated with women)			0.83		
Position (in space)			0.71		
Failure			0.67		
Names			0.59		

(continued)

**Table 2.** (continued)

	Relational	Organizational	Structural	In Practice	Critical Analysis
Actors not otherwise defined			0.56		
Roles			0.56		
Humans, including roles			0.55		
If (uncertainty, doubt, and vagueness)			0.50		
Political roles, acts, . . .			0.49		
Travel			0.48		
Transaction loss			0.45		0.48
Space			0.44		
Understated, caution			0.42		
Transaction exchange			0.39		
Economic/business orientation			0.36		
Positive outlook				0.65	
Virtue: moral approval				0.56	
Positive affect				0.54	
Evaluation positive				0.50	
Active				0.48	0.44
Try: activities to reach a goal				0.42	
Power				0.40	
Compare				0.37	
Strong			0.33	0.36	0.34
Socially defined interpersonal processes				0.36	
Skills				0.35	
Communication				0.35	
Hostility/aggressiveness					0.58
Vice: moral disapproval					0.35
Support/criticism negative					0.42
Power conflict					0.51
Exert/movement category					0.58
Natural processes (birth-dead)					0.55
Work (socially defined ways for doing work)					0.55
Descriptive action verbs					0.54
Exchange					0.45
Difficulty of language	-0.50				0.35
Explained variance	3.705	3.622	3.542	3.093	2.796

on several orthogonal factors was preferred to confirmatory factor analysis in which language traits should load uniquely on one factor, but factors are allowed to correlate. The latter approach would imply deleting nonunique items from the analysis, which is unproblematic for survey and experimental research—as for each respondent, sufficient other items remain—but not for natural language content analysis, as deleting language traits would amount to deleting units of observation exhibiting precisely these traits from the study. Moreover, word categories may actually indicate different types of embeddedness at the same time. For example, the category time/space may load both on relational embeddedness and on structural embeddedness because time/space can refer to both formal and informal connections. Because our analysis concerned the confirmation of the four types of embeddedness to be observed in message content throughout the research period, we performed a single factor analysis for the complete period of observation. The factor analysis revealed four factors that roughly represent the four forms of embeddedness derived from the literature. This indicates that these previously identified factors actually emerge in daily use of language.

On the first factor, verbs related to emotional states had the highest factor loading, followed by “we” and “our.” Terms indicating needs, moral values, and relationships also loaded on this factor. These indicators all imply communication about social ties, which are an important part of *relational embeddedness*. In this interpersonal sphere, actors also talk about successes and, to a lesser extent, failures.

The second factor is characterized by terms indicating power issues and affiliations. Moreover, individuals refer to themselves and express firmness and sureness. The use of these terms corresponds to communication about *organizational embeddedness*—actors’ formal roles and power. Communication about communication form or format loaded on this factor as well, indicating that discussions concern formalized and institutionalized ways of communicating. Saying “yes” or “of course” had the highest factor loading, indicating obedience to, and agreement with, the suggestions of superiors. Unexpectedly, a passive orientation was also part of this factor. An explanation could be that agreeing is a more passive response than disagreeing.

On the third factor, various language indicators related to roles had high loadings: roles, humans (including roles), political roles, and the roles of females. Often, names or actors are mentioned. Mentioning roles and names is typical for talking about who knows what. Thus, this factor resembles *structural embeddedness*. Several indicators relating to travel/space/geographical positions and business exchange were also part of this factor. Individuals mention their contacts to show their position in the structural network. Somewhat surprisingly, talking about failures, doubts, and caution loaded also on this factor.

The fourth factor is characterized by the occurrence of terms relating to activity, trying to reach goals, processes, skills, and communication, and thus seems to correspond to *embeddedness in practice*. In line with the assumption that geographically dispersed employees share and discuss their local practices with each other, comparison also loaded on this factor.

Finally, a fifth factor emerged that can best be described as *critical analysis*—comprising hostility, power conflict, negative criticism, and moral disapproval. This criticism often

deals with signaling problems, or with the course of action to be taken, according to the high number of descriptive action verbs being used. The analytical nature of negative alerts is exhibited by the difficulty of language, as measured by the frequent usage of uncommon words (in contrast to relational embeddedness, which was expressed in relatively simple language). We did not anticipate this fifth factor to emerge from our analysis, although it could have been expected on the basis of theories about negativity (Kleinnijenhuis, 2008). The four embeddedness factors represent four approaches to solving problems; the fifth factor seems to reflect the signaling of these problems.

It was decided to include critical analysis as a fifth factor in our confirmative analysis. In this way, we could test whether this fifth factor has complementary value in explaining social influence next to the four embeddedness factors that emerged from our theoretical considerations. To provide the reader with more insight into the meaning of the five factors observed in the organizational communication content, it is useful to review some examples for each factor. Relational embeddedness scores are high for messages like “Tom<sup>1</sup>, may I ask you to correct your chart concerning incoming material control for site X! . . . This is to protect the employee in the event. . . .” Indicators of relational embeddedness are “you” and “employee.” Organizational embeddedness scores are high in—often short—messages such as “self-assessment form of site X,” “crisis management pocket guide,” “environmental benchmarking follow-up,” “near-miss on radioactive level measurement in site X,” “comparison of certificates has been performed since . . . .” Note that organizational embeddedness communication refers to organizational sites, management procedures and forms. Structural embeddedness is observed in messages referring to relevant documents or experts such as “Please see more detail in HMC case no. 513 or link below.” Embeddedness in practice scores were high for messages that told others how things were actually done, for example, “Please use this info to improve security in your site to avoid similar accidents” or “this is the most recent table to use.” Critical discourse does not deal with solutions but starts with problem identification, thus with negativity, for example, “Second degree burn after touching the hot end of a heat gun” or “Prevention of risks involved with operator long hair.”

*Social influence.* Respondents will usually match language style and common language traits of a community to remain on speaking terms and to socially adapt by means of verbal mimicry (Gonzales et al., 2010). Social influence presupposes mimicry as well, but the litmus test of social influence is whether *uncommon* language traits will be adopted. Agreement with respect to relatively uncommon language aspects is the key to understanding the usage of statistical techniques to assess text (dis)similarity in Natural Language Processing (Landauer & Dumais, 1997; Manning & Schütze, 1999).

Social influence becomes visible in communicative influence, that is, in the (dis)similarity between language use of originators of and respondents to messages. It would have been possible to measure whether specific language traits are used similarly in two isolated postings by using a balance score, such as  $1 - (|a - b|) / (a + b)$  (Gonzales et al., 2010). Instead, we propose a measure that also considers whether specific language traits are *uncommon* in the corpus of texts (see Manning & Schütze, 1999, pp. 162-189, 541-566).

The uncommonness of a specific posting with respect to a specific language trait can be expressed by its standardized *z* score with respect to that trait across all the postings.

Subsequently, a simple agreement measure between an originator's message and a response is obtained by multiplying the  $z$  score of both messages. As an example, suppose that a specific language trait was used 9 times by an originator and 11 times by a respondent. Furthermore, suppose that the language trait is relatively common, for example, occurring on average 9 times per message in our corpus. A multiplied  $z$  score would—rightfully so—indicate an absence of social influence ( $z_i z_j = 0$ , because  $z_i = 0$ ); the observed counts are both due to common use of language within the community of interest. Note that a measure of verbal mimicry would render both messages highly similar,  $1 - |9 - 11| / (9 + 11) = 0.9$ , indicating a strong degree of mimicry.

To arrive at composite measures of originators' overall influence, we simply add up the multiplied  $z$  scores for all 200 language traits assessed. Note that the multiplied  $z$  scores do not reflect directly the disagreement or agreement regarding topics, but rather the extent to which topics addressed by originators set the agenda for the responses. Negations or disagreement with the sender with respect to a topic addressed by the sender will not only result in *negative* multiplied  $z$  scores on language features such as “power conflict,” “support/criticism negative,” “hostility/aggressiveness,” and “vice: moral disapproval” that reflect *disagreement* but also in positive multiplied  $z$  scores that reflect the agenda agreement, that is, the agreement concerning what to argue about.

Two composite measures of social influence were created: *Generalized influence* is computed as the summation of the multiplied  $z$  scores for all of the 200 language traits. In addition, a more specific measure we call *influence on embeddedness* was computed; the sum of the multiplied  $z$  scores for the four embeddedness factors. The latter measure reflects the extent to which messages conveying specific types of embeddedness prompt respondents to exhibit embeddedness. More so than a measure of generalized influence, influence on embeddedness captures whether originators conveying relational, organizational, structural, or practical embeddedness influence respondents to also convey their embeddedness.

## Data Analysis Techniques

With social influence as a feature of dyadic relationships between the message of an originator and the subsequent message of a respondent as the dependent variable, the dyadic relationships between originators of postings and respondents to postings are the obvious units of analysis. Regression analysis tests whether the degree to which choices made by originators prompt those made by respondents depends on the four types of embeddedness. The regression model states that social influence depends on four types of embeddedness. A multilevel random coefficients regression model (implemented, among others, in the R package lme4) was used to allow for the possibility that specific respondents may be more susceptible to persuasive attempts than others, whereas specific senders may be simply more persuasive than others, regardless of their embeddedness. Our measure for social influence is formalized as follows:

$$SocInf_{or,re} = b_1 REmb_{or} + b_2 OEmb_{or} + b_3 SEmb_{or} + b_4 PEmb_{or} + b_5 CritA_{or} + a + a_{or} + a_{re} + \varepsilon$$

**Table 3.** Embeddedness and Critical Analysis for the Four Networks of Practice

	Relational Embeddedness		Organizational Embeddedness		Structural Embeddedness		Embeddedness in Practice		Critical Analysis	
	M	SD	M	SD	M	SD	M	SD	M	SD
Network 1	-0.20	0.96	-0.10	0.38	0.11	1.37	-0.01	1.10	0.19	1.23
Network 2	0.06	1.01	-0.07	0.38	-0.13	0.54	0.00	0.88	-0.04	0.84
Network 3	0.13	0.98	0.30	2.13	-0.12	0.47	0.04	0.89	-0.29	0.60
Network 4	0.28	1.00	0.04	0.75	-0.01	0.65	-0.01	0.97	-0.13	0.73
$\eta^2$ significance	0.04***		0.02***		0.01***		0.00 (ns)		0.03***	

Note: ns = not significant.  $n = 8,115$  messages.

\*\*\* $p < .001$ .

where  $SocInf_{or,re}$  = Social influence of or(iginator) on re(spondent);  $REmb_{or}$ ,  $OEmb_{or}$  = Relational embeddedness, organizational embeddedness;  $SEmb_{or}$ ,  $PEmb_{or}$  = Structural embeddedness, and embeddedness in practice of originator;  $CritA_{or}$  = Critical analysis by originator;  $a$  = Intercept, regression constant across all postings;  $a_{or}$  = Persuasive appeal originator ( $M=0, SD=\sigma_{or}$ );  $a_{re}$  = Susceptibility respondent ( $M=0, SD=\sigma_{re}$ );  $\epsilon$  = Residual, unexplained variation at the level of specific postings ( $M=0, SD=\sigma_{\epsilon}$ ).

It should be noted that the model is specified as a model of influence at the micro level. Although relationships at the micro level may be relatively weak, as manifested by a low explained variance, they still may account for a stable relationship at the macro level. A similar relationship between micro and macro effects occurs for example in the domain of consumer behavior, where it might be highly uncertain whether a higher income would increase a specific consumer’s spending in a specific shop (micro-level influence), whereas it is much more certain that a higher income across consumers will increase spending across shops (macro-level influence). Similarly, in the area of media effects, small and variable influences on specific respondents at a given point in time often converge in strong media influence at the aggregated level (Kleinnijenhuis et al., 2007; McCombs & Shaw, 1972).

## Results

### Descriptive Results

**Embeddedness.** To get an impression of the actual level of embeddedness found in the four NoPs, Table 3 displays means and standard deviations of the four types of embeddedness and critical analysis for each of the four networks. Note that means of zero and standard deviations of one would be obtained if the networks were perfectly equal to each other.

Table 3 shows that in none of the four NoPs do the mean scores deviate much from zero, whereas most standard deviations are close to one. By and large, embeddedness does not differ much over the four NoPs, which can also be inferred from the small explained

**Table 4.** Social Influence on Embeddedness and Generalized Influence in the Four Networks of Practice

	Influence on Embeddedness		Generalized Influence (all indicators)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
NoP 1	0.40	1.00	1.23	6.30
NoP 2	0.02	0.31	0.11	1.83
NoP 3	0.00	0.08	0.08	1.28
NoP 4	0.00	0.07	0.59	1.34

Note: NoP = Network of Practice.

variances: The largest  $\eta^2$  amounts to 0.04 only (for relational embeddedness). Differences with respect to pragmatic embeddedness are even nonsignificant. This finding again legitimates the choice to consider the four NoPs as one network in the remainder of this article.

*Social influence.* Table 4 gives an overview of the means and standard deviations of social influence exerted by originators of postings on respondents to postings.

Table 4 shows that NoP 1 (Health and Safety), which was characterized by a high degree of critical discourse, critical remarks, and disapproval (see Table 3), scores relatively high when it comes to average influence of originators on respondents ( $M = 1.23$ ). The variance in NoP 1 with respect to social influence is extremely high, which suggests (hierarchical or charismatic) power differences, with some participants exerting strong influence and others exerting no influence at all.

Table 4 shows also that the variance in generalized influence is much larger than the variance in influence on embeddedness. This indicates that whereas generalized influence is concentrated in specific actors, influence on embeddedness is more distributed over actors. As unequal variance of dependent variables renders unstandardized regression coefficients difficult to interpret, we will present standardized regression coefficients to test the hypotheses.

## Hypotheses Testing

The hypotheses to be tested maintain that the four types of embeddedness increase the likelihood of impact on others.

The results of a multilevel analysis to test the hypotheses are presented in Table 5. This table shows that the four factors of embeddedness were significant predictors of influence on embeddedness.

First, embeddedness in practice had the expected effect: The higher the embeddedness in practice, the stronger both generalized embeddedness and influence on embeddedness. The effects on generalized influence were stronger. Hypothesis 1 is supported.

For organizational embeddedness, a negative effect on social influence was found, especially for influence on embeddedness. That is, the more originators conveyed organizational embeddedness in their messages, the weaker their influence was on others. Hypothesis 2 is therefore rejected.

**Table 5.** Standardized Regression Coefficients to Test the Research Model

Source Characteristics (independent variables)	Influence on Embeddedness			Generalized Influence		
	$\beta$ (standardized)	<i>t</i>	<i>p</i>	$\beta$ (standardized)	<i>t</i>	<i>p</i>
Relational embeddedness	0.05	3.40	***	-0.09	-6.77	**
Organizational embeddedness	-0.10	-7.51	***	-0.03	-2.07	*
Structural embeddedness	0.13	10.47	***	0.08	6.67	**
Embeddedness in practice	0.03	2.41	**	0.08	6.28	***
Critical analysis	-0.02	-1.15	ns	-0.01	-0.96	ns
Intercept (unstandardized a)	0.08	2.18	*	0.053	4.17	***
Standard deviation intercept						
Per respondent/receiver ( $\sigma_{or}$ , SD susceptibility)	0.11			0.02		
Per originator/sender ( $\sigma_{re}$ , SD persuasive power)	0.46			0.20		
Goodness of fit ( $R^2$ )	0.12			0.33		
<i>N</i> postings; <i>k</i> actors	7,210; 602			7,210; 602		

Note: *K* is smaller than 620 because some members of the Networks of Practice never contributed.  
\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

Structural embeddedness showed the strongest effects: The higher the structural embeddedness, the stronger the social influence exerted, especially with respect to influence on embeddedness. Thus, there is strong support for Hypothesis 3.

With regard to relational embeddedness, the results were less clear. Relational embeddedness had a positive effect on influence on embeddedness—that is, the more terms about relational embeddedness the originator used—the more terms indicating embeddedness were used by the respondent. However, relational embeddedness had a negative effect on generalized influence. That is, prompted by messages conveying relational embeddedness, respondents took over terms related to embeddedness but did not accommodate to the other linguistic indicators. Hypothesis 4 is therefore only partly supported.

Critical analysis had no effect on either measure of social influence; regression coefficients were insignificant.

The intercept of the regression equation, which indicates the amount of influence of a sender on a receiver when the embeddedness factors amount to their average value ( $= 0$ ), exhibits variance which depends on the susceptibility of each specific receiver ( $\sigma_{re} = 0.11$ , resp. 0.02), and especially on the persuasive power of each specific sender ( $\sigma_{or} = 0.46$ , resp. 0.20).

## Discussion

This article examined the effects of communication content on the emergence of social influence in NoPs. Based on a sequential analysis of postings, we found support for the

hypothesis that communication content governs social influence: Social influence is stronger for actors whose messages exhibit a higher degree of structural embeddedness and embeddedness in practice. Surprisingly, organizational embeddedness was found to weaken social influence, whereas relational embeddedness was found to have differential effects on social influence in terms of embeddedness (which it increased) and generalized social influence (which it decreased). Based on these results, we can conclude that embeddedness (as evidenced in actors' communication) is a determinant of their social influence.

A possible explanation for the different ways in which different forms of embeddedness affect social influence is that such influence is primarily based on a network member's utilitarian value to other members, in terms of helping others to find practical solutions and relevant knowledge. Embeddedness in practice increases one's ability to provide valuable answers and solutions to other members' problems, and structural embeddedness increases one's ability to locate relevant knowledge (and guide other members toward that knowledge). All this increases an actor's utilitarian value to other members in terms of being able to provide practical solutions to problems and questions they encounter in their daily work. It seems that precisely this utilitarian value increases actors' influence.

Focusing on relational embeddedness, on the other hand, may have a social value in helping other members become more embedded in the network, but is not conducive to exerting generalized social influence. The basis for generalized social influence seems primarily anchored in utilitarian value, and the social aspects of the network may not be directly relevant to finding practical answers and solutions. Contrary to our hypothesis, messages conveying organizational embeddedness *weakened* actors' influence. An increased focus on the formal organization's interests does not seem to be directly useful for solving the problems that other network members encounter in their daily practice, as Agterberg et al. (2010) show. Messages about organizational structure, strategy, and management are not what most of the NoP members seem to be looking for: They need practical solutions, and (access to) relevant knowledge; the more an actor is able to fulfill these needs, the more he or she will be regarded as influential in the network.

### *Theoretical Implications*

In terms of theory, the contribution of this article is threefold. First, the four forms of embeddedness, as well as social influence, were extracted from the actual messages by automated content analyses. Thus, the article refined and tested assumptions made in previous research (Burt, 1999; Reagans & McEvily, 2003) about the quality of relationships affecting social influence in networks. Most importantly, quality of relationships is translated into the content of actors' communication in terms of four forms of embeddedness: embeddedness in practice, organizational embeddedness, structural embeddedness, and relational embeddedness. These forms of embeddedness have been found earlier in a case study on NoPs (Agterberg et al., 2010), but emerged also out of a factor analysis of language indicators. Moreover, they predicted social influence on embeddedness. The concept of embeddedness is an important addition to theory on NoPs, as it indicates that these networks should not be conceptualized as tools that management can implement, and can

simply be expected to lead to fruitful knowledge exchange. The success of an NoP depends on its members being practically and structurally embedded and thus on conditions that emerge almost by definition in a bottom-up fashion, out of shared experiences, practices, and a shared social context.

Our second contribution lies in providing more insight into the tension between the practice-based nature of NoPs on one hand and the formal management interests that are at stake when such networks are used with the explicit goal of integrating geographically dispersed knowledge on the other. Actors who are highly involved in both the “content” and the “connections” of the network (in terms of their expertise and connectedness) seem more likely to exert social influence. These actors primarily fulfill the role of “*primus inter pares*”—their influence is based on their utilitarian value in terms of providing knowledge and contacts that are useful to members in their daily practice. Actors who primarily communicate in terms of formal authority, however, place themselves at a distance from the shared practice on which the dynamics in the networks thrive. The negative influence of organizational embeddedness is in line with literature on how to manage practice-based environments such as communities of practice (CoPs) or NoPs. Strategies for managing CoPs and NoPs in a way that unleashes the full knowledge potential they represent are often characterized as “light touch” or in terms of “stewardship” (Wenger, 1998), “care” (Von Krogh, 1998), “cultivation” (Ward, 2000; Wenger, McDermott, & Snyder, 2002), “nurturance” (Alvesson et al., 2002), or “fine tuning” (Alvesson & Kärreman, 2001). NoPs are strongly self-organizing and emergent in nature, independent from (or even negatively influenced by) interventions by management (Alvesson et al., 2002; Thompson, 2005). This explains why a stronger emphasis on formal management roles (organizational embeddedness) actually leads to less influence in the network, and it is also in line with Mintzberg’s (1983, p. 192) observation that a focus on authority as expressed by the language of organizational embeddedness lowers one’s influence in a professional bureaucracy: “So whereas the Machine Bureaucracy relies on authority of a hierarchical nature—the power of office—the Professional Bureaucracy emphasizes authority of a professional nature—the power of expertise.”

Finally, the focus on practically relevant *content* in an NoP that we derive from our results is also an addition to existing theory in this field. Literature on organizing NoPs tends to focus on the social dimension of these networks, that is, on the importance of social stimuli such as trust and social capital for creating value from such networks (Vaast, 2004; Wasko & Faraj, 2005) instead of utilitarian stimuli. This focus is somewhat surprising, given that NoPs are by definition practice-oriented and thus primarily functional in nature. It is perfectly understandable that actors providing functional value to other actors are the ones who have most influence on the discourse in the network—after all, obtaining practically useful knowledge is the primary motivation for most members to participate in an NoP at all.

### *Practical Implications*

Consequently, a first implication for practice is that those responsible for organizing and managing NoPs should not focus exclusively on ways to enhance the social dynamics

within the network—instead, their focus should be on providing relevant contacts and content. One way to do this would be to identify potential network leaders who have the ability to provide utilitarian value: recognized experts in the field, who are well connected with those within and outside the network.

A second implication for practice is that formal management involvement in NoPs is a very delicate issue. On one hand, involvement of the formal management seems to be required in order to ensure that what happens in the network contributes to organizational goals. On the other hand, our results show that actors who are more embedded in the formal organization are less influential. Authority in the network is based on expertise and connectedness, so it would be advisable to identify actors who meet these criteria but feel responsible for management goals as well.

### *Methodological Implications and Future Research*

To our knowledge, this is the first study to trace social influence in organizational communication networks employing automated content analysis (Krippendorff, 2004; Van Atteveldt, 2008) of members' interactions, rather than Social Network Analysis (Marsden & Friedkin, 1994) or retrospective interviews with a sample of participants (Yuan et al., 2007). Consequently, this study is not hindered by problems involving the generalization from sample network to population network or by problems involving respondents' incomplete or incorrect recall of events. Individuals sometimes lack the ability to judge to what extent they were influenced by others, and self-report measures often suffer from social desirability constraints. For decades, studies on actual communication effects were restricted to domains where experiments (Maass, Salvi, Arcuri, & Semin, 1989) or combinations of content analyses and panel survey studies were possible (McCombs & Shaw, 1972). The current study shows that, through automated content analysis, communication effects can be measured in the organizational domain as well, once organizations are willing to share their internal messages with researchers.

Gonzales et al. (2010) recently showed that automated content analysis is a fruitful approach to study social processes in groups. However, they only analyzed communication in small groups, which were created ad hoc for the duration of an experiment. We show that it is also possible to analyze the communication of much larger, real-life networks. The efficiency of automated content analysis pays off especially when larger data sets have to be analyzed. Gonzales et al. (2010) used only function words to determine the metric of verbal mimicry. We took a broader approach by also analyzing content words. By taking a broad range of words into account, we were able to show that the four types of embeddedness proposed by Agterberg et al. (2010) are also reflected in language use. Future research could further establish the tested embeddedness model by trying to replicate the four factors of embeddedness in other organizational networks. It might also be interesting to compare the rather implicit and unobtrusive content-analytic measures of influence used in the present study with measures of influence based on self-report measures. Although the required data are hard to obtain, further research should also account for evolutionary variations—trials, mutations—in NoPs that do not stem from “spreading the word” but from exogenous shocks (Monge, Heiss, & Margolin, 2008) in the organizational environment

(e.g., reorganizations), in networks' structure (e.g., due to innovations in supply chains), in the relational sphere (e.g., new employees and new customers), and in organizational practice (e.g., due to technological innovations).

The effects of organizational embeddedness and relational embeddedness were not as predicted. We explained this finding post hoc by proposing that formal messages about structure and strategy are not very useful in NoPs that focus on the solution of practical problems. This explanation coincides with the literature on managing CoPs and NoPs, as well as with Mintzberg's view on authority in a professional bureaucracy, but it should be explicitly tested in future research. An interesting empirical question could be whether messages that are primarily practice-oriented yield more responses, or longer threads, than messages that are primarily hierarchical or social in nature.

### Acknowledgments

The authors would like to thank Wouter van Atteveldt and Marlous Agterberg for their research contributions and the anonymous reviewers of *Communication Research* for their helpful comments.

### Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

### Funding

The authors received no financial support for the research and/or authorship of this article.

### Note

1. Names of persons and names of organizational sites are replaced with fictitious names for reasons of privacy.

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