

(running head: Working with Tweets)

Working with Tweets: The Effectiveness of Lean Communication in Collaborative Problem-Solving¹

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Abstract: Among social network sites and tools, Twitter and other microblogging tools are characterized by their particularly "lean" communication form, based on quick and short messages, particularly appealing for personal use by the so called "generation Y". In this paper we investigate whether lean communication - and particularly Twitter - can be used as a tool for teamwork in organizations. Therefore, our research question is focused on whether Twitter could represent a viable communication tool in the future enterprise for collaborative problem solving. More specifically, whether the 140 characters limit would actually make a difference. To answer this research question, we propose here a comparative study of Twitter, a well-known SNS for microblogging, and Skype, a typical communication platform for individuals and organizations. The laboratory experiment method was selected in order to conduct a rigorous comparison with well- defined measurements. Different teams of the same size carry out a well structured problem-solving task communicating via Twitter or Skype. Comparative group performance is measured in terms of task completion time. Our results show that the lower volume of information exchanged via Twitter does not negatively affect group performance: Twitter teams are just as effective as Skype teams. These results can be partly explained in terms of media richness theory, but more interestingly they may be related to the different group dynamics within teams using different systems, and to further dimensions of investigation including the subjects, the task, the technological features and the organizational coordination modes, disclosing new paths for further research.

¹This paper is the outcome of a joint effort from the three authors, who worked in close collaboration. In particular, sections 1, 6 and 7 are to be attributed to Andrea Pontiggia; sections 2 and 3 to Daniela Isari; and sections 4 and 5 to Francesco Virili.

Keywords: social network sites, experiment, microblog, problem-solving, teamwork, technology acceptance.

1 Introduction

Twitter is defined as a “microblog”: the suffix "micro" is referred to a peculiar trait: each message, called "tweet" has a maximum length of 140 characters. This form of "lean" communication, since its debut in 2006, is having an extraordinary success. Recently, Twitter users were accounted for reaching half a billion, with more than 140 millions in the US (Semiocast 2012).

Twitter could be essentially characterized as a "short message" social network tool. The usage of short, concise forms of textual communication is particularly evident among US digital natives. According to a recent survey, "Cell-phone texting has become the preferred channel of basic communication between teens and their friends, and cell calling is a close second" (Lenhart et al., 2012, p. 2). Young generations show an intensive use of lean communication forms, in particular those enabled by ubiquitous technologies (Halse & Mallinson 2009). They frequently communicate, interact, and ultimately decide with short messages like SMSs and "tweets" and instant forms of communication enabled by SNS: written and spoken language is also affected by this emerging phenomenon (Danet & Herring, 2007), as well as information seeking behaviors (Weiler, 2004), information processing and learning styles and strategies (Lau & Phua, 2010, Siemens 2004).

A recent survey shows that in US the so-called "youngest adults", aged 18-24, represent the fastest growing usage group among Twitter adult users (Smith & Brenner, 2012).

In the next few years, as the proportion of digital natives at work is going to grow, we may therefore expect to have new ways of communicating, interacting, organizing and ultimately working together in organizations. We may envision future teamwork based not only on social networking, but also on lean communication with short textual messages: what we called here "working with tweets".

The goal of this research is to empirically analyze new ways of "working with tweets".

Our research may be positioned within the study of social network sites and tools (SNSs), a phenomenon which is disclosing exciting fields of exploration, including the study of new usage patterns, the availability and analysis of the so called "big data" produced by social networks, and the design of new organizational forms and new business models enacted by social networks (Boyd & Ellison, 2007; Beer 2008).

Research in the emerging field of SNSs in organizations has so far explored users' motivations and purposes (Chou et al., 2010; DiMicco, et al., 2008; Jackson, Yates & Orlikowski, 2007); privacy issues (Gross & Acquisti, 2005; Hiltz, Passerini, & Dwyer, 2007); different approaches and collaboration patterns between private, recreational use and work use of SNSs (Ploderer, Howard & Thomas 2010; Jin, Park & Kim, 2010); relationships with organizational social capital and implications for knowledge management within organizations (Steinfeld, J. M. DiMicco, Ellison, & Lampe, 2009) and impacts of SNSs on different types of communication in work settings (Zhao & Rosson, 2009). Recent studies point out that managers adopt multiple media simultaneously (Leonardi et al., 2012) and the increasing trend towards the simultaneous adoption of various social media by companies has highlighted the need for criteria for the choice, appropriate use and classification of different tools within companies (Kaplan & Haenlein, 2010).

Specific research dedicated to working with SNSs (see e.g. Ogata et al., 2001; Rooksby & Sommerville, 2012) has still to figure out how SNSs may affect "core" organizational research fields like teamwork (Hackman, 1990), group problem solving (Bales & Strodtbeck, 1951), group decision making (Kiesler & Sproll, 1992), and enable new emerging patterns of collaboration in the workplace. This is quite natural and understandable: SNS studies are just at their infancy, and they are still exploring the phenomenon. For example, Ploderer, Howard & Thomas (2010) show how different communities (amateurs, professionals and celebrities) interact and collaborate on line, but the prevalent focus is on private use of SNSs, outside the typical workplace setting. As another example, (Zhao and Rosson, 2009) give an interesting picture of potential and actual usage patterns, motivations and attitudes towards Twitter at work; but their

interest and focus is on informant's perceptions and not on the new or changed work activities enabled by Twitter.

Therefore, this contribution is aimed at empirically studying the usage of Twitter in a "core" organizational research field: collaborative problem solving. While recognizing the importance of individualistic and competitive settings in problem solving (Qin et al 1995), we intentionally focused on the study of groups of subjects collaborating towards the solution of a common problem, using Twitter as a communication and interaction platform. The ultimate goal of our research is to be able to design new forms of organizational problem solving, based on social networking and short textual messages.

Therefore, our research question is focused on whether Twitter could represent a viable communication tool in the future enterprise for collaborative problem solving. More specifically, whether the 140 characters limit would actually make a difference.

While no specific research was previously dedicated to explore the potential of Twitter as organizational problem-solving tool, previous studies on collaboration and problem solving in virtual teams, as related to media choice and media richness theories reviewed in the following section, suggest that a basic relationship may exist between the problem solving task characteristics and structure and the type of communication channels used for collaboration. In other words, media richness should match task equivocality. Extant literature (Daft & Lengel, 1986; Majchrzak et al., 2000a; Powell et al., 2004) suggests that unstructured and ambiguous tasks typically require richer interactions, based on face to face contacts and live video conferences; structured and well-defined tasks may benefit of leaner communication media, like text, chat and instant messaging. Our research attempts to make a further step forward, investigating whether the (about) hundred character limit, typical of SMS and "tweets", but absent in other media, actually makes a difference in textual communication for organizational problem solving.

In order to answer this research question, we designed a laboratory experiment, comparing two well known textual communication media, with and without the (about) hundred character limit. In particular, the experiment is focused on textual-only communication for group problem solving, comparing Twitter, the

famous 140-character microblog, with the Instant Message function of Skype, one of the most successful Internet communication platforms, where textual messages are unlimited in length.

Skype is one of the “oldest” and most successful synchronous communication and collaboration platforms (official statistics from the Company released in 2011 show there were 663 million registered users (US SEC 2011)). Both are leaders in their area, widely diffused; both are available for free for all the main technological platforms. The comparison of Twitter and Skype was accomplished in a series of laboratory experiments in which a problem-solving activity was carried out by groups of subjects using the two different systems. Consistently with our particular focus on exploring generation Y workers future communication and collaboration patterns, we selected for the experiment a sample of undergraduate students.

The structure of the paper is the following: after this Introduction, in Section 2 the historical evolution of Twitter usage is illustrated. Section 3 is dedicated to the theoretical background. In Section 4 this experimental research is framed within a wider research design based on multiple-stage experiments. The experimental focus and setting, the data sample and measurements are discussed. Section 5 reports the results of the experiments. Section 6 provides a discussion of our findings. Finally, Section 7 is dedicated to conclusions, limitations of the study, further experimental stages, implications and opportunities for new investigations.

2 Twitter use: previous studies

2.1 Evolution of Twitter usage

When it was created in 2006, Twitter’s design showed two peculiar features. The first is a 140-character post limitation, constrained by the use of the mobile SMS channel (Sagolla, 2009). This feature directly derives from the diffusion of mobile phones and the success of SMS as a pervasive communication form.

The second feature was a a general purpose of sharing information about present-life experience, well expressed by the famous question “What are you doing?”. These two features, together with blogs typical of one-to- many communication, define the initial ‘broadcast nature’ of the tool.

While mainly designed to simply post status messages and short communications, not addressed to specific recipients, Twitter soon began an extraordinary example of collective technology adaptation and evolution.

2.2 Use of Twitter in private and social sphere

Well beyond the original intentions of the founders, users have been continuously introducing new conventions and notations, new usage patterns, and new technical features like software applications to increase the mobile use of the platform. To make a few examples: the user convention of addressing another user with the @ symbol allows quick recognition of messages directed to a specific recipient (addressivity: Huberman, Romero, & Wu, 2009; Honeycutt & Herring, 2009; Miller, 2009). Similarly, the convention of grouping a topic by the “hashtag”—#sign—was introduced by users (Pogue, 2009).

Twitter usage pattern evolution has its roots just after its launch, as it was promptly adopted in the social and political sphere. For example the American presidential candidates began very soon using Twitter to keep their ‘followers’ informed of their activities and upcoming appearances. Subsequently, the platform was adopted by news organizations to share breaking news stories (Mischaud, 2007).

Also users attending conferences started to tweet comments and questions. This way a sort of parallel stream of conversation is generated, opened to a wider audience which was not physically attending the conference. Twitter users discovered a new way to participate by reading tweets and sending tweets with information, questions and so on (Ebner, Beham, Costa & Reinhardt, 2009; Balcom 2007).

Twitter started soon to be used not only as a lean communication channel but also as a reference pointer: sharing links to longer articles, discussions, posts, videos, etc. This immediacy and availability of up-to-date information about what people are saying ‘right now’ and ‘in short’ on a given topic is a peculiar advantage of a microblog like Twitter over different channels. Research on blogging and blog reading also underlines the conversational, oral and prompt nature of Twitter, compared to “traditional” blogs (Baumer, Sueyoshi & Tomlinson, 2011).

To sum up, Twitter's evolution so far shows that this microblog's initial aims and features have been largely expanded and modified according to its users' preferences. This accounts for the wide potential of this microblog for communication and coordination purposes.

2.3 Use of Twitter in Organizations

Not only individual users but also companies rapidly adopted microblog platforms like Twitter, contributing to shape and adapt it to business aims. The first obvious consideration is that blogs and microblogs can support communication with customers. Together with other social network tools, they represent an important instrument to establish the company's "presence" in the market (Culnan et al., 2010). Besides these purposes of communicating to the external public, "internal use" of microblog tools in companies are also reported. According to a report issued by Gartner Group (Mann, 2009) companies encourage the use of microblogs to have employees "share ideas or communicate about what projects they're working on". This use points out the potential of microblogs as collaboration tools within the organizational context. A recent survey by McKinsey on companies' use of Web 2.0 tools (Bughin, Chui, & A. Miller, 2009) has also shown that 64% of the companies in the sample used Web 2.0 platforms for internal use, which "delivers benefits by multiplying the opportunities for collaboration and by allowing knowledge to spread more effectively". Although many companies use a mix of tools, the survey shows that among all respondents deriving benefits, the more heavily used technologies are blogs, wikis, and podcasts—the same tools that are popular among consumers.

The studies and evidence collected until now seem to suggest that in the organizational world there may be a tendency towards an increasingly extensive use of Twitter. The potential for its use as a teamwork tool may be in the process of being achieved, particularly by the youngest generations. The laboratory experiment described in the following sections is designed to explore this possibility. The experimental design is grounded in the theoretical background depicted here below.

3 Twitter use: theoretical background

3.1 Media richness theory

According to the Media Richness Theory (MRT: Daft & Lengel, 1984, 1986) the efficacy and effectiveness of different media may vary according to the degree of “information richness” they possess. The concept of information richness, originally indicating “the ability of information to change understanding within a time interval,” Daft and Lengel 1986, p. 560) is typically used in MRT to distinguish high information richness media, like face to face interactions and video communication channels ("rich communication media"), from low information richness media, like e-mail and paper-based written documents ("lean communication media").

The hundred character limit seem to characterize SMS and Twitter as very lean media, even when compared with typical lean media like e-mail, in spite of the original meaning of the "information richness" concept, which is more related to the nature than to the size of the message (Rau at al., 2008). A textual conversation via SMS or Tweets, given the very short length of the messages, would be split over many different message units, in comparison, for example, to a textual conversation over an unlimited instant messenger system like the Skype chat. Moreover, the form and even the language used would tend to economize and synthesize the number and length of words, ending up in a quite different form of communication (Danet & Herring, 2007, Honeycutt & Herring, 2009). Twitter may therefore show a lower degree of media richness compared to Skype chat because of the 140-character tweet limitation.

3.2 Twitter and the media richness hypothesis

Assuming that Twitter shows a lower degree of media richness in comparison with a typical textual instant messenger like Skype chat, the so called "media richness hypothesis" may be a helpful departure point for a comparative evaluation of the two systems. "According to the media richness hypothesis, rational and effective users choose media of appropriate richness for tasks that involve communication, and, if due to accessibility constraints their choice of

communication media is restricted to media of lower than appropriate richness, a decrease in task outcome quality will occur" (Kock 2005, p. 118).

Noticeably, the original media richness hypothesis has been variously disputed both from the empirical and from the theoretical point of view. Several empirical investigations that have compared the outcomes of working teams using different media have indeed shown contradictory results (Shinnawi & Markus, 1997; Kock 1998; Suh 1998; Majchrzak et al., 2000a; Powell et al., 2004). In some cases they have pointed out that lean communication media can support group effectiveness also in the presence of complex tasks (Kock, 1998; Hung et al., 2007). Even within organizations many different media, both rich and lean, are often simultaneously used by managers to make the very same communication, in redundant patterns of communication through multiple channels (Leonardi et al., 2012).

These studies show that, besides media richness, many factors may affect the relationship between media choice and the effectiveness of teamwork and their outcomes. Among them: characteristics of the task (Dennis et al., 2008), characteristics of the subjects, including cultural and generational factors (Rice et al, 1998; Lau & Phua 2010); technology acceptance (Davis, 1989; Lee et al., 2007); socio-organizational factors like social influence (Fulk & Schmitz, 1990; Markus, 1994), organizational dependencies and coordination modes within the group (Malone & Crowston, 1994, Crowston 1997; Dennis et al., 2008), team dynamics and size (Bradner et al., 2005).

Actually, recent studies observed on line a few communication patterns that may be indicative of the possibility to use Twitter as a collaboration tool (Honeycutt & Herring, 2009), opening scenarios in which the significant media richness limitation due to the 140 characters limit may be compensated by the other factors.

The experiment carried out in this work, as explained in the methodological section, controls some of these factors (characteristics of the subjects; characteristics of the task; type of communication medium) and leaves each team free to make their own choice regarding the organization of work, representing a first step of a series of experiments where these factors will be configured in

alternative ways, in order to actually test the potential and the limitations of a lean communication media like Twitter for collaborative problem solving.

4 Methodology

According to the studies reviewed above, SNSs and particularly short message communication media such as SMSs (160 char) and Twitter (140 char), may be at the horizon in the enterprise of the future, but their actual usage is still limited, especially for teamwork. Their potential for typical organizational activities, like collaborative problem solving, is still largely unexplored. Teams usually collaborate and interact with F2F meetings, telephone, audio and video conference calls, e-mail and document exchanges. But besides enterprise communication, short text messages (and tweets) increasingly play a strong role in personal, private communication, particularly for younger generations, influencing the way people interact and even the evolution of their shared language. It is reasonable to expect that when the "digital natives" will actually start massively populating the enterprises, the communication patterns and media choices could evolve in favour of short messages and tweets.

Therefore, our research question is actually pointing to the future: will Twitter and similar lean communication media disclose new ways of working together in the future? Would the message length limitation actually affect the teamwork outcome?

This question can be addressed with a range of alternative methodological choices, both for the research method, and for the empirical operationalization of the actual variables and measures.

As we have seen, different research streams in extant literature have produced useful theoretical concepts and empirical observations to make sense of the emerging phenomenon of new technologies and media for organized collaborative activities, i.e. computer supported cooperative work. Besides individual preferences and attitudes and capabilities, the basic elements to take into account are task, organizational coordination and technology. The choice of technology/media (e.g. Twitter vs Skype) is typically in relationship both with the type of coordination mode (e.g. spontaneous collaboration vs rule-based) and with the type of task (e.g. unequivocal and structured vs. ambiguous and unstructured).

Section 2 shows how the basic concepts derived from media richness theory were proven to be particularly useful to explain the relation between task and technology. According to the empirical studies on virtual teams recalled above, more equivocal and unstructured tasks may require a more rich and complex technology as communication medium, or even direct F2F contact, while unequivocal and structured tasks may be accomplished with leaner forms of communication. On the other hand, the organizational literature on coordination modes shows how the nature of the activities, their dependencies and their appropriate coordination modes are determinant for the final organizational outcome.

In synthesis, extant literature in organization and CSCW suggests the most relevant dimensions involved in investigating the organizational use of Twitter and similar lean media communication technologies are: the subject (younger generations vs more mature subjects), task type (structured and well defined versus unstructured and ambiguous), and organizational factors (including dependencies, coordination modes, team dynamics, team size). The evidence collected until now by previous studies, based on media richness theory, seem to suggest that Twitter and similar short message textual media could find their way in core organizational activities when simple, structured and well defined activities would be accomplished by the new "generation Y" employees, working in distributed teams.

The basic methodological choice proposed here is the classical randomized experiment (cfr. e.g. Shadish, Cook, & Campbell, 2002). It is particularly appropriate to this investigation, not only for the impossibility to currently observe "generation Y" employees in field studies (younger generations are simply too young to be found in the contemporary corporations), but also to explicitly take into account the influence of the dimensions under investigation (alternative media choice by different subjects, tasks, organizations), removing the influence of uncontrollable external factors. For example, it may be hard to understand if a preference for a particular communication tool or a better task performance in an actual work setting could have been influenced by differences in usage conditions, working environment, by the users' previous experience and knowledge of the system, and by the various and changing purposes and patterns

of actions typical of organizational teamwork. Only in the laboratory is it possible to observe a significant sample of subjects completing exactly the same task in identical conditions with two different tools.

This experimental investigation is essentially focused on whether the 140 character limit could actually affect group problem solving performance. The simplest way to operationalize this investigation would be a single binary experiment: the binary variable would be the choice of a two (otherwise identical) alternative communication media with/without the 140 char limit; the output variable would be group problem solving performance.

On the other hand, it would be interesting and important to take into account the possibly relevant factors suggested by extant literature: subject, task, organization. In principle, a multi-factorial experiment may be designed. The three dimensions potentially affecting technology choice (subject, task, organization), when expressed by simple binary variables, would give rise to a 2x2x2 factorial design, similarly for example to the 3x2x2 design used in (Suleiman & Watson, 2008). The resulting experimental matrix would still be inadequate to capture the essential dimensions of the underlying phenomena: for example, it is difficult to express the universe of subjective attitudes towards media choice with a single binary variable; the same is true for the different task types and structures and for the relevant organizational factors.

The approach proposed here is therefore based on a factorial series of binary experiments, reducing the actual degrees of freedom in subjects, tasks, and group organizations in order to investigate in sequence, and at different research stages, the various conditions under which short-message communication could actually make a difference.

This paper focuses on a first series of binary experiments, in which we have made the following experimental choices, illustrated here in Table 1.

Dimension	Description
Subjects (random assignment)	Undergraduate students ("digital natives"); various degrees of IT skills
Task (fixed)	Unequivocal, well structured; individual task; group task

Organization (free configuration)	5 members teams; spontaneous coordination, task assignment and control
Media (binary control variable)	Skype text-only chat, unlimited length versus Twitter messages, 140 characters length limitation

Table 1: Experimental variables.

Subjects. Here the basic binary distinction would be between "Generation Y" subjects and others. The relevant discriminants are not only the evident demographic factors (particularly age), but also IT knowledge, subjective attitudes towards technology and perceptions of ease of use. The experimental choice here is to focus on undergraduate students (therefore around their twenties), with a random selection and an accurate record of individual IT knowledge, attitudes and perceptions, assuming (and then testing this assumption) that the variability in the recorded factors would not affect the experimental output.

Task. The theoretical expectations here are that equivocal, ambiguous tasks would require richer communication media, while leaner communication would be chosen for structured, well defined, unequivocal tasks. The experimental choice here is to choose a well structured and unequivocal task in the first experimental stage; more unstructured and equivocal tasks in further experimental stages.

Organization. The relevant organizational factors are difficult to include in a simple variable: not only group size, but also the coordination mechanisms adopted may be relevant here, particularly how the task activities are distributed among group members and how the intermediate results are shared, compared and controlled. The experimental choice here is to leave each group free of organizing spontaneously. We recorded all the intra-group communication messages, in order to accomplish an extensive analysis of the coordination modes and group dynamics. Group dynamics and coordination modes analysis are the focus of a following research stage.

Media choice: different media with different degrees of media richness could be taken into account here. The experimental choice here is to focus on the 140 character limit of pure textual communication. Therefore the comparison is between Skype textual communication (no length limit, conversation log unitary

and easy to access and read) and Twitter textual communication (fractioned in single short messages, fragmented conversation log). Further relevant media choices would be explicitly addressed in further experimental stages, including audio channels, video channels and F2F contacts with different technical implementations.

4.3 Experimental setting

In the series of binary experiments reported in this paper, users are randomly assigned to two groups of the same size working in the same conditions to complete a certain problem-solving task. Group A (“treatment”) is using the textual communication tool under observation, limited to 140 char (Twitter). Group B (“control”) is using a similar, but unlimited-length textual communication tool (Skype).

In Table 2 here below the schematic diagram of the randomized design is represented. Cfr. Table 8.1 in (Shadish, Cook, & Campbell, 2002, p. 258).

<i>R</i>	<i>X</i>	<i>O</i>
<i>R</i>		<i>O</i>

Table 2: Schematic diagram of the randomized design.

According to this experimental design, (cfr. e.g. Shadish, Cook, & Campbell, 2002, chapter 8), similar subjects are randomly assigned to either receive a treatment (*X*) (i.e., 140 char limit) or not. No treatment in this case means just using a traditional (unlimited length) textual communication tool. The two groups have to accomplish a standard problem-solving task, and their efficacy is measured and compared, in order to control for differences exclusively due to the treatment, i.e. using a 140-char textual communication tool (microblog: Twitter) instead of a an unlimited textual communication tool (chat: Skype).

Two problem-solving tasks were designed and tested, an individual task and a group task. Only the group task is relevant for the experimental series reported in this paper.

Both for the individual and the group task, a “game master” was assigned to every five persons. The master could communicate with the five subjects individually (for the individual task) or simultaneously (for the group task). Depending on the tool used, there were Skype masters or Twitter masters.

Each person in the group was given a workstation connected to the Internet. For each group, six workstations were needed, five subjects + one master. A typical session had four or six groups distributed in a PC room of 24 or 36 workstations. Both the Skype systems and the Twitter systems could communicate only by the exchange of text messages: any audio or video channel was disabled. Moreover, no kind of direct, face-to-face communication was allowed, under continuous control by the organizers.

The Skype groups were naturally connected as in a typical text conference session: everybody could send and receive messages to the whole group.

The Twitter users were configured in order to obtain a similar network configuration. In each group, each user was a “follower” of all the other ones, including the master. On the other hand, each user was also “followed” by all the other ones, including the master. Therefore, each “tweet” from any group member could be shared within the whole group.

4.4 Individual task

The individual task consists of translating five 5-letter sequences in the corresponding 5-number sequences according to a given translation table. The task requires both accuracy and speed. The choice of a character-by-character translation task was justified by its analytic, calculative nature, and also by its simplicity, not requiring any particular background knowledge, but still requiring care, analytic speed and some need of cross-checking. In particular, the following translation table was given to the subjects: (a=1; b=2; c=3; d=4; e=5; f=6; g=7; h=8; i=9; l=10; m=11; n=12; o=13; p=14; q=15; r=16; s=17; t=18; u=19; v=20; z=21).

In the individual task, the individual user cannot communicate with the other users but only with his master. The tool (Twitter or Skype) is used to transmit standard instructions from the master to each individual, to send the results to the master and, if necessary, for the master to give feedback in presence of errors. In

this case the individual is required to check the calculations and resubmit the results.

4.5 Group task

After completing the individual task, the subjects are requested not to leave their place, waiting for everyone to complete its assignment. Then, the group compositions are finally unveiled: each teammate receives from the master her first group message and can start communicating by exchanging text messages with the other subjects. No one knows the exact the physical location of their teammates The group task instructions follow by the master.

The group task consists of the following calculations, based on the 5-number sequences translated during the individual task:

1. Calculate the total of the even elements for each of the 5 sequences: a, b, c, d, e
2. Calculate the total of the odd elements for each of the 5 sequences: f, g, h, i, j
3. Calculate the two grand totals ($z = a+b+c+d+e$; $k = f+g+h+i+j$)
4. Calculate $A = z-k$
5. For each sequence, $e = \min$ (even components); $O = \max$ (odd components)
6. Calculate B as the sum of $(e*O)+2$ of each sequence
7. Calculate $C = A+B$

The group task is conceived to be still well structured but also articulated, involving many operations and a significant need for cross-checking the intermediate results. Moreover, the subtasks 1, 2 and 5-6 may be parallelized and accomplished by different team members. Therefore, different organizational choices for the division of labour, the emergence of roles and the coordination and control of activities may be adopted.

4.6 Sample, measures and questionnaires

The subjects under examination were university students of management who volunteered to participate. To engage the students and motivate them, emphasis was given to the competitive nature of the game, encouraging them to show that

their randomly selected tool (Twitter or Skype) could turn out to be the best one and their team could be the winner of the series of games. In some of the bigger sessions, small prizes were provided for the winning groups.

Both individual and group task efficacy was recorded both in terms of task completion time and number of translation errors.

With an initial survey at the beginning of each session, we collected information about the subjects under investigation, in order to be able to assess the influence the typical factors affecting intra-group variability: demographic factors, level of knowledge of IT tools, prior experiences with communication and SNS tools, (including Skype and Twitter).

At the end of each session, we administrated an exit survey to collect information on user perceptions of usefulness and ease of use, and their behavioral intention of usage. Moreover, we proposed a few general questions on their usage experience, assessing the emotional impact of the tools.

The questionnaires were printed and handed out to the subjects. Care was taken to keep the questionnaires short and simple, limiting the questionnaire administration and filling-in time to a few minutes before and after each session. The initial survey recorded, besides the name, e-mail, age, and gender of the subject, the frequency of usage of Twitter, the frequency of usage of Skype, (on a scale of 1-5, from “unknown” to “I use it several times a week”), the usage of other SNS tools.

To test the level of IT knowledge of the subjects, we also provided five multiple-choice questions, assigning 1 score point for each correct answer and using the total (from 0 to 5) as a general indicator of IT knowledge.

The survey administered after the experiment recorded the standard perceptions of usage according the technology acceptance model (Venkatesh, et al, 2003), with four questions on perceived usefulness, four questions on perceived ease of use and three questions on behavioral intention of adoption. User perceptions and intentions were recorded both in reference to the individual task and in reference to the group task.

Moreover, ten questions on the emotional experience of using the tool were formulated, based on the semantic differential method introduced by Osgood (1952).

We collected 220 valid questionnaires, a sample of sufficient size for a well-grounded exploratory analysis.

We then excluded from the sample 40 questionnaires related to the first two experimental sessions, which we considered as “testing” sessions, in which we recorded the timing of the experiment, testing different alternative choices and collecting elements for a fine tuning of the experimental setting. Data analysis was then conducted on 180 valid questionnaires: 90 questionnaires measured users’ perceptions about the system use for individual problem-solving and 90 questionnaires measured perceptions about the system use for group problem-solving. All the questionnaires are reported in the Appendix.

5 Results

In order to assess whether Twitter (140 char limit) could be preferred to Skype (no 140 char limit) as a textual media for group problem-solving, our analysis takes into account four dimensions: group problem-solving performance, user experience, user interactions and users’ perceptions in the adoption choice. The results will be discussed as follows.

5.1 Group problem-solving performance

Variable	sample mean			t-test			
	Skype	Twitter	diff.	sig.	p_value	t_value	df
Group probl. solv. time (min)	20.89	20.78	0.11	-	0.95	0.06	9.22

Table 3. t-test analysis of the group task performance (problem-solving time measured in minutes).

Twitter group performance is similar to Skype group performance. As shown in Table 3, the average group problem-solving completion time is 20.8 minutes for Twitter teams and 20.9 minutes for Skype teams, and the difference is not statistically significant. This result indicates that the two systems seem to be equally effective in team problem-solving, thus supporting our initial expectation that Twitter, with its 140-characters message limit, can be compared to other

unlimited textual communication tools (Skype) for this kind of organizational activity.

5.2 Users' previous experience

It is important to assess users' previous experience of Twitter versus Skype. Figures 4 and 5 show that on average, our sample has a significantly lower previous usage experience with Twitter (average score 1.9) than with Skype (average score 2.7). In our entry questionnaire (reported in the Appendix) a score 2 corresponds to the sentence "I know what it is but I've never used it", while a score 3 corresponds to the sentence "I have used the system a few times". On average, our subjects had never used Twitter before; on the other hand, they were quite well acquainted with Skype.

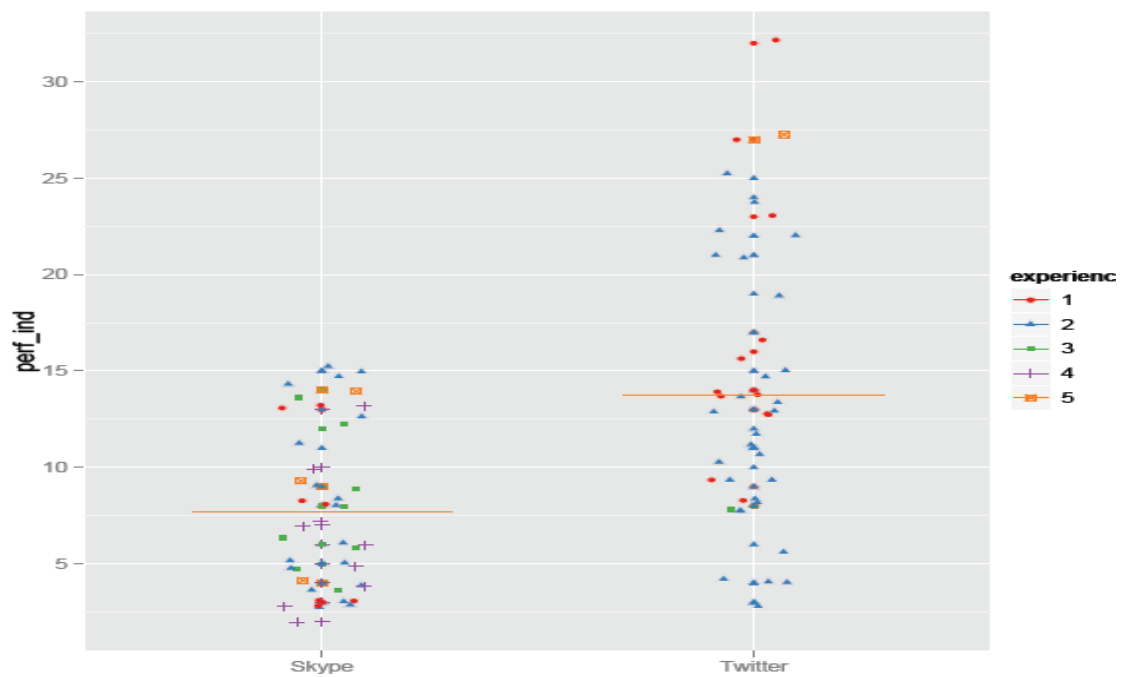


Figure 2. Users' previous experience with Twitter/Skype (experience measured by entry questionnaire with a scale 1 -5, where 1 = "I don't know this instrument at all" and 5 = "I use it very frequently (several times a week)", see Appendix)

Variable	sample mean			t-test			
	Skype	Twitter	diff.	sig.	p_value	t_value	df

User prev. exp. with the system	2.73	1.88	0.85	<1%	0.00	5.47	153.16
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Table 4. The t-test analysis show a significant difference in users' previous experience with Skype vs Twitter.

5.3 User interactions

Another relevant is the intensity of interactions within the teams. We measured this intensity of interaction by the number of messages exchanged among team members during the group task.

Table 5 shows that individuals within Twitter teams exchanged on average 30 messages; while individuals within Skype teams exchanged on average 83 messages, with a significant difference. The effect is even stronger if we consider that the distribution of values related to Twitter interactions is clearly less dispersed² than Skype's and is concentrated on low values, as seen in Figure 4 below.

Variable	sample mean			t-test			
	Skype	Twitter	diff.	sig.	p_value	t_value	df
Messages exchanged (count)	82.78	30.44	52.34	<1%	0.00	4.08	9.12
Messages exchanged per minute	3.96	1.60	2.36	<1%	0.00	3.51	11.54

Table 5. The average number of messages exchanged by individuals within Skype teams and Twitter teams is significantly different.

² We could use the variance of individual interactions as a measure of dispersion: the value for Skype groups is 1229.28, much higher than for Twitter groups, reporting a variance of 88.43.

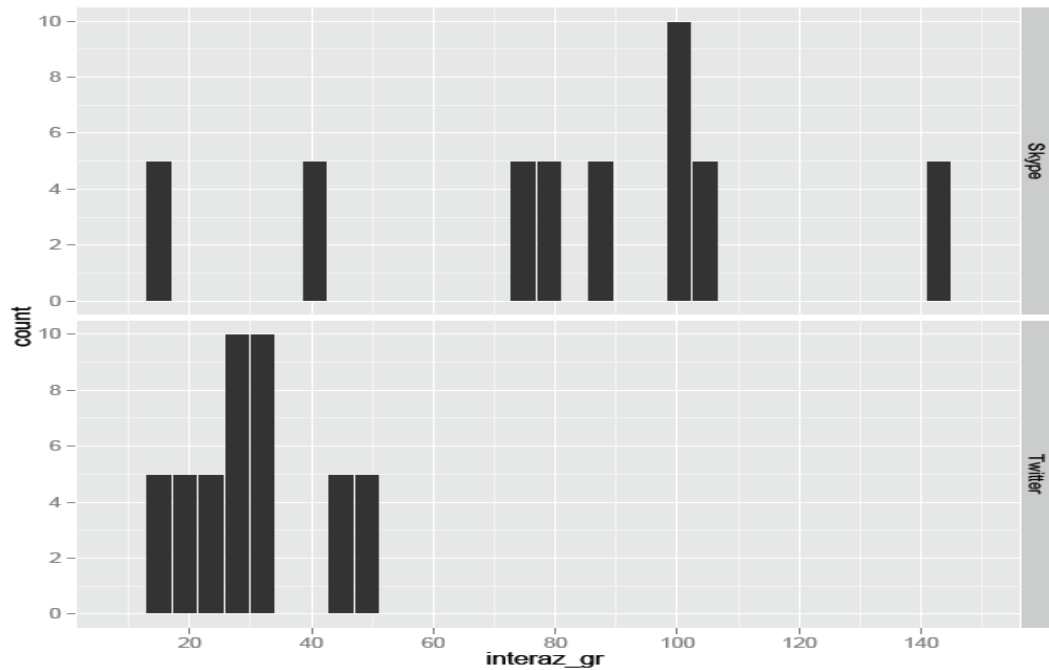


Figure 4. Distribution of values related to Skype teams and Twitter teams interactions.

Table 5 also shows that the average number of messages exchanged per minute within Twitter teams was 1.6; while the average number of messages exchanged per minute within Skype teams was 4.

This means that not only did Twitter teams exchange fewer messages but they were also much slower in communicating than Skype teams.

5.4 Users' perceptions in the adoption choice

Besides their performance, the two systems were also compared in terms of users' perceptions and behavioral preferences.

As shown in Table 6, Skype outperforms Twitter in perceived usefulness for group problem-solving (5.6 versus 4.5); while the difference in terms of perceived ease of use is smaller but still significant (5.9 versus 5.5).

Variable	sample mean			t-test			
	Skype	Twitter	diff.	sig.	p_value	t_value	df
User perceived usefulness	5.59	4.47	1.12	<1%	0.00	3.41	78.41
User perceived ease of use	5.93	5.48	0.45	5%	0.05	1.99	74.27

Table 6. Perceived usefulness and perceived ease of use of the two systems for group problem-solving.

Behavioral intention of adoption (Table 7) shows that users would prefer to adopt Skype for similar problem-solving activities in the future (5.4 versus 4.1).

We remind that users' perceptions were measured by a Likert scale (as from TAM questionnaires reported in the Appendix), where the score 4 corresponds to a neutral position; therefore, in general, users' perceptions are on average quite close to the neutral position for both systems, with a slight preference for Skype in terms of perceived usefulness and behavioral intention of adoption.

Variable	sample mean			t-test			
	Skype	Twitter	diff.	sig.	p_value	t_value	df
User behav. intention of adoption	5.38	4.08	1.30	<1%	0.00	3.46	76.60

Table 7. Behavioral intention of adoption for the two systems for group problem-solving.

6 Discussion

The main pattern clearly emerging from data analysis is that on average, the 140 character limit did not affect computer mediated group problem solving performance: Twitter teams and Skype teams were equally effective. On the other hand, Skype and Twitter group communication patterns were quite different: Skype users interacted significantly more quickly and more frequently than Twitter users. The richer communication and interaction patterns observed in Skype groups were, so to say, rather unproductive: Twitter teams, exchanging shortest and less frequent messages equated on average Skype team performances. A first basic explanation could be given by the experimental choice of a structured task: in line with media richness theory, unequivocal, structured tasks may well be accomplished with leaner communication media. A further experimental stage based on a different type of task would confirm this outcome.

This result is also in line with what recently observed in (Leonardi et al., 2012): SMS and other lean media, in addition to traditional media, may sometimes be effective in managerial communication, with a potentially high level of equivocality.

An interesting explanation may reside in the organizational coordination factor. In this experimental research stage the teams were free of organizing spontaneously. We are now proceeding to the analysis of the textual logs of intragroup communication, in order to understand if, besides the 140 chars limit, the actual type of group coordination adopted by the teams in assigning activities to group members, performing, sharing and controlling the results could have actually made the difference in group performance.

For example, Twitter groups may have developed more hierarchic coordination patterns, closer to a “one-man-band” model. In these groups, single leaders could have led the problem-solving process, reducing the need for interactions among members for discussion, negotiation, mutual support, etc. On the other hand, Skype teams could have adopted a more participative coordination mode, based on distributed communication and more balanced roles within the group. In these groups, each member could actively contribute the solution of the problem through more frequent and rich discussions.

At the moment, we do not have enough evidence to prove this conjecture: to this aim, a comprehensive text analysis of the message database (recorded in the system log files) would be necessary. Such an effort would suggest an entirely new study, based on a new data set to be elaborated with a different methodology and on new theoretical grounds. Nevertheless, the analysis proposed here could serve as a fruitful basis for further research in this direction.

7 Conclusions

Is really "working with tweets" a viable and useful prospect for the next "Generation Y" organizations? Our experimental approach allowed us to produce some elements of evidence, involving young subjects that are going to enter the enterprise of the next future, and investigating on the specific feature of the 140 char limit typical of Twitter and SMSs.

The first element of evidence is that the 140 characters limit deeply affects the teamwork communication patterns: Twitter teams interacted significantly less than Skype users, exchanging less messages and less frequently. According to this experimental result, the 140 characters limit has a relevant effect on teamwork

communication, cutting significantly not only the length but also the volume and the frequency of interactions.

The second element of evidence is that, on average, teamwork performance was not affected by the strong reduction of textual interactions: Twitter teams were just as effective as Skype teams in collaborative problem solving.

Our evidence shows that there may be a significant opportunity for "generation Y" organizations for on line collaboration with Twitter, at least as far as structured, unequivocal tasks are concerned.

7.1 The wider picture

The overall scenario is obviously much more complex: different subjects, different tasks, different teamwork dynamics and different technical features deserve further investigation, as briefly outlined here below.

Our subjects were young and basically IT-skilled, but on average not yet expert on Twitter usage: the comparison of different skills and attitudes toward Twitter may certainly enrich the analysis.

Extant literature is diverging on the effectiveness of new media for on line collaboration in presence of equivocal tasks: the natural further experimental stage would therefore be based on equivocal and complex tasks.

Besides the 140 characters limit, Twitter specific technical features including broadcasting, synchronicity, addressivity, publication, persistency, may significantly influence on line collaboration effectiveness in different ways and would deserve further experimental investigation.

The organizational and social factors are probably the most interesting and complex to investigate: the "Generation Y" enterprise teamwork dynamics are obviously not yet observable in the field. In the laboratory we can open a window on how young subjects interact and collaborate on line using new media and tools, with a view to the evolution of on line coordination. To this aim the analysis of the on line conversation logs may raise opportunities for further research.

An interesting hypothesis to explore would be that Twitter groups may develop more hierarchic coordination patterns, closer to a "one-man-band" model. On the other hand, Skype teams may show a more participative coordination mode, based on distributed communication and more balanced roles within the group.

7.2 Further research steps and additional research areas

In this perspective, the study of group roles development and leadership patterns within Skype and Twitter teams, based on the qualitative analysis of the textual message database, might give useful insights for understanding if and how the use of different tools might influence group dynamics.

Such an extension of this research is already in progress as a part of a more extended research design, but it is not proposed here, because it is based not only on an entirely new dataset, but also on different methods of analysis, and a different theoretical base. Nevertheless, we hope that this first research stage contribution could represent a fruitful initial point of departure, proving that Twitter teamwork performance could actually equal Skype teamwork performance in group problem-solving for certain type of subjects and tasks, overcoming Twitter 140 characters design limitations in media richness.

Our study has several limitations: the first is due to the high specificity of the problem-solving task designed for the experiment. We are aware that a few simple translation and calculation tasks may not be representative of the whole category of organizational problem-solving activities; nevertheless the narrow focus of the experiment does not exclude generalizability but defines a field of application that can progressively be extended. Further studies, based on many different types of tasks, may enrich this view and improve the type of generalization proposed in this study (Lee & Baskerville, 2003)³.

7.3 Theoretical and managerial implications

As underlined in the introduction, an evolving research program on "working with tweets", and, more generally, on enabling novel forms of organizational collaboration, appears to be quite promising both from the theoretical and the applicative point of view. The first elements of empirical evidence suggest that the 140 characters limitation may not negatively affect group performance; on the other hand, new generations are increasingly using lean communication to interact and collaborate on line. What type of activities are better performed this way? How to choose the right blend of traditional and lean communication tools? What

³ ET generalization: from description to theory: (Lee & Baskerville, 2003).

are the success factors to be considered in the overall picture when designing new forms of organizational collaboration? Finding the proper answers to such a range of questions would imply a significant advance of our theoretical knowledge on computer supported cooperative work, giving the manager of the future enterprise new leverages for building competitive advantage.

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