Association for Information Systems
AIS Electronic Library (AISeL)

MCIS 2007 Proceedings

Mediterranean Conference on Information Systems (MCIS)

2007

DYNAMIC CONTEXTUALIZATION IN COMPUTER SUPPORTED COOPERATIVE WORK

Adi Katz
Sami Shamoon Academic College of Engineering of the Negev, adis@sce.ac.il

DYNAMIC CONTEXTUALIZATION IN COMPUTER SUPPORTED COOPERATIVE WORK

Adi, Katz, Sami Shamoon Academic College of Engineering of the Negev, Jabotinsky Street. 84. P.O.Box 8412, Ashdod, Israel, adis@sce.ac.il

Abstract

Computer-mediated collaboration, a dominant mode of organizational communication particularly in dispersed and multinational organizations, introduces unique opportunities but also new problems. One of these problems is the higher risk of misunderstandings, which is more likely to occur in computer-mediated teamwork than in face-to-face teams (Cramton, 2001). Moreover, it may be particularly acute when distributed workers come from different functional backgrounds, holding different perspectives (Dougherty, 1992; Powell et al., 2004). Dispersed collaborations are also likely to suffer problems of culture since collaborators are embedded in a different local work setting with its own rules, language, histories, and myths (Armstrong & Cole, 2002).

Current theories of communication suggest that misunderstanding may be reduced by contextualization, i.e., providing contextual information to explain a core message. However, a central hypothesize in the current research, is that contextualization is beneficial in some situations but not in others. Treating contextualization as a form of adaptive behavior, the research model aims to understand its contingent impact on performance in collaborative tasks. The motivation for contextualization is explained, arguing that it can be predicted by the extent to which the perspectives of the collaborators are different or shared: a difference of perspectives between collaborators motivates them to contextualize in order to increase mutual understanding and thereby increase performance. Computer support should also motivate communicators to contextualize by making it easier for them to do so. A controlled experiment tested these relationships in a collaborative machine-assembly task performed by dyads. The collaborators' perspectives and the level of computer support were manipulated, and contextualization behavior, mutual understanding and performance were measured.

Results show that contextualization is effective only for dyads with different perspectives and may be detrimental when perspectives are similar. When computer support is available, users may contextualize even if it is counterproductive. Therefore, computer-mediated collaboration should be designed to ensure only effective contextualization. Some potential practical implications for collaborative systems are offered.

Keywords: CMC, CSCW, organizational communication, collaboration, mutual understanding, performance, shared perspectives, adaptive behavior, contextualization, communication complexity.

1 INTRODUCTION

Computer-mediated collaboration and distributed work (e.g., virtual teams) is a phenomenon that introduces unique difficulties and opportunities, which in turn present new challenges to organizational design (e.g., team composition) and technological design (e.g., computer support for collaboration). Such design requires an understanding of how distributed workers behave effectively, how they adapt in the face of complex and turbulent business conditions, and how such adaptation affects their performance. One such adaptive behavior is contextualization, i.e., the explicit addition of contextual information to a core message to ensure effective communication. The lack of contextualization has been named as one of the most frequently occurring problems in communication between distributed workers (Cramton, 2001; Maznevski & Chudoba, 2000; Hinds & Bailey, 2003). Common to all situations requiring the communication of contextual information is the likelihood of being misunderstood because of information the speaker possesses but the listener does not. Organizational workers who gain expertise in a given domain tend to develop their own perspectives and professional language, and when specialists in different fields collaborate, these gaps hinder communication (Fischer, 1981). Similiar gaps occur when collaborators come from different cultural or national backgrounds. Contextual information can describe both the situation in which the speaker creates the message such as the speaker's geographic location as well as the speaker's perspective concerning the content of the message such as the speaker's level of expertise in the mentioned domain.

Perspectives can include domain knowledge, terminology and interpretations, intentions and attitudes, social context and physical context (Krauss and Fussell, 1996; Boland and Tenkasi, 1995). On the one hand, different perspectives ensure a variety of worldviews, ideas and capabilities that are important in collaborative work (Pelled, 1996; Milliken and Martins, 1996). On the other hand, different perspectives increase misunderstanding between communicators and requires them to overcome the gap (Clark and Marshall, 1981; Sperber and Wilson, 1986). The current research concentrates on terminology, one aspect of a perspective that can be classified as being at the more molecular (as opposed to molar) level of perspectives. Overcoming differences at any level requires effort, but overcoming differences at the molecular level, which relates to making references e.g. the terminology used, is more cognitively demanding (Roβnagel, 2000). In addition, differences between collaborators in professional language (jargon) or national language are a major cause for communicational breakdowns.

Contextualization is treated as an adaptive behavior that involves tradeoffs between costs (expenditure of cognitive resources) and benefit (higher mutual understanding which gains better communication and thereby better performance). In terms of this cost-benefit lens, the degree of using contextualization can be predicted by the extent to which the perspectives of the collaborators are different or shared: difference of perspectives between collaborators motivates them to contextualize in order to increase mutual understanding and thereby increase performance. Benefits seem to be high when a message is liable to be misunderstood because the listener lacks the context available to the speaker (Gumperz, 1982; Weick and Meader, 1993).

In his popular cultural framework Hall (1976) proposes that cultures can be situated in relation to one another through the styles in which they communicate. Hall defines a 'shared-context dimension' to differentiate cultural patterns of communication: in some communication patterns (high on the shared-context dimension), "most of the information that needs to be transmitted is already [assumed] in the person, while very little is in the coded, explicit, transmitted part of the message". Other communication patterns (low on the shared-context dimension) are just the opposite, "i.e., the mass of the information is vested in the explicit code. Twins who have grown up together can and do communicate more economically [high on the shared-context dimension] than two lawyers in a courtroom during a trial [low on the shared-context dimension]" (Hall, 1976). Dispersed collaborations, which involve multinational communication, are likely to suffer problems of culture that stem from the lack of necessary contextual information, omitted by collaborators who come from cultures that are high on the shared-context dimension.

While the need to support effective communication and to increase the likelihood of mutual understanding (MU) is particularly relevant to computer-mediated communication, the cognitive effort required for contextualization is particularly heavy in computer-mediated communication because information transfer, especially the transfer of complex information, is less efficient than in richer media (Kraut et al., 2002). It may therefore be especially important to understand contextualization behaviour and its impact on performance in computer-supported collaborative work.

2 OBJECTIVES

Treating contextualization as a form of adaptive behavior, a model is proposed for understanding how distributed workers choose to contextualize and how contextualization affects performance in collaborative tasks. The research model is presented in Figure 1.

The first objective is to empirically test that contextualization is used to overcome communication difficulties arising from perspective differences, to enhance performance. The second objective is to extend current research by demonstrating that contextualization may be unhelpful or even detrimental when communicators share perspectives.

According to the research model, communicators engaged in computer-mediated collaboration react to communication difficulties resulting from a state of different perspectives by contextualizing, to ensure high performance. The immediate effect of contextualization behaviour, however, is on MU, which in turn affects performance. Perspective differences and computer support for contextualization are both the antecedents of contextualization, which aims to achieve MU between collaborators, to ensure higher team performance. In practice, perspective differences and computer support can be designed or controlled by the organization. Adaptive behaviour, in contrast, is at the individual's discretion. In a laboratory experiment, perspective differences and computer support were manipulated and the subjects' reactions and performance were monitored.

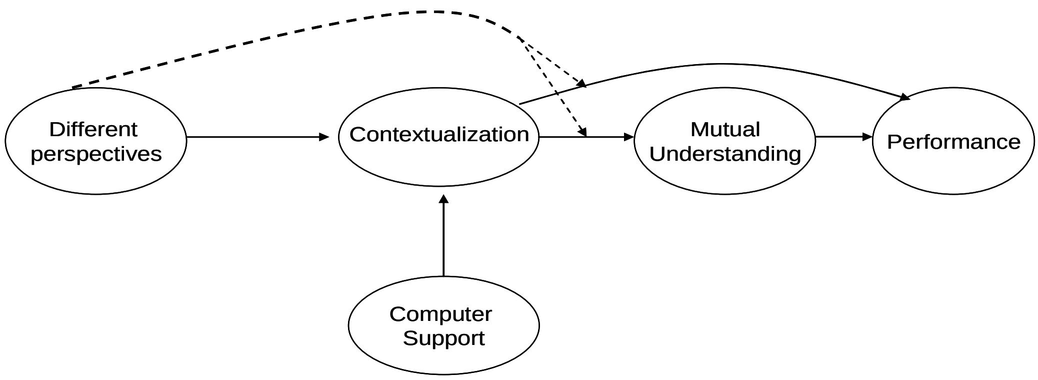

Figure 1. Contextualization as an adaptive behaviour to achieve MU and to enhance performance.

The research propositions:

- Proposition 1: Differences in perspectives increase contextualization behavior.
- Proposition 2: The impact of contextualization on MU and performance is contingent on perspective differences: for shared perspectives, contextualization does not lead to higher MU and performance, but for different perspectives, it does.
- Proposition 3: Higher MU leads to higher performance.
- Proposition 4: Greater computer support for contextualization increases contextualization behaviour.

3 METHOD - EMPIRICAL TESTING

A controlled laboratory experiment tested the relationships in a collaborative machine-assembly task that required knowledge sharing. Two hundred and fifty eight subjects were randomly assigned as 129 dyads of communication partners. Distributed subjects communicated to collaboratively assemble a machine. To do so, they interacted through a computer-mediated collaboration system to connect machine parts into a working machine.

The two collaborators sat separately in front of their respective computers, seeing the same set of simulated objects in real time (Figures 2). The collaborators alternated between two roles, namely, the *director* (knowledge holder) and the *performer*, who was the only one of the two collaborators who could operate on objects. To make it easy for the collaborators to identify which objects they can manipulate, each subject was assigned a colour (red or blue) and the machine parts were painted either red or blue so that a red subject could perform only on red objects (and blue subjects on blue objects). At each of the 16 steps, only a specific and predefined machine part could be moved by one of the subjects acting as the performer. The director received this knowledge at the beginning of the experiment as a printed page of instructions. The ‘blue subject’ received information about red machine parts at the odd steps and the ‘red subject’ about blue parts at the even steps. This situation in which each collaborator was given partial instructions, that actually concerned the parts only his partner could move, required partners to share this knowledge effectively. Each director communicated the information to the performer, who then moved and positioned objects on the computer screen by pointing and dragging them appropriately.

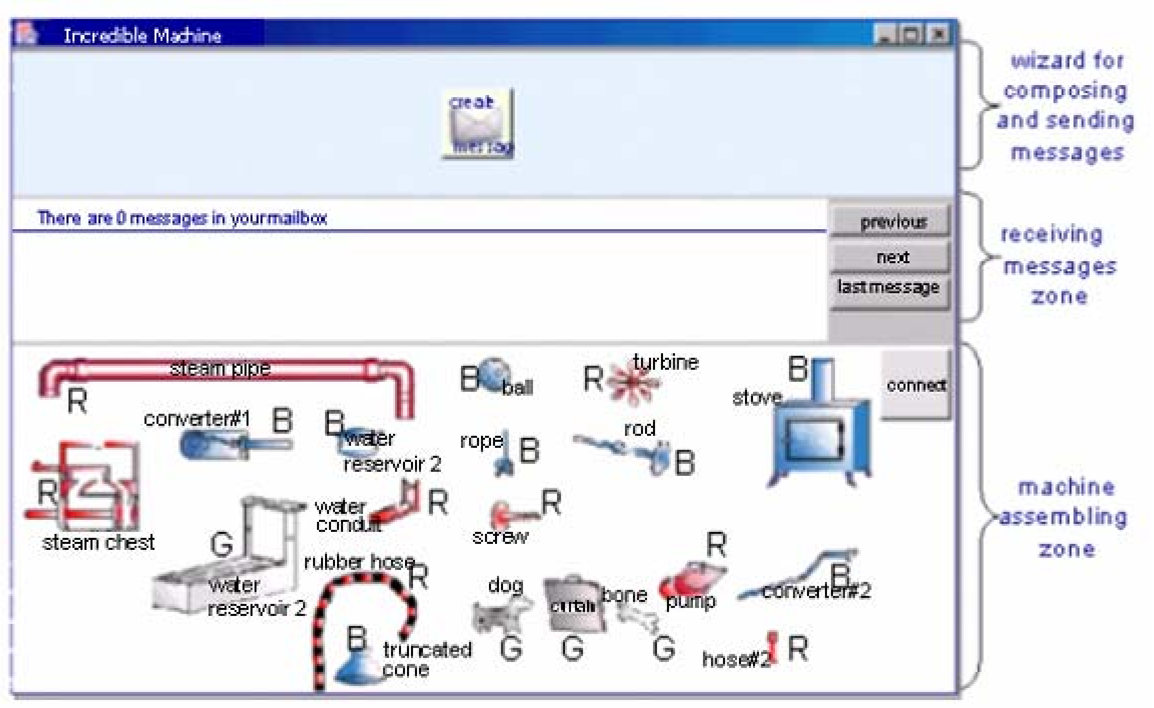

Figure 2. The initial collaborative screen

The experiment is a full factorial (2*3) randomized design with two independent factors between groups, achieved by manipulating two variables, the collaborators' perspectives and the level of computer support. Perspective differences were manipulated by providing both members of the same dyad with the same term or different terms to identify the same machine part (shared versus different perspectives). These terms appear as labels close to the pictures of the objects in Figures 2; computer support for contextualization was manipulated by employing three collaboration systems that differ in the user's ability to add contextual information to a message (no support, low support and high support). The collaboration system structured the communication, distinguishing between core and context in messages. Working in the message composition zone while viewing the machine-assembling zone (Figure 2), the user had to first select the core message from a list of predefined templates, and only then he could add the contextual information to the core and finally send the message. The manipulation of computer support levels was achieved by three variants of the machine composition zone (upper part of Figure 2). The user's ability to add contextual information depended on the level of computer support. The no-support configuration had no functionality designed to support the user in adding contextual information to the core message. In the low-support configuration, after choosing a predefined message template, the user was able to expand the message by typing a limited short string of free-form text that served as additional context to the core message. In the high-support configuration, users were able to freely contextualize by typing unlimited free-form text in a text box placed right below the selected core message.

Additionally, three dependent variables were measured: contextualization behavior, MU and performance. Contextualization behaviour was measured by the number of units of context found in the text communicated. All messages were fully recorded and later analyzed to determine the units of context per message. Mutual understanding (MU) was measured at the end of the task by an 8-question survey calibrated in a second pilot. Performance was measured by the number of successful links (maximum of 16 links) so that more connections in a limited time range exhibit higher performance. See Katz and Te'eni (2007) for further detail of the experiment, manipulations and measures.

People's perceptions of the costs and benefits of the communication situation are related to the idea of communication complexity, i.e., they consider the cognitive cost of ensuring successful communication in situations that jeopardize mutual understanding (Te'eni, 2001) and the cognitive benefit of mutual understanding (and also of better performance). In addition to testing the research model, a dynamic view of collaboration was taken, by testing the impact of changes in the problem space on communication behaviour. An objective measurement of communication cognitive complexity that changes throughout the machine assembly was developed based on the concept of entropy in Shannon's information theory of communication (Shannon, 1948; Shannon and Weaver, 1949). This measurement was used to test the idea that cognitive complexity can tap communication difficulties and signal the need for contextualization.

4 RESULTS

The results of the empirical tests revealed that: a) communicators adapt by engaging in contextualization behaviour in order to overcome difficulties arising from perspective differences (Proposition 1); b) performance depends on MU in collaborative tasks that require exchange of information (Proposition 3); c) the impacts of contextualization on MU and on performance are contingent on whether communicators share or differ in their perspectives: contextualization increases MU and performance in cases of different perspectives, but it does not increase MU and even decreases performance in situations of shared perspectives (Proposition 2). In other words, contextualization is effective only when needed and counterproductive when not needed and suggests that contextualization has costs that may offset its benefits when used inappropriately. Nevertheless, contextualization has its limits and although it overcomes some of the negative effects of different perspectives, it cannot completely eliminate them. Finally, results show that higher levels of support increase contextualization behaviour regardless of whether it is necessary (Proposition 4). Results support the proposed model with statistically significant links in the directions predicted (shown in Figure 3).

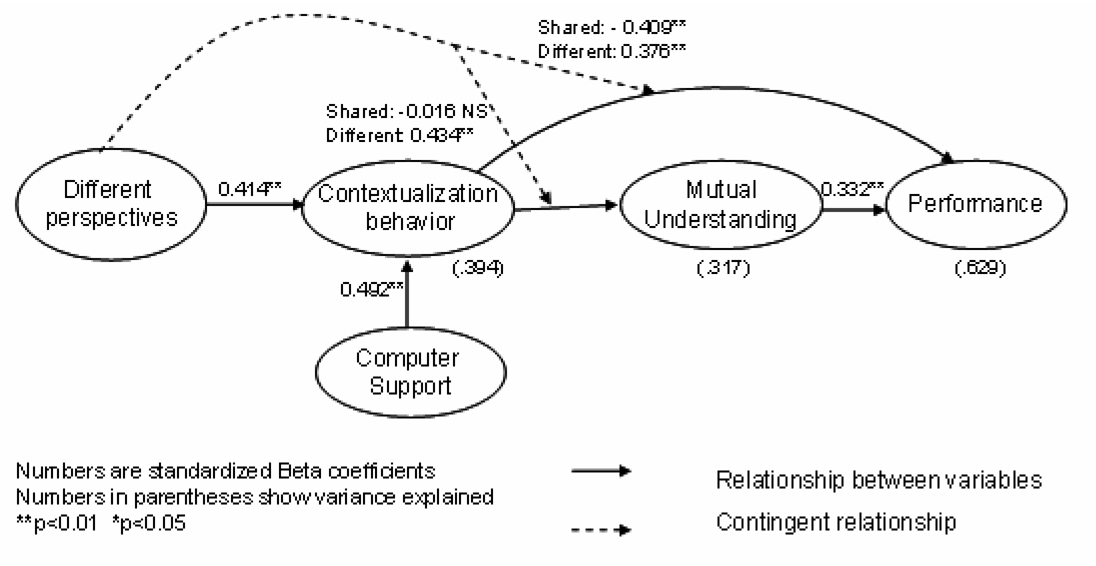

Figure 3. Results of overall model tested with hierarchical regressions

Results testing the dynamic view of collaboration reveal that cognitive complexity can tap communication difficulties and signal the need for contextualization. For instance, figures 4-5 respectively present actual use of contextualization and the number of erroneous connections at each assembly step, alongside with the objective cognitive complexity of each step. It is clear that complex assembly steps are characterised by more contextualization behaviour, and by poorer performance.

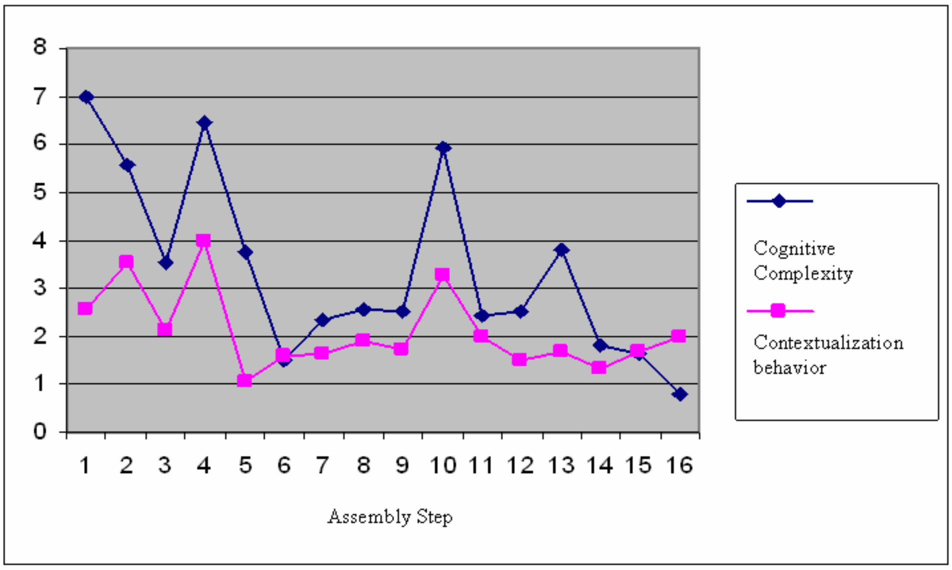

Figure 4. Contextualization behaviour alongside with cognitive complexity at each assembly step

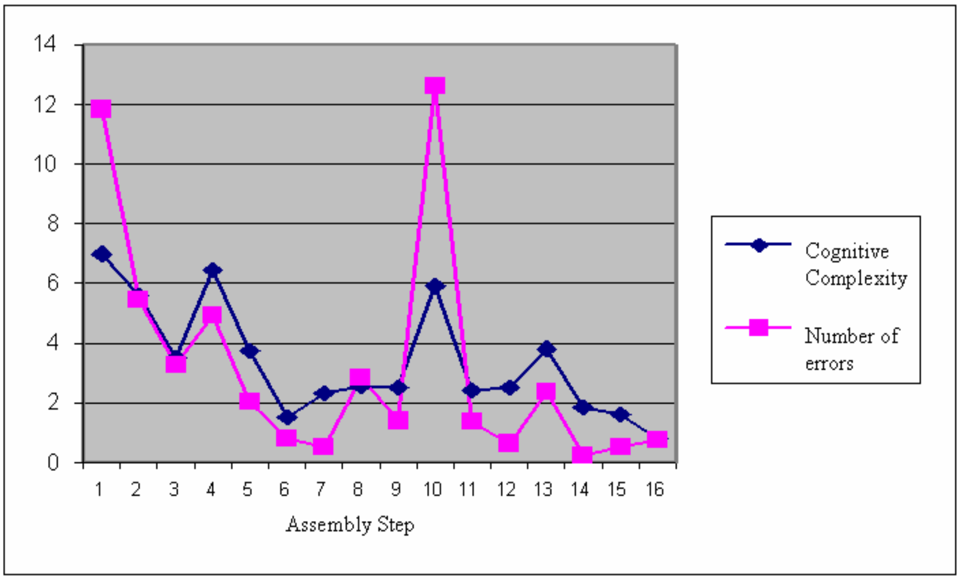

Figure 5. Number of erroneous connections alongside with cognitive complexity at each assembly step

5 CONCLUSIONS

The current study contributes to the field of distributed work by demonstrating in a controlled environment how computer-mediated collaborators adapt their communication behaviour under different organizational and technological conditions. This research on contextualization in distributed work contributes to current thinking that collaborators who hold different perspectives must add contextual information in order to eliminate any possible misunderstandings between them (Hinds and Bailey, 2003). The research empirically tested and confirms that contextualization can overcome communication difficulties arising from perspective differences and thereby enhance performance, and extends current research by demonstrating that contextualization may be unhelpful or even detrimental when communicators share perspectives. Here, research contributes to the growing literature, such as Majchrzak et al. (2005), which suggests that contextualization has costs that may offset its benefits when it is used inappropriately. Although people adapt in the face of complex business conditions, they sometimes fail to identify the appropriate conditions to adapt. Specifically, results show how technology can be designed to promote contextualization, even when it is unnecessary, resulting in lower performance. People may adapt incorrectly, when costs artificially appear to be low in this case.

The user's cost-benefit considerations and the contingencies of adaptive behaviour need to be taken into account in the design of employee training, group composition and computer support for adaptive behaviour. This study suggests that when computer support is available, users may contextualize even if it is counterproductive. Concentrating on computer support, one conclusion is that computer-mediated collaboration should be designed to ensure only effective contextualization. When contextualization is needed, collaborative systems should motivate communicators to contextualize. Some potential practical implications for collaborative systems are touched, such as systems that are capable of assessing perspective differences and react appropriately by encouraging contextualization and prompting users for more details or by allowing contextualization only when it contributes to collaboration.

The research results can be used not only to explain contextualization in computer-supported collaborative work but applied also to online collaborative games, e-tourism, e-learning and other sorts of communication conditions that present barriers to successful interaction due to use of different terminologies and subject-specific terms. Results show the importance of designing systems that support effective contextualization to achieve good collaboration, which in turn will result in high performance.

References

Armstrong, D., & Cole, P. (2002). Managing distances and differences in geographically distributed work groups. In P. Hinds & S. Kiesler (Eds.), Distributed Work (pp. 167-190). Cambridge, MA: MIT Press.

Boland Jr., R. J. and Tenkasi, R. V. (1995). Perspective making and perspective taking in communities of knowing. Organization Science, 6(4), 350-372.

Clark, H. H., and Marshall C. R. (1981). Definite reference and mutual knowledge. In: A. K. Joshi,B. L. Webber and I. A. Sag (eds.), Elements of Discourse Understanding Cambridge, U. K.: Cambridge University Press, pp. 10-63.

Cramton, C. D. (2001). The mutual knowledge problem and its consequences for dispersed collaboration. Organization Science, 12(3), 346-371.

Dougherty D. (1992). Interpretive barriers to successful product innovation in large firms. Organization Science, 3(2), 179-198.

Fischer, D. 1981. Communication in Organizations, West Publishing Company, Minnesota.

Gumperz, J. J. (1982). Discourse Strategies. Cambridge University Press, Cambridge.

Hall, E. T. 1976. Beyond Culture, Anchor Press/Doubleday, Garden City, NY.

Hinds, P.J. and Bailey, D.E. 2003. Out of sync: Understanding conflict in distributed teams, Organization Science, 14(6), 615-632.

Katz, A., Te'eni, D. (2007). The Contingent Impact of Contextualization on Computer-Mediated Collaboration, Organizational Science, 18, 261-279.

Krauss, R. M. Fussell, S. R. (1996). Social psychological models of interpersonal communication. In: E. T. Higgins and A. Kruglanski (eds.) Social Psychology: A Handbook of Basic Principles, Guilford, New York, pp. 655-701.

Kraut, R.E., Fussell, S.R., Brennan, S.E. and Seigel, J. (2002). Understanding effects of proximity on collaboration: Implications for technologies to support remote collaborative work. In: P.J. Hinds and S. Kiesler (eds.) Distributed Work, MIT Press, Cambridge, MA, pp. 137-162.

Majchrzak, A., Malhotra, A. and John, R. 2005. Perceived individual collaboration know-how development through information technology-enabled contextualization: Evidence from distributed teams, Information Systems Research, 16(1), 9-27.

Maznevski, M. and Chudoba, K. 2000. Bridging space over time: Global virtual team dynamics and effectiveness, Organization Science, 11(5) 473-492.

Milliken F.J. and Martins L.L. (1996). Searching for common threads: understanding the multiple effects of diversity in organizational groups. *Academy of Management Review*, 21(2), 402-433.

Pelled, L.H. (1996). Demographic diversity, conflict, and work group outcomes: An intervening process theory. Organization Science, 7(6), 615-631.

Powell, A., Piccoli, G. and Ives, B. (2004). Virtual teams: A review of current literature and direction for future research. The Data Base for Advances in Information Systems, 35(1), pp. 6-36.

Shannon, C. E. (1948), A Mathematical Theory of Communication, Bell System Technical Journal, 27, 379-423, 623-656.

Shannon, C. E., Weaver, W. (1949), The Mathematical Theory of Communication, Urbana: University of Illinois Press.

Sperber, D. and Wilson, D. (1986). Relevance: Communication and Cognition. Harvard University Press.

Te'eni, D. 2001. A cognitive-affective model of organizational communication for designing IT, MISQ Rev., 25(2), 251-312.

Weick, K.E. and Meader, D.K. (1993). Sense making and group support systems. In: L. Jessup and J.S. Valachich (eds.) Group Support Systems: New Perspectives, Macmillan, New York.