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Abstract

Individual learning in organizations is an important activity to be nurtured for corporate procedures, policy, and knowledge sharing. One essential mechanism for individual learning is communication, increasingly occurring via multiple media environments. Understanding individual learning effectiveness depends on our ability to understand and predict media effects. Since recent research on media richness theory suggests that its central proposition does not hold, we explore why this may be. Within the context of communications among individuals in three media environments (asynchronous online, synchronous video conferencing, and face-to-face), this research explores individual perceptions of media and outcomes through individual cognitive communication processes. We link cognitive learning theories and their influence on individual learning and media perceptions to media theories. Results suggest that asynchronous media allow time to pause and reflect during learning, playing an important role in determining an individual's perceptions of media and learning outcomes. This study presents an important contribution to studies of media, technology mediated learning, and individual learning in organizations.

Keywords: Cognition, communication, individual learning, synchronous media, asynchronous media, media richness.

INTRODUCTION

A growing number of organizations are reporting significant performance improvements (cost savings and new revenue streams) because they have found new ways of encouraging employees to learn and share knowledge. Organizational learning is said to occur when individual learning is communicated to others and ultimately to the whole organization (Crossan et al. 1999). Communication plays a critical role in workplace learning and knowledge development (Weick and Westley 1996), and newer communication technologies such as e-mail and video-conferencing play an increasing role in organizational learning by facilitating (or inhibiting) the flow of learning among individuals and groups in organizations (Crossan et al. 1999).

In examining media use and media outcome literature and individual learning literature, we identified an underlying tension between media attributes that have historically defined effective communication in complex situations and the needs of learning-based communication. The original core of media richness theory was the notion that "communication transactions that can overcome different frames of reference or clarify ambiguous issues to change understanding in a timely manner are considered rich" (Daft and Lengel 1986, pg. 560). Thus, media richness theory naturally favored face-to-face communication as the richest medium when processing complex information because it supports maximum transmission of communication cues, it is personalized, exhibits language variety, and allows instant feedback.

On the other hand, individual learning and information processing is frequently associated with communication that allows time to enable individuals to engage in important cognitive activities such as encoding, rehearsing, elaborating, and reasoning. Constructivist learning theory emphasizes exchanges between a learner and the environment and suggests that communication activities require cognitive activities such as elaboration and feedback. These activities require participants to take time to reflect on the content of the communications as they occur in order to effectively process and store learning in memory (Anderson 1990). In this view, therefore, the "need for speed" is not necessarily a critical element in learning, and could actually strain cognitive resources and impair learning outcomes.

This paper draws on media richness theory, organizational communication, and individual learning literature to explore the processes of reducing equivocality through effective communication interactions (which we have termed *cognitive communication processes*) during learning interactions in face-to-face, video-conference, and asynchronous online environments. Our research questions are:

(1) *Do the cognitive communication processes of learners differ by media environment?*

(2) *To what extent are learning outcomes and media perceptions influenced by cognitive communication processes and how does media influence those relationships?*

Our theoretical contribution is the integration of cognitive processes in learning theory as a mechanism that explains, in greater depth, perceived richness. This integration could enable new theories about organizational media choice and outcomes. This paper presents a literature review, model development, research methods, results, and conclusions from a discussion of findings, and implications for future research.

LITERATURE REVIEW, RESEARCH MODEL, AND HYPOTHESES

Media Richness and Organizational Communication

Individuals communicate in organizations for two main reasons: to reduce uncertainty and to reduce equivocality (Daft and Lengel 1986). Reducing uncertainty requires more information; reducing equivocality requires clarifying multiple interpretations of information. According to Daft and Lengel's (pp. 559-560) original theorizing:

> Managers work under conditions of bounded rationality and time constraints. The key factor in equivocality reduction is the extent to which structural mechanisms facilitate the processing of rich information. Information richness is the ability of information to change understanding within a time interval. Communications that require a long time to enable understanding…are lower in richness. In a sense, richness pertains to the learning capacity of a communication.

Thus, rich information reduces equivocality in the shortest time. Daft and Lengel further argued that "the communication media used in organizations determines the richness of information processed," providing a direct link between the concept of information richness and media richness, defined as a property of a medium that enables it to support the transfer of rich information that reduces equivocality quickly.

Since then, media richness theory has been used in a variety of research contexts to explain media choice by individuals in organizations and to interpret communication outcomes. A medium's ability to convey the maximum number of cues, personalization, language variety, and feedback in the shortest possible time to reduce equivocality defines the medium as rich or lean. By implication, face-to-face communication is the richest medium and thus should be used in situations with high levels of equivocality and task complexity. Subsequent media richness research has added important understanding about the role of social influence, media symbolism, situational factors, social presence, channel expansion theory, and temporal considerations in the development of richness perceptions.

We note that one area missing from these studies is an examination of the impact that immediacy of feedback—as a dominant feature of media theories—has on individual learning and sense-making. We turned to analogous research in formal collaborative learning environments in the context of both technologies in the classroom and outside the classroom. Interestingly, these studies produced results that contradict media richness theory. Synchronous, computer-mediated groups were found to develop greater critical thinking skills than face-to-face, non-mediated groups (Alavi 1994) and students in a Virtual Classroom® exhibited better

content mastery and higher subjective satisfaction than students in face-to-face classrooms (Hiltz and Wellman 1997). A closer look at individual learning theory is needed as research in communication, individual learning and mediated learning provide an important foundation for studying organizational learning.

Individual Learning Theory and Sense-Making

Formal learning has been studied extensively over many decades and cannot be reviewed here in detail. During our review, we elected to use constructivist learning perspectives for insight into our research because it emphasizes the need for learners to have interactions with their environment (Leidner and Jarvenpaa 1995). Constructivist learning theories assume that knowledge is constructed by the learner consistent with insight from cognitive psychology (Anderson 1990). The mind of each learner produces its interpretation of reality through processes of attention, encoding, rehearsal, elaboration, retrieval, reasoning, and problem solving.

Collaborationists extend the constructivist process of learning to individuals interacting with peers; individuals learn principally through interaction and dialogue with other learners. An important implication of this is that learning occurs best in naturalistic settings so that learners can transition effectively to solving real world problems. This perspective is consistent with Weick's (1997) organizational sense-making as a socially embedded activity involving individuals engaged in their own processes of enactment, selection, and retention which have their foundation in social interactions and conversations with others. In both perspectives, conversations play an important role in creating and modifying knowledge.

In summary, a review of the literature illustrates the importance of considering cognitive-based interactions (i.e., those that engage deep level thought processes like reasoning and problem solving) among individuals as a key driver in the learning process. We interpret this as providing an important insight into studies of organizational media effects. Specifically, an additional potential origin of media effects occurs in the nature and amount of cognitive interactions that individuals have with each other as they communicate.

Research Model and Hypothesis

Figure 1 illustrates our research model. The input variables are the three different media (face-to-face, video-conference, and asynchronous online). The communication processes are represented by the types of communication interactions taking place; the outcomes are perceptions of learning outcomes (Alavi 1994) and media perceptions (Burke and Chidambaram 1999). Learning outcomes are defined by the ability of peer interactions to improve critical thinking, integrate facts, inter-relate important topics, and increase understanding. Media perceptions refer to media social presence (the extent to which one feels the presence of a person with whom they are interacting), communication effectiveness (the ability of the medium to permit accurate and meaningful exchanges), and communication interface (including ease of use and simplicity).

According to Oliver and McLoughlin (1997), there are five types of communication interactions occurring between two parties that result in learning: social, procedural, expository, explanatory, and cognitive. Social interaction establishes rapport and includes small talk and greetings, while procedural interactions exchange information on requirements, procedures, and standard practices. Expository interactions demonstrate knowledge in response to a direct request. Explanatory interactions occur when learners explain knowledge and develop content. Cognitive interactions provide feedback and create opportunity for debate and reflection. While all types are positively associated with learning, greater learning occurs during expository, explanatory, and cognitive interactions. In our research, these types of interactions represent cognitive communication processes. During a pilot of this study (Haggerty et al. 2000), four orthogonal factors were identified: social, procedural, a combined expository/ explanatory factor, and cognitive interaction. The research model in Figure 1 reflects this finding and the new explanatory interaction construct combines items from both of the previous constructs.

Given our research questions and the model developed above, we could hypothesize that individuals using synchronous face-to-face and video media will perceive greater communication richness and, therefore, experience greater learning outcomes and positive media perceptions. However, individual learning theory would lead us to hypothesize that individuals using media supporting their need for feedback and time for reflection will perceive greater communication richness and, therefore, experience greater learning outcomes. Based on the research questions and these competing views, we considered the null hypotheses 1 through 4 for the first research question, and null hypotheses 5 through 8 for the second research question.

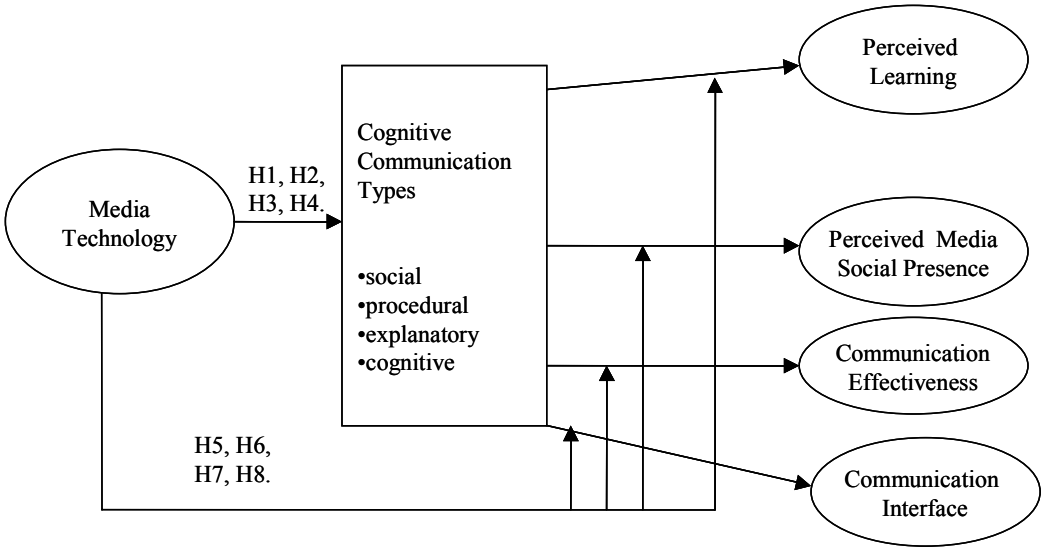

Figure 1. Initial Research Model

H_0 1-4: There will be no difference between groups in perceptions of (H1) social interactions, (H2) procedural interactions, (H3) explanatory interactions, or (H4) cognitive interactions.

H_0 5-8: (H5) Perceived learning development (PLD) will not be influenced by (H5a) levels of social interaction, (H5b) levels of procedural interaction, (H5c) levels of explanatory interactions, or (H5d) levels of cognitive interactions, and (H5e) media will not moderate the relationship between PLD and levels of communication types.

H_0 (6a)through (6e), (7a) through (7e), and (8a) through (8e) proceed in the same way with the relationship between media social presence, communication effectiveness and communication interface respectively.

RESEARCH METHODOLOGY

This exploratory study used formal learning settings rather than organizational settings to provide a more controlled environment to investigate the relationships among media, learning conversations, and perceived richness of the learning environment. In line with collaborationist theory, we focused on peer-to-peer interactions with face-to-face, video-conference, and online media. Subjects were enrolled in one of two business schools; the classroom and video-conference courses were taught at one school and the online course was based at another. We attempted to control for variables such as individual differences, task type, task equivocality, and context by ensuring that all three environments were populated with MBA students in collaborative learning environments (i.e., all three environments based their pedagogy on peer to peer interactions) using business cases. Business cases are exemplars of constructivist learning theory, focusing student learning activities on analyzing, discussing, debating, and solving business problems. We limited the survey to individual respondents who had been working together long enough to be familiar with each other, the learning methodology, and the medium in use.

Data was captured using a pencil and paper survey for subjects in the face-to-face and video-conference settings, and an online survey for the online respondents. Face-to-face respondents returned 94 surveys (71% response rate), video-conference respondents returned 35 surveys (69% response rate), and online respondents returned 109 surveys (92% response rate). The quantitative data was supplemented with interviews and interaction transcripts.

Learning outcomes were measured as perceived learning development (seven items) and self reported learning (three items) (Alavi 1994). These seven-point scale measures captured respondent perceptions of the change in their abilities due to interactions they had with their peers. Media perceptions were measured by three semantic differential scales, drawn from Burke and Chidam-

baram (1999): media social presence (seven items), communications effectiveness (eight items), and communications interface (four items).

Based on factor analysis of pilot study results (Haggerty et al. 2000), expository and explanatory items from the original typology were combined. Three items were used for social, procedural, and explanatory interactions, and four items for the cognitive interaction types based on the same pilot study. For each item, respondents used a seven-point scale to rate the level of the interaction in frequency and length, the quality of the interactions, and the contribution of the interaction to learning. The amount of perceived higher order peer communications was calculated as the product of respondent frequency times length on each of the items created to measure social, procedural, explanatory, and cognitive communication scales.

DATA ANALYSIS

Descriptive statistics on the three groups are shown in Table 1. In general, the classroom respondents were slightly younger with less work experience. Given the age, maturity, and education level of the students in the programs, we had no reason to believe that the age or experience differences would lead to significant bias in the variables. We judged that all respondents would be sufficiently adjusted to their media environment so that any differences detected between groups would not be the result of lack of experience with the media itself.

Table 1. Survey Group Comparisons

Group	Age	Gender	Avg. Work Experience (yrs)
Classroom MBA n = 95	29.5*	M-75%, F-25%	5.7*
Video MBA n = 24	38.8	M-79%, F-21%	17.7
Online MBA n = 109	38.9	M-72%, F-28%	17.3

*statistically significant difference at $p < .001$

Reliability analysis of the survey instrument indicated that the scales for all four dependent and four independent variables exceeded the suggested minimum (.70) for reliability according to Nunally (1967). Convergent validity was assessed using principal components factor analysis. Discriminant validity was assessed with partial least squares analysis comparing the item loading for a construct with the same item's loading on other constructs and examining each construct to see if it shared more variance with its items than it did with other constructs. Analysis of the measurement model showed some problems with items for the media social presence construct, which led to dropping two of seven items. Additionally, the two constructs for learning outcomes showed insufficient discriminant validity and were combined. Finally, explanatory and cognitive interactions loaded to a single factor and were collapsed into a single construct entitled analytic interactions.

To address the first research question and test hypotheses 1 through 4, analysis of variance (ANOVA) was performed comparing respondent perceptions from each media of the frequency, length, quality, and contribution to learning of each of the peer to peer interaction types (Table 2). Where ANOVA indicated statistically significant differences between the groups, a post hoc Sheffe test examined where these existed. Since group sizes were not equal, the analysis was duplicated using a non-parametric equivalent test—the Kruskal-Wallis analysis of ranks. The non-parametric tests replicated the parametric test results.

To address the second research question and hypotheses 5 through 8, multiple regression equations were performed for each dependent variable using the three communication types that emerged from the measurement model analysis. Additionally, we incorporated a procedure for testing the moderating influence of media on the relationship between the communication types and perceived outcomes (Baron and Kenny 1986).

For regression equations on each dependent variable, the amount of social, procedural, and analytical interaction was included in the equation along with two dummy variables representing the media. The regression equation was:

$$\textit{Perceived Learning Development (PLD)} = \beta_1 Social + \beta_2 Procedural + \beta_3 Analytical + \beta_4 Dummy_1 + \beta_5 Dummy_2$$

Table 2. Mean Perceptual Differences by Media for Attributes of Each Interaction Type

Interaction Type	Perceived Frequency		Perceived Length		Perceived Quality		Perceived Contribution to Learning	
Social $H_0$1	**Mean (sig.)**	Sheffe Result	**Mean (sig.)**	Sheffe Result	**Mean (sig.)**	Sheffe Result	**Mean (sig.)**	Sheffe Result
Face-to-face	**5.17**		**3.74**		**4.03**	Less than video**	**4.06**	
Video	**5.56**		**4.28**		**5.01**		**4.90**	
Online	**3.79**	Less than face-to-face* Less than video*	**2.78**	Less than face-to-face* Less than video*	**3.86**	Less than video**	**3.68**	Less than video**
Procedural $H_0$2	**Mean (sig.)**		**Mean (sig.)**		**Mean (ns)**		**Mean (ns)**	
Face-to-face	**3.89**	Less than video***	**3.50**		**4.14**		**4.26**	
Video	**4.83**		**4.01**		**4.83**		**4.80**	
Online	**3.48**	Less than video*	**2.87**	Less than face-to-face** Less than video*	**4.16**		**4.10**	
Analytical $H_0$3,4	**Mean (sig.)**		**Mean (sig.)**		**Mean (sig.)**		**Mean (sig.)**	
Face-to-face	**4.00**	Less than online*	**4.10**	Less than online***	**4.36**	Less than online*	**4.57**	Less than online**
Video	**4.56**		**4.38**		**4.73**		**4.90**	
Online	**5.21**		**4.53**		**5.29**		**5.12**	

* p<.001, ** p<.01, *** p<.05

where $Dummy_1$ is 1 for face-to-face and 0 for online, and $Dummy_2$ is 1 for videoconferencing and 0 for online. The beta weight for the media dummy variables was examined for significance. If it was significant, then three interaction terms representing the product of that specific media and each type of interaction were added to test for a moderated influence of media on interactions and outcomes. Significant beta weights on the interaction terms would be viable evidence of the respective media as a moderator influence between communication types and outcomes. The results of this procedure are shown in Table 3.

DISCUSSION

This research sought to understand how media and learning theories can provide a better understanding of cognitive, collaborative learning in different media environments. This section discusses results relevant to the first research question and Table 2. This is followed by an examination of the results relevant to the second research question and Table 3.

With respect the first research question and the results of the data analysis in Table 2, some interesting findings are revealed.

Table 3. Regression Equation Comparison of Only Significant Betas

	Social (H_o_a)$^+$	Analytical (H_o_c/d)$^+$	Face to Face (dummy1)	Constant
H_o5 – Perceived. Learning Development (R^2=.353)				
Face-to-Face	.28*	.293*	-.633*	3.439*
Video/ Online	.28*	.293*		3.439*
H_o6 – Media Social Presence (R^2=.168)				
Face-to-Face, Video, Online	.291*	.116***		2.99*
H_o7 – Communication Effectiveness (R^2= .219)				
Face-to-Face	.192**	.183**	-.761*	4.252*
Video/ Online	.192**	.183**		4.252*
H_o8 – Communications Interface (R^2=.146)				
Face-to-Face		.229*	-.478**	3.94*
Video/ Online				

$^+$ = hypothesis 5, 6, 7, or 8 according to dependent variable
*p<.001 **p<.01 ***p<.05

For hypotheses 1 through 4 (where 3 and 4 combine explanatory and cognitive interactions), we reject the null hypothesis that no differences exist between groups.

Social Interactions: Perceptions of the frequency, length, quality, and contribution to learning of social interactions vary by group; online respondents exhibited lower mean perceptions of social interactions than both face-to-face and video (frequency and length) and than just video for quality and contribution to learning. Interestingly, video respondents reported significantly higher mean quality of social interactions than the other two groups.

Social communication is peer interaction for greetings and creating an engaging atmosphere. It seems reasonable that differences in perceptions of social communications followed media theories; environments that are synchronous and have face-to-face elements support perceptions of higher levels of social interactions. Face-to-face and video-conference media support stronger social presence, multiple cues, and language variety and respondents in these media were more likely to comment that social interactions were very important: "talking about both personal and professional life helps respondents get to know each other and interpret each other's comments." Synchronous media, therefore, would appear advantageous when peer social interaction is important, such as when social knowledge helps to place peer comments into personal context.

Procedural Interactions: Table 2 also shows that video-conference respondents reported higher procedural communication frequency than the other two groups and longer communications than online. Additionally, the online group reported significantly lower procedural communication length than the face-to-face group.

Peer procedural interactions clarify assignments and class procedures. Of the three media, video-conference discussions among many groups thousands of miles apart and connected with limited technology is the most procedurally demanding. Moreover, each local group could interact locally off-camera to gain important procedural information from each other. It seems reasonable that interaction levels for video subjects would be higher in all respects than face-to-face and online. Moreover, the online group would likely report shorter interactions than the face-to-face group simply because it takes more effort to type comments than to speak them. Again, synchronous media would appear advantageous when peer procedural interaction is important, possibly because synchronous media allow rapid feedback to clarify procedural issues.

Analytical Interactions: Finally, differences existed between the groups for analytical interactions. Face-to-face respondents reported a lower mean level of analytical interactions with their peers in terms of frequency, length, quality, and contribution than the online group. Or, stated differently, asynchronous interactions were perceived to occur more frequently, were longer and of a higher quality, and contributed the most to learning.

This finding may startle some because it seems to contradict media theories. Analytical communications are generally aimed at reducing equivocality; they involve peer arguments, debate, justifications, explanations, and critical reflection as expected in a collaboratively based learning experience. How could they be perceived as being higher in quality and learning contribution

online than media rich synchronous face-to-face and video media? Collaborative learning theory, however, supports these findings because it emphasizes time for reflection and feedback. Asynchronous online communication and the effort required to type text-based responses are likely to encourage reflection, introspection, and measured responses which are perceived as being higher in quality and learning contribution. Moreover, asynchronous communications allow parallel thought and responses while synchronous media require interactions serially, one at a time; this might explain why online interactions are perceived as occurring more frequently and being longer.

These interpretations are corroborated by interviews with online respondents who said they felt they could engage in deeper discussions and were more likely to engage in debating someone else's point of view than in person. One online respondent offered:

> I think it is important to understand the power of the written word. It is permanent versus the spoken word, which evaporates once it is said. Once you write something and post it to the discussion it is there for everyone to see…you really need to think about how you are saying what you want to say.

Another online respondent offered:

> I would spend a lot of time getting into deep discussions with people, post my responses, then download what other people had done and comment on their analysis….When someone challenges your point of view, it makes you do more research and more work.

Common among these online respondents was the perception that asynchronous communication media gave them time to assimilate feedback they got from other learners, time to engage in critical reflection, and time to respond. Moreover, the *reduced* social cues in the online environment were said to encourage emotional detachment, enabling them to feel more comfortable engaging in analytical peer interactions. An online respondent offered:

> One of the real benefits is that you don't get the verbal and visual messages that you get in a classroom debate. You can see everything as logical and objective whereas in class, you can see if someone is getting red faced, embarrassed or angry while they are trying to communicate their opinion.

This should not imply that the online environment is completely devoid of social cues—several online respondents noted being conscious about not "sounding terse."

The common theme of these findings suggests that in highly equivocal situations, where communications and sense-making require frequent and high quality interactions involving debate and criticism, time-paced or asynchronous interactions and reduced cues may contribute to stronger learning.

With respect the second research question and the results of the data analysis in Table 3, we next examine the relationship between important outcomes and interaction types on media influences.

Perceived Learning Development: Table 3 shows statistically significant communication results based on multiple regression analysis. Mean perceived learning development can be predicted by levels of social and analytical interactions. This leads us to reject null hypotheses 5a and 5c/d and conclude that levels of social and analytical communication positively influence perceived learning development. Since we did not detect statistically significant procedural interaction differences on learning development, we cannot reject null hypotheses 5b. Finally, hypothesis 5e predicted no moderating influence of the media on the relationship between learning development and the communication types. This was tested using the dummy variables and the interaction terms when a dummy variable was significant. The results suggest that while group membership makes a difference in the overall mean of perceived learning development, none of the interaction terms were significant. Thus we cannot totally reject null hypothesis 5e.

Media Social Presence: The regression equations for media social presence show that no media were significant, and the regression equations were identical. This suggests that social presence perceptions can be predicted such that as social and analytical communications increase, perceptions of media social presence also increase. Thus we reject null hypotheses 6a and 6 c/d. However the beta weights for procedural communications and media influences were not statistically significant; therefore, we cannot reject null hypotheses 6b and 6e respectively.

Communication Effectiveness: The regression equation for communication effectiveness suggests that communication effectiveness is predicted by social and analytical interactions with both contributing positively. Thus we reject null hypotheses 7a and 7c/d and conclude that levels of social and analytical communication positively influence perceptions of communications effectiveness. The beta for procedural interactions, however, was not statistically significant; we cannot reject null hypotheses 7b. Finally, hypothesis 7e predicted no influence of the media on the relationship between perceptions of communication effectiveness and the communication types. The results suggest that while group membership makes a difference in the overall mean of communication effectiveness, none of the interaction terms were statistically significant; we cannot totally reject null hypothesis 5e.

Communication Interface: Finally, the regression equation for communication interface suggests it is positively related to analytical communication (reject H8c/d) and that face-to-face respondents had lower mean perceptions of communications interface compared to the online respondents. This leads to a partial rejection of H8e. Hypotheses 8a and 8b cannot be rejected as no statistically significant difference was found on communication interface by social and procedural interactions.

Media and learning literature suggest that perceived learning development is positively influenced at the same rate by social and analytical communications, regardless of the media. This is consistent with learning theory; in everyday learning, it seems reasonable that individuals can use either media and still experience similar improvements in their learning outcomes. Moreover, what is most influential to learning is the amount of social and analytical interactions in which individuals engage, regardless of media.

Interestingly, the richer medium—synchronous face-to-face—has a *lower* mean perceived learning development compared to online. This suggests that face-to-face respondents rate their peer interactions as having less influence on their learning than the online group. Again, this seems to run counter to generally accepted media richness perceptions, but although all environments are based on collaborative, peer-to-peer interactions solving business cases, face-to-face media arguably have a greater diversity of influences, with instructor interactions likely the most influential.

STUDY LIMITATIONS

We believe it is important not to conclude prima facie that one media is "better" than another for learning. This research only examined one mechanism of learning interaction (peer-to-peer) and not learning interactions that may occur with other individuals or materials in the environment. Findings are also limited in that students were used as respondents and this group might not generalize to individuals learning in everyday practice in organizations. Further, because we could not randomly assign individuals to their media, we must acknowledge that prior individual preferences for a media may be a plausible alternative explanation for the study findings. Moreover, while we have confidence in the results, this research was based on respondent perceptions and not measurable learning outcomes. While we tried to minimize external biases with nearly identical respondents discussing the same business case but in different media environments, there were some differences between the face-to-face group and it may be possible that different instructors influenced respondents' perceptions to some degree.

SUMMARY

Within the context of communications among individuals in three media environments (asynchronous online, synchronous video conferencing, and face-to-face), this research explores individual perceptions of media and outcomes through individual cognitive communication processes. It links cognitive learning theories and their influence on individual learning and media perceptions to media theories as a novel approach to studying organizational learning. A significant conclusion is that asynchronous media allow time to pause and reflect during peer-to-peer learning, playing an important role in determining an individual's perceptions of media and learning outcomes. Moreover, we suggest that classic media richness theory be reconsidered in terms of the effect of time for reflection. Finally, we believe this study makes an important contribution to media studies, technology-mediated learning, and individual learning in organizations. For organizational learning, these results suggest that media previously considered less rich (such as email) may support learning interactions between colleagues. Consequently, organizations can use this information to provide technological mechanisms to facilitate problem solving and debate between individuals that can the starting point for organizational learning processes.

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