ORIGINAL PAPER

TIME PRESSURE IN COMPUTER-BASED CREATIVE COLLABORATION

MARGARIDA ROMERO[1], ELENA BARBERA[1]

Manuscript received: 02.02.2015; Accepted paper:14.06.2015;

Published online: 30.09.2015.

Abstract. *Time pressure influences individual and collaborative creative process and outcomes. Although the influence of time pressure on creativity has been widely studied in individual learning contexts, there is still no substantial body of research in collaborative contexts, and the specific context of computer-based creative collaboration. In this exploratory study we aim to characterize time pressure in the context of computer-based creative collaboration by introducing the specificities of time pressure in collaborative contexts and analyzing the influence of computer-mediated communication. We analyze the factors involved in defining the optimum level of temporal pressure in collaborative tasks in computer-supported contexts, taking into account the temporal pressure differences in intragroup individual and group creativity.*

Keywords: *Creativity, Creative Collaboration, Collaborative Learning, Higher Education, Time Factor, Time pressure.*

1. INTRODUCTION

Time pressure has been analyzed both as an objective reality and a subjective perception. Gross (1994) distinguishes between the objective time pressure defined by calendar time and the subjective time pressure perception of urgency in response to the objective pressures of calendar deadlines. The subjective perception of time pressure was related to objective work load in the study by Zuzanek (1998), who observed a higher rate of subjective time pressure when the respondents work longer hours and spend more time taking care of children. However, individual differences, such as test anxiety (Feather & Volkmer, 1988), could also influence the subjective perception of time pressure and the preferred level of time pressure for carrying out academic tasks. Two subjects involved in the same learning activity could have a different perception of the time pressure depending on their time availability, their time use preferences (polychrony, procrastination) and other individual differences constituting their optimum level of time pressure. These individual differences are not a problem when the learning activity allows the learners a certain temporal flexibility within which they can regulate the level of time pressure by deciding the time-on-task quantity, structure and quality. Nevertheless, when the activity rhythm is not flexible and the time-on-task cannot be regulated by the learners, they may feel out of their optimum level of time pressure and suffer from too much or not enough pressure.

Individual differences in preferences towards a certain level of time pressure also apply to creativity work. While some people consider themselves more creative with a certain

[1] E-learn Center, Open University of Catalonia, Spain. E-mail: margarida@uoc.edu, ebarbera@uoc.edu.

amount of time pressure, others prefer to have sufficient time to develop more creative work, thus showing different time pressure preferences in creative tasks. According to Amabile and colleagues (2002, p.1), time pressure "may undermine precisely the kind of thinking needed to do creative work". The relation between time pressure and the creative process and outcomes is a critical question in education in order to regulate learning times to promote the development of creativity in individual and collaborative learning tasks.

This paper aims to evaluate the optimum level of time pressure in the context of computer-based creative collaboration. Firstly, time factors in general, and more specifically time pressure, are characterized in the context of education. Creativity in education is then reviewed according to the 21st century skills framework. We explore creativity in the context of individual and collaborative learning tasks, with a focus on creative collaboration in the context of computer-based environments.

2. TIME FACTORS IN EDUCATION

The time factor and time quality are important aspects in understanding learning activities (Gros, Barberà & Kirschner, 2012; Romero, 2010; Romero & Barberà, 2011), and especially in the creative process of collaboration. Effective learning requires a certain amount of time for the learner. In the context of formal learning, the learning process is designed within a particular instructional design temporality, and a certain amount of time is allocated and regulated by the teacher in the context of the institutional learning time. Teaching and learning times are regulated at different levels, including the institutional level, the instructional and teacher level and the learner level. The Academic Learning Time model (ALT; Caldwell, Huitt & Graeber, 1982; Berliner, 1984) has contributed to characterizing each of these three times:

1. The **scheduled time** of the educational system and the learning centre. The flexibility at this level can be found in the start and finish date of the learning programs, and the flexibility of the academic year, terms and holidays.
2. The **allocated time** is the time defined by the teachers to be allocated to the learning tasks.

The learner's **engaged time, or Time-on-Task (ToT)**, refers to the time learners spend actually learning. Learners can define the time they wish to invest in the task (engaged time or ToT) within the flexibility of the duration of the allocated time. The greater the flexibility of the allocated time, the higher the potential of the engaged time. While some learners require a minimum engaged time and undertake their learning activities trying to spend the least time possible on achieving their objectives (principle of least effort), other learners who have the possibility of spending more time will decide to spend longer on the learning activity.

3. TIME PRESSURE AND PERFORMANCE

Time pressure is defined as a specific kind of stress that is experienced by an individual who perceives that they have less time than required to carry out a task. McGrath (1976) explains time pressures as the imbalance between individuals' resources and the situational demands.

The relation between time pressure and performance in professional and academic settings has been studied in order to analyze how much pressure increases performance. Andrews and Farris (1972) observed that time pressure was associated with above average performance, and even those professionals who performed better preferred more pressure. Prior research on performance effects has pointed towards a curvilinear relation between time pressure and individual and group performance (Karau & Kelly, 1992; Kelly and Karau, 1999). Beersma and colleagues (2003) observed that time pressure leads to faster performance, but lower performance quality. The group organization could also be influenced by the degree of time pressure experienced by the group. On the one hand, Isenberg (1981) observed a more salient leadership in groups with higher time pressure. On the other hand, Kelly and McGrath (1985) observed that in a context of lower pressure the teams developed more original and creative tasks.

4. TIME PRESSURE REGULATION

Time pressure could be regulated at each of the Academic Learning Time (ALT) model levels as shown in Table 1.

Table 1. Time pressure regulation in the ALT model.

ALT	Time pressure regulation
Scheduled Time	Intensive programs have higher time pressure than flexible enrolment programs that allow learners to complete the program with a certain amount of flexibility.
Allocated Time	The teacher can regulate the level of time pressure by increasing the time for completing a task or by increasing the task requirements but maintaining the initial deadline.
Engaged Time	Learners are able to regulate their time pressure to a certain extent when the allocated time offers a degree of flexibility. The learner could decide to start the task earlier and lighten the task load. Also, the learner could, intentionally or not, increase the time pressure by starting to work on the task at the last minute (procrastination). According to Chu and Choi (2005) learners who show a preference for time pressure, and have the ability to meet the deadlines, could intentionally procrastinate, leading to *active procrastination* behavior, as opposed to the *passive procrastination* behavior of learners who delay task completion for other reasons, such as a fear of failure.

In this study, we focus on time pressure as a subjective perception of stress in the context of a long-term creative task where students working in groups have several weeks to complete the task. In this context, the members of the group may have different time pressure preferences. In certain contexts, some of the members of the group may prefer to start working earlier to reduce the time pressure, while others could be active procrastinators who prefer to procrastinate in order to work under a higher level of time pressure, and there may even be other members who are passive procrastinators who delay task completion for other reasons. In this context, the procrastinators prevent their teammates from reducing the time pressure when the teammates' contributions are interdependent.

5. TIME PRESSURE AND CREATIVITY

Despite the positive effects of time pressure on individual and group performance, the results have been much less consistent regarding the quality of performance. It does appear, however, that time pressure can have a negative impact on creativity (Amabile et al, 1997; Andrews & Smith, 1996). Baer and Oldham (2006) observed diverse types of time pressure, some of which could hinder creativity while others seem to foster it. They use the term "experienced creative time pressure" to describe a situation "the extent to which employees feel they have insufficient time to develop creative ideas at work" (p. 963). In their research, they observed that a moderate level of time pressure increases the level of creativity. They discuss the possibility that time pressure and creativity show an inverted U-shaped relationship.

In collaborative contexts, a high level of time pressure could reduce performance quality; Bowman and Wittenbaum (2012, p.309) observed that groups experiencing "high time pressure engaged in shorter discussions about the decision alternatives and exchanged less information than groups with low time pressure". The reduction of quality in the collaboration process in terms of information and discussions could explain the reduction of collaborative creativity in contexts of high time pressure.

6. CREATIVITY, A KEY COMPETENCY FOR THE 21ST CENTURY

Creativity is recognized as one of the key competences for the 21st century. According to Kickmeier-Rust and Albert (2012, p. 680), 21st century skills involve "meta-skills such as problem solving, non-linear thinking, creativity, or communication skills". Frydenberg and Andone (2011) propose the 4Cs model, which includes Critical thinking and problem-solving, Communication, Collaboration and Creativity and innovation skills.

Creativity refers to the generation of ideas that are original, valuable or useful (Sternberg & Lubart, 1999). The importance of the usefulness of the ideas or acts that are considered creative is highlighted by Franken (1994: p. 396) who considers "creativity as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others".

7. CREATIVE COLLABORATION

For years, creativity has been conceived as an individual trait, but also as a process and the product of that process (Amabile, 1996; Eysenck, 1995; Plucker, Beghetto & Dow, 2004; Romero & Barberà, 2012; Romero, Hyvönen & Barberà, 2012; Runco, 2007). In this paper we consider creativity from a socio-cognitive viewpoint in terms of both an individual and a shared process. Creativity is not merely an original act or idea but also an accepted new solution that is collaboratively (co)constructed and shared by a group. The output of creativity may be an act that transcends the creator of the creativity (Sak & Oz, 2010) and produces "changes in an existing domain, or transforms an existing domain into a new one […] What counts is whether the novelty he or she produces is accepted for inclusion in the domain" (Csikszentmihalyi, 1997: p. 315).

Creativity is nowadays considered as a collaborative and situated process (Eteläpelto & Lahti 2008) that cannot be understood as an individual process. In this study we discuss the concept of creative collaboration and the way this competency could be supported by the use of computer-based environments in online learning. The analysis of the creative process in the context of individual creativity is developed through McFadzean's (1998) creative continuum analysis and the Assessment Scale for Creative Collaboration (ASCC), which was developed in the context of the CoCreat European Lifelong Learning Project.

8. COMPUTER-BASED CREATIVE COLLABORATION

Computers could act as cognitive and metacognitive tools. The potential uses of technology are extensive and they could be oriented towards supporting some cognitive process, such as creativity in general and more specifically creative collaboration. According to Yamamoto and Nakakoji (2005, p.514), computer-based "tools for fostering, not obstructing, creativity need to be designed around the understanding of what representations a user needs to interact with". Fozard, Bouma, Franco and Bronswijk (2009) argue the value of collaboration technologies as a support to enhance fun and creativity in the second half of life. According to Lambropoulos, Romero and Kommers (2011), technologies enable the creation of shared contexts for engaging participants. Fun technologies are an opportunity for adults of all ages to engage in creative collaboration and interaction.

9. TIME PRESSURE IN COMPUTER-BASED CREATIVE COLLABORATION

Despite the creative collaboration opportunities described in the previous section, computer-based collaboration has been also observed as a factor that introduces a higher level of time pressure "in terms of expectations regarding the frequency and timeliness of communication" (Thomas & Bailey, 2009, p.627). Computer Mediated Communication (CMC) increases the time pressure felt by the group in four aspects. Firstly, computer-based interaction increases the time pressure on the group because they take more time to exchange the same information than face-to-face groups (Walther, 1992). Secondly, the CMC groups must learn how to use computer-based environments, which increases the time pressure depending on their e-competence. Thirdly, CMC groups often work from different locations, which require asynchronous exchanges or planning to meet synchronously, depending on the temporal availabilities of the teammates (Romero, 2010). Fourthly, in some cases, the groups working on a computer-based creative collaboration task as short-term groups, with no previous history together, also experience increased time pressure (Walther, Anderson & Park, 1994). For these reasons, computer-based creative collaboration could increase the time pressure felt by the members of the group.

In the context of creative collaboration tasks, the individuals engaged in a team should decide on a certain temporal organization within the constraints of the task's temporal flexibility. The temporal organization of the collaborative task will place different levels of time pressure on each of the teammates, depending on their individual temporal profile in terms of time availability (the less time availability, the more time pressure), their polychronic or multitasking acceptance (the more multitasking acceptance, the less time pressure), their age (Romero, Hyvönen & Barberà, 2012) and their time management competencies (the more competent, the less time pressure), among other intra-psychological factors that influence the

time pressure perception at the individual level. The intragroup diversity of the teammates in terms of time availability, polychrony and time management will produce different levels of perceived time pressure for each of the teammates in the group, and generate both an individual and a shared perception of the time pressure during the collaborative learning task. In order to reach a creative process and outcome, both the individual and collaborative time pressure should be optimum.

10. CONCLUSIONS

Creative collaboration in computer-based learning activities will be better developed when the optimum level of temporal pressure is achieved at the individual and collaborative level. The optimum level of temporal pressure should take into account the temporal pressure differences and preferences in intragroup individual and group creativity. In order to define the task plan and the time regulation required during the task for adjusting the collaborative level of time pressure, the team should take into account the levels of time pressure for each of the teammates and consider adjusting the task to allow the members with the lowest levels of time pressure preference to maintain their optimum level. Reducing procrastination behavior during the collaborative task, and increasing the asynchronic modalities of collaboration could allow the group to work at lower levels of time pressure and lead to higher quality performance, increased originality and creativity in the collaborative process and products.

Acknowledgements: This work was funded through the LLP Key Activity 3 project: *CoCreat - Enabling Creative Collaboration through Supportive Technologies* - code 511733-LLP-1-2010-1-FI-KA3-KA3MP. The support offered by the *European Commission* as well as the *Education, Audiovisual and Culture Executive Agency*, as responsible for the management of *Lifelong Learning Programme*, through the project mentioned above, is gratefully acknowledged.

This publication reflects the views only of the author, and the Commission cannot be held responsible for any use, which may be made of the information contained therein.

REFERENCES:

[1] Gross, B.L. *Advances in Consumer Research,* **21**, 120, 1994.
[2] Zuzanek, J., *J.of Occupational Science*, **5**(1), 26, 1998.
[3] Feather, N.T., Volkmer, R.E., *J.of Personality and Social Psychology*, **55**(2), 266, 1988.
[4] Amabile, T.M., Mueller J.S., Simpson W.B., Hadley C.N., Kramer S.J., Fleming L., *Time pressure and creativity in organizations: a longitudinal field study*, Harvard University, 2002.
[5] Barbera, E., Gros, B., Kirshner, P., *British J.of Educational Technology,* **43**(2), E53, 2012.
[6] Romero, M., *Gestion du temps dans les activités projet médiatisées à distance: le facteur temporel en e-learning*, Editions universitaires européennes, 2010.

[7] Romero, M., Barbera E., *The International Review of Research in Open and Distance Learning*, **12**(5), 125, 2011.
[8] Caldwell, J.H., Huitt, W.G., Graeber, A.O., *Elementary School Journal*, **82**(5), 471, 1982.
[9] Berliner, D.C., *The half-full glass: A review of research on teaching*, in Using what we know about teaching, Alexandria VA, Association for Supervision and Curriculum Development, 1984.
[10] McGrath, J.E., *Stress and behavior in organizations*, in *Handbook of industrial and organizational psychology*, 1976.
[11] Andrews, F.M., Farris, G.F., *Organizational Behavior and Human Performance*, **8**(2), 185, 1972.
[12] Karau, S.J., Kelly, J.R., *Journal of Experimental Social Psychology*, **28**(6), 542, 1992.
[13] Kelly, J.R., Karau, S.J., *Personality and Social Psychology Bulletin*, **25**(11), 1342, 1999.
[14] Beersma, B., Hollenbeck, J.R., Humphrey, S.E., Moon, H., Conlon, D.E., Ilgen, D.R., *Academy of Management Journal*, **46**(5), 572, 2003.
[15] Isenberg, D.J., *Organizational Behavior and Human Performance*, **27**(1), 119, 1981.
[16] Kelly, Janice R., and Joseph E. McGrath. "Effects of time limits and task types on task performance and interaction of four-person groups." *Journal of Personality and Social Psychology* 49, no. 2 (1985): 395.
[17] Chun C., Hsin, A., Choi, J.N., *The Journal of Social Psychology*, **145**(3), 245, 2005.
[18] Amabile, T., Whitney, D., Weinstock, J., Fallang, C., *What really happens in creative projects: Event sampling through electronic data collection*, Division of Research, Harvard Business School, 1997.
[19] Andrews, J., Smith, D.C., *Journal of Marketing Research*, **33**(2), 174, 1996.
[20] Baer, M., Oldham, G.R., *Journal of Applied Psychology*, **91**(4), 963, 2006.
[21] Amabile, T. M. "Creativity in context." (1996).
[22] Bowman, Jonathan M., and Gwen M. Wittenbaum. "Time Pressure Affects Process and Performance in Hidden-Profile Groups." Small Group Research 43, no. 3 (2012): 295-314.
[23] Csikszentmihalyi, Mihaly. *Creativity: Flow and the Psychology of Discovery*. HarperCollins e-books, 2009.
[24] Eysenck, H. J. Genius: *The natural history of creativity*. Cambridge: Cambridge University Press, 1995.
[25] Eteläpelto, Anneli, and Jaana Lahti. "The resources and obstacles of creative collaboration in a long-term learning community." *Thinking Skills and Creativity* 3, no. 3 (2008): 226-240.
[26] Fozard, J. L., Herman Bouma, Alain Franco, and JEMH van Bronswijk. "Homo ludens: Adult creativity and quality of life." *Gerontechnology* 8, no. 4 (2009): 187-196.
[27] Franken, R. *Human motivation*. Pacific Grove, CA: Brooks/Cole, 1994.
[28] Frydenberg, Mark, and D. Andone. "Learning for 21st century skills." In *Information Society (i-Society), 2011 International Conference*, pp. 314-318. IEEE, 2011.
[29] Kickmeier-Rust, Michael D., and Dietrich Albert. "A Domain Model for Smart 21st Century Skills Training in Game-Based Virtual Worlds." *In Advanced Learning Technologies (ICALT), 2012 IEEE 12th International Conference*, pp. 680-681. IEEE, 2012.
[30] Lambropoulos, Niki, Margarida Romero, and Piet Kommers. "Editorial: special issue on community-based innovation: designing shared spaces for collaborative creativity." International journal of web based communities 7, no. 4 (2011): 403-406.

[31] McFadzean, Elspeth. "The creativity continuum: towards a classification of creative problem solving techniques." *Creativity and Innovation Management* 7, no. 3 (1998): 131-139.
[32] Plucker, Jonathan A., Ronald A. Beghetto, and Gayle T. Dow. "Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research." *Educational Psychologist* 39, no. 2 (2004): 83-96.
[33] Romero, Margarida, Pirkko Hyvönen, and Elena Barberà. "Creativity in collaborative learning across the life span." *Creative Education* 3, no. 4 (2012): 422-429.
[34] Romero, Margarida, and Elena Barberà. "Creative collaboration continuum enhanced by online education: Time pressure, time quality and social interaction." *In 34th IATUR Conference on Time Use Research*. 2012.
[35] Runco, M. A. *Creativity: Theories and themes: Research, development, and practice*. Amsterdam: Elsevier Academic Press, 2007.
[36] Sak, Ugur, and Ozge Oz. "The effectiveness of the Creative Reversal Act (CREACT) on students' creative thinking." *Thinking Skills and Creativity* 5, no. 1 (2010): 33-39.
[37] Sternberg, Robert J., and Todd I. Lubart. "Investing in creativity." *American psychologist* 51, no. 7 (1996): 677.
[38] Thomas, Michelle, and Nicholas Bailey. "Out of time: work, temporal synchrony and families." *Sociology* 43, no. 4 (2009): 613-630.
[39] Walther, Joseph B. "Interpersonal Effects in Computer-Mediated Interaction A Relational Perspective." *Communication research* 19, no. 1 (1992): 52-90.
[40] Yamamoto, Yasuhiro, and Kumiyo Nakakoji. "Interaction design of tools for fostering creativity in the early stages of information design." *International Journal of Human-Computer Studies* 63, no. 4 (2005): 513-535.