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Multitasking Effects on Individual Performance: An Experimental Eye-Tracking Study

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Abstarct:

Purpose: *The main objective of this research is to identify the impact of parallel performance of various tasks on the individual effectiveness. Moreover, a methodological goal was set for the research to explore the possibilities of using eye-tracking in the studies of multitasking.*
Design/Methodology/Approach: *The study was conducted in the form of an experiment. All participants worked at the same computer station time was measured with Eye Tracker.*
Findings: *It was confirmed that multitasking requires more time to accomplish tasks and deteriorates creativity, but not correctness of the answers in case of simple tasks. Interestingly, in case of multitasking under time pressure, the performance was worse.*
Practical Implications: *Deeper understanding of the determinants and effects of multitasking on organizational and individual performance enables the adjustment of work organization and management style in order to achieve optimal results.*
Originality/Value: *This paper brings new insights to the studies of multitasking not only in terms of the results of an experimental research, but also in terms of methodological concerns like eye-tracking as a new method of empirical diagnosis.*

Keywords: *Multitasking, individual performance, eye-tracking.*

JEL Codes: *L2, C91, M12.*

Paper type: *Research article.*

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1. Introduction

Multitasking is the ability to perform parallel tasks (Appelbaum *et al.*, 2008). In a broader sense it requires transferring attention between tasks (task switching), and in a narrow sense – physical performance of two activities at the same time (for example, talking on the phone and checking e-mail). Such a way of performing tasks facilitates employees the access to more extensive knowledge and inspiration for new ideas, which boosts their creativity (Buser and Peter, 2011), the development of their knowledge and skills, and helps to prevent monotony at work. At the same time, continuous transfer of attention between tasks effects in high costs and can lead to work fragmentation (Bendoly *et al.*, 2013), as well as to subjectively experience overload having a negative impact on productivity, professional development and the level of perceived stress (Zika-Viktorsson, 2006). That is why one of the challenges in modern management is to ensure effective operations, i.e. to allocate risk, motivate work, and direct employees' efforts among their various activities (Holmstrom and Milgrom, 2012), despite changes in working environment with multitasking among them.

2. Literature Review

2.1 Empirical Strategy to Assess Preference Stability

The effect of multitasking on individual performance is determined by various factors. The identification of these factors and understanding of the mechanisms of their impact help in better work organization. At the individual level multitasking depends on internal predispositions (ex. cognitive resources, intelligence, resistance to stress, the need for diversity), knowledge and experience, as well as on perception of tasks. At the organizational level the determinants include organizational structure, working environment, workload, empowerment of workers, and last but not least, type and complexity of tasks (Marchewka, 2018). Current studies on the impact of multitasking on individual performance focus on various factors. Some of the examples are presented in Table 1.

Table 1. *Studies on the impact of multitasking on individual performance*

Authors (year)	Main constructs	Research methods	Results
González & Mark, 2005	- task switching - working spheres	observation at work	One of the most challenging aspects of switching between tasks is managing transitions between different contexts of these tasks.
Takahashi, 2011	- overlapping tasks	observation at work	Multitasking boosts performance by the elimination of redundancies.

Aral, Brynjolfsson, & Van Alstyne, 2012	- multitasking - project-level and individual-level performance - productivity	questionnaire and analysis of emails	There is an inverted-U shaped relationship between multitasking and productivity.
Adler & Benbunan-Fich 2014	- multitasking - self-interruption - external interruption	experiment	While performing difficult tasks, forced multitasking resulted in significantly lower performance compared with subjects who did not multitask and the subjects who were able to multitask at their discretion (self-interruption).
Mesmer-Magnus, Bruk-Lee, & Sanderson, 2014	- work-related personality correlates	questionnaire	People with high levels of sociability, energy, and self-reliance cope better with multitasking than these who are detail-oriented and prefer more organization.
Nannerup & Olsen, 2014	- performance measurements	formal model	In case of multitasking motivation system based on performance measurements brings better results than monitoring.
Ghaffari & Emsley, 2016	- good and bad multitasking - multi-project environment	experiment	A boundary between good and bad multitasking can be established on the basis of the rate of resource availability.
Kurapati, Lukosch, Eckerd, Verbraeck, & Corsi, 2017	- planner task performance - multitasking ability	experiment	Multitasking ability directly impacts performance in a positive and significant way.
Cai & Guinote, 2017	- multitasking - lack of power	experiment	In comparison of control and powerful employees, powerless employees are less able to effectively multitask.
Srna, Schrift, & Zauberman, 2018	- multitasking - performance - perception	experiment	The mere perception of multitasking has positive effect on performance.
Broeker, Liepelt, Poljac, Künzell, Ewolds, de Oliveira, & Raab, 2018	- multitasking - decision-making	theoretical considerations	Human multitasking should be considered as a choice according to judgment and decision making theory.

Among methods applied in studies of multitasking at work the experiment is one of the most frequently used. However, the diagnosis of multitasking is usually based on self-reports or on the observation of behaviors. Eventually the conclusions do not refer to underlying mechanisms of the process. That is why there appears a need for more precise and thorough methods of the analysis.

2.2 Eye-tracking in Business Studies

Eye tracking is becoming more and more popular in research of the ergonomics of computer program interfaces (Poole and Ball, 2005; Goldberg and Kotval, 1999), in

studies of the legibility and usability of websites (Nielsen and Pernice, 2010; Bojko, 2006; Cowen *et al.*, 2002), as well as in studies of consumers' purchasing decisions and their responses to packaging design (Gomes *et al.*, 2010; Świda and Kabaja, 2013). Eye tracking in business studies is also aimed at identifying and analyzing user's focus patterns while performing assigned tasks, for example for the improvement of an information architecture and graphical interfaces of IT tools (Nesterak *et al.*, 2018) like an ERP class IT system (Nesterak, 2018). Yet there are not many attempts to use eye tracking in studies on multitasking, what creates new promising opportunities for the research. The most commonly used device for measuring eye movements is an eye tracker. It monitors eyeball movement measuring the relative position of an eye toward a head and the orientation of an eye in the space (Young and Sheena, 1975). The main advantage of eye tracking is collecting big data and creating flexible possibilities of their processing and aggregation, despite low representative of samples, i.e., small samples (Pernice and Nielsen, 2009).

3. Research Procedure

Given the current state of studies on multitasking, the main objective of this research was to identify the impact of parallel performance of various tasks on the individual effectiveness. Moreover, the methodological goal that is set for the research is to explore the possibilities of using eye-tracking in the studies of multitasking. The following hypotheses were tested in the presented pilot study:

H1: Multitasking decreases individual performance.
H2: Eye-tracking while multitasking can help to derive useful conclusions for improving individual performance.

The study was conducted in the form of an experiment. All the participants were asked to help in the preparation of an integration trip for the employees. They had to accomplish three tasks (Figure 1):

- a decision task regarding the choice of the accommodation;
- an analytical task regarding calculations related to the schedule of the trip;
- a creative task – writing an e-mail promoting the trip.

46 students of Cracow University of Economics participating in the pilot study were randomly assigned to one of the four groups (Figure 2):

- experimental group A – participants were asked to work simultaneously on the three tasks;
- experimental group B – participants were asked to work simultaneously on the three tasks under time pressure (time limit was set at 600 seconds);
- experimental group C – participants were asked to work simultaneously on the three tasks described and were slightly disturbed during the work;
  control group – participants were asked to perform three tasks sequentially.

Figure 1. *The task board used in the experiment*

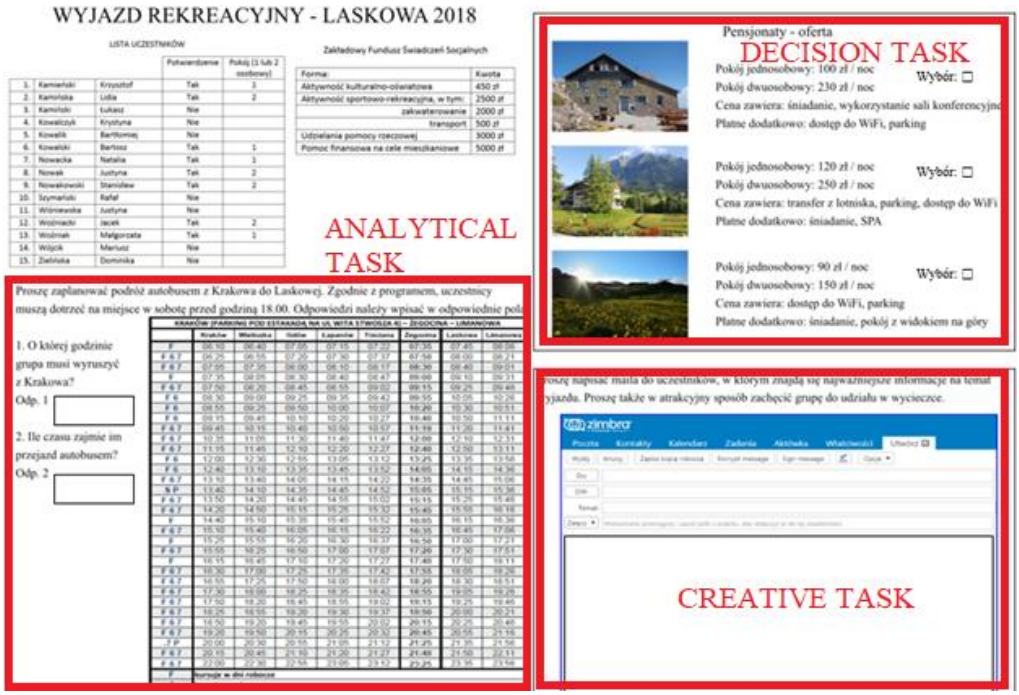
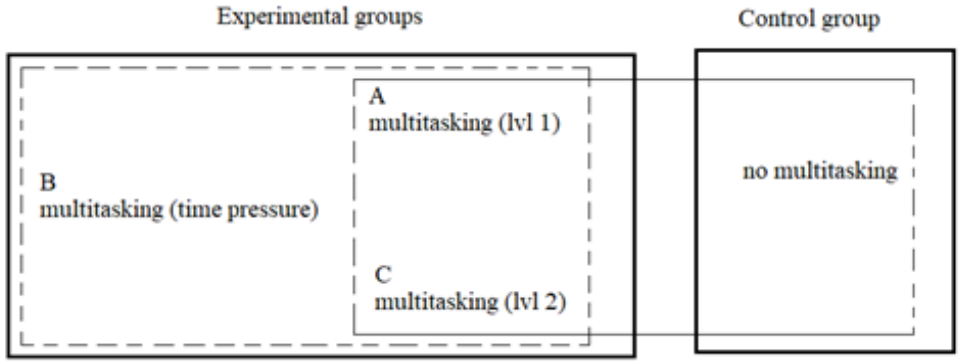


Figure 2. *The scheme of the experimental groups*



As the experimental conditions for groups A and C were similar, for the comparisons with a control group, the results were aggregated (M – multitasking, bM – no multitasking). The characteristics of experimental groups are presented in Table 2.

Table 2. *The characteristics of experimental groups*

	Experimental groups			**Control group**
	A	**B**	**C**	
Number of participants	10	10	10	16
Male	9	4	3	4
Female	1	6	7	12
Age	21,7	21,7	20,4	23,1

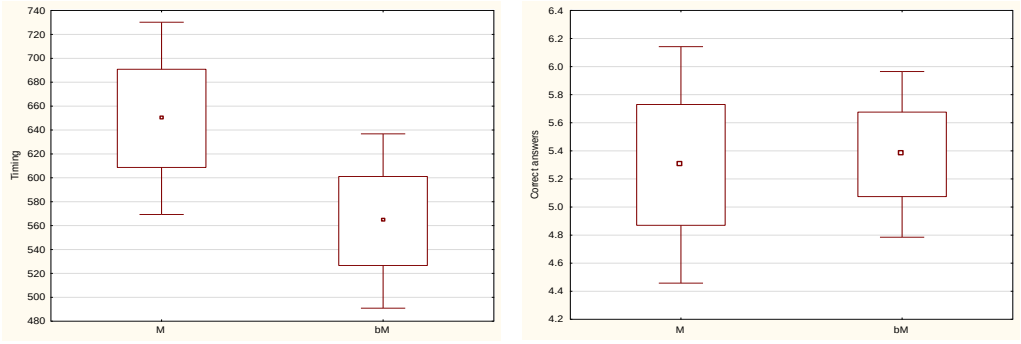
Individual performance was assessed on the basis of the time of accomplishing of all tasks and the correctness of the answers (including spelling mistakes and length of an email) and creativity. Moreover, in case of experimental groups A, B and C eye-fixation time in predefined areas of the task board was monitored.

All participants worked at the same computer station (with external monitor HP, 24”). In case of experimental groups eye-fixation time was measured with Eye Tracker Tobii X3-120 and then Tobii Studio Professional – a software for preparing and conducting eye tracking research and for detailed analysis of the obtained research material – was used for the analysis of the results.

4. Results

Given the size of the experimental groups statistical inference was not justified. However some clear tendencies were observed (Figure 3). First of all, multitasking requires more time (645 vs. 562 seconds). The correctness of the answers is comparable (including the length of an email and spelling mistakes), but the level of creativeness in no multitasking conditions appears to be much higher.

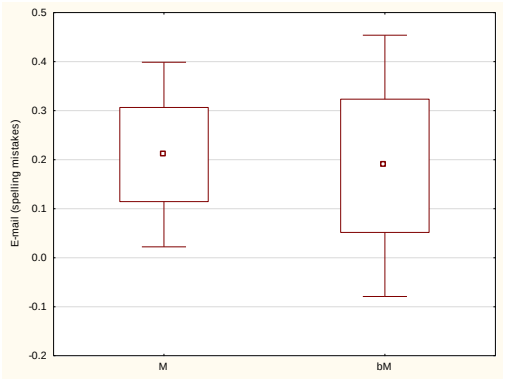
Figure 3. *The comparison of the results between multitasking and no multitasking conditions*

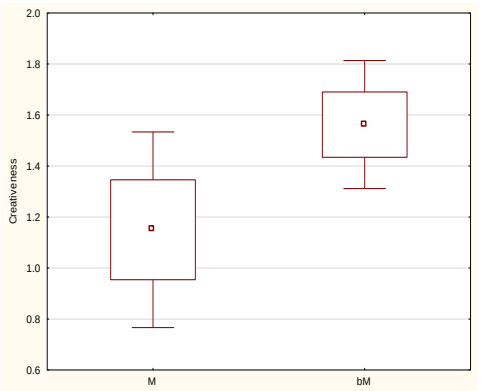


In Table 3 the comparison of the results between experimental groups A, B, and C are presented. It was observed that workload difference between group A and C did not affect the performance, whereas in case of time pressure (group B) the overall assessment of the results was lower (4,5 points vs. 5,3 in group A and 5,9 in group C). At the same time multitasking under time pressure did not deteriorate creativity.

Table 3. *The comparison of the results between experimental groups A, B, and C*

Experimental group	Time (seconds)	Correct answers (average)	Spelling mistakes (average)	Length of an e-mail (average number of words)	Creativity (average)
A	664	5,3	0,2	80,4	1,2
B	530	4,5	0,1	52,6	1,3
C	626	5,9	0,3	76,9	1,3





In case of control group the order of performing the tasks was imposed, while participants of experimental group could choose to begin with decision or analytical task (Table 4). If there were significant differences in the performance between the experimental groups, the information about the order of tasks could be used to set the procedure of dealing with these tasks.

Table 4. *The order of performing the decision and analytical task*

Task order – first task	**Experimental groups**		
	A	**B**	**C**
Decision task	0%	20%	40%
Analytical task	100%	80%	60%

The analysis of eye-fixation time in decision task shows that in each of the experimental groups participants focused more on the details of Offer 1 and the picture of Offer 3 (Table 5). Offer 1 and Offer 3 were equally often chosen in group A and C. In case of group B, performing under time pressure, the range of choices is

more diversified, what may suggest that the decisions were more chaotic. Interestingly, total time of eye-fixation on decision task in group B was the longest.

Table 5. *The comparison of eye-fixation time (in seconds) in decision task*

	Offer 1	Offer 2	Offer 3	Total time	Total Offer 1	Total Offer 2	Total Offer 3	P Offer 1	P Offer 2	P Offer 3	F Offer 1	F Offer 2	F Offer 3
A	50%	-	50%	62,25	25,78	17,22	19,25	23,91	15,60	14,59	1,87	1,61	4,65
B	30%	10%	60%	78,78	29,40	18,49	30,87	27,47	17,05	26,81	1,93	1,44	4,05
C	50%	-	50%	74,80	34,94	19,27	20,59	33,54	17,90	15,82	1,39	1,36	4,76

P – price and other information about the accommodation (offer 1, offer 2, offer 3)
F – photo (offer 1, offer 2, offer 3).

To sum up, hypothesis H1 was partially verified as it was confirmed that multitasking extends the duration of tasks by 15%. These observations are consistent with the conclusions by Hall, Leung and Li (2015). Multitasking also decreases creativity, but it does not deteriorate the correctness of the answers. At the same time it was found that what deteriorates the correctness of the answers is multitasking under even small time pressure.

Finally, hypothesis H2 was confirmed as eye tracking enabled the identification of the order of performed tasks and helped the diagnosis of time spent on analyzing certain problems. It was found that in case of a decision task the participants analyzed the middle option for the shortest time and they hardly chose that option, what suggests that graphical presentation of tasks influences the results.

5. Conclusions

Deeper understanding of the determinants and effects of multitasking on organizational and individual performance enables the adjustment of work organization and management style in order to achieve optimal results, especially given the changes in modern working environment. The aim of the presented study was to identify the relation between multitasking and individual performance. It was confirmed that multitasking requires more time to accomplish tasks and deteriorates creativity, but not correctness of the answers in case of simple tasks. Interestingly, in case of multitasking under time pressure, the performance was worse. For managers it is an important observation: simple tasks may be performed simultaneously if there is no time restrictions, but in case of creative tasks, the focus should be only on one task at a time. The main limitation of this study was the small size of samples. However, the number of participants did not significantly differ from other eye-tracking studies.

Moreover, this paper brings new insights to the studies of multitasking not only in terms of the results of an experimental research, but also in terms of methodological concerns: eye-tracking as a new method of empirical diagnosis of mechanisms of multitasking was positively verified. Exploring the process of performing parallel

tasks with the regard to monitoring eye movements helps to understand the impact of the graphical presentation of tasks and to optimize the patterns of work. It is a promising direction for future studies.

References:

Adler, R., Benbunan-Fich, R. 2015. The effects of task difficulty and multitasking on performance. Interacting with Computers, 27(4).

Appelbaum, S., Marchionni, A., Fernandez, A. 2008. The multi-tasking paradox: perceptions, problems and strategies. Management Decision, 46(9).

Aral, S., Brynjolfsson, E., Van Alstyne, M. 2012. Information, technology, and information worker productivity. Information Systems Research, 23(3 part 2).

Bendoly, E., Swink, M., Simpson III, W.P. 2013. Prioritizing and monitoring concurrent project work: Effects of switching behavior. Production and Operations Management, 23(5).

Bojko, A. 2006. Using eye tracking to compare web page designs: A case study. Journal of Usability Studies, 1(3).

Broeker, L., Liepelt, R., Poljac, E., Künzell, S., Ewolds, H., de Oliveira, R. F., Raab, M. 2018. Multitasking as a choice: a perspective. Psychological Research, 82(1).

Buser, T., Peter, N. 2012. Multitasking. Experimental Economics, 15(4).

Cai, R.A., Guinote, A. 2017. Doing many things at a time: Lack of power decreases the ability to multitask. British Journal of Social Psychology, 56(3).

Cowen, L., Ball, L.J., Delin, J. 2002. An eye-movement analysis of web-page usability. London: Proceedings, HCI Conference.

Ghaffari, M., Emsley, M.W. 2016. The boundary between good and bad multitasking in CCPM. Journal of Modern Project Management, 4(1).

Goldberg, J.H., Kotval, X.P. 1999. Computer interface evaluation using eye movements: Methods and constructs. International Journal of Industrial Ergonomics, 24(6).

Gomes, T., Fischer, J., Ouzts, A. 2010. An eye tracking approach to consumers' preference to private label versus public label. Clemson: Clemson University.

González, V.M., Mark, G. 2005. Managing currents of work: Multi-tasking among multiple collaborations. ECSCW 2005 - Proceedings of the 9th European Conference on Computer-Supported Cooperative Work.

Hall, N., Leung J., Li, C. 2015. The effects of multitasking on operations scheduling. Production and Operations Management, 24(8).

Holmstrom, B., Milgrom, P. 2012. Multitask principal–agent analyses: Incentive contracts, asset ownership, and job design. The Economic Nature of the Firm: A Reader, Third Edition, 7(1991).

Kurapati, S., Lukosch, H.K., Eckerd, S., Verbraeck, A., Corsi, T. 2017. Relating planner task performance for container terminal operations to multi-tasking skills and personality type. Transportation Research Part F: Traffic Psychology and Behaviour, 51.

Marchewka, M. 2018. The effects and determinants of multitasking. Aspirare: an International Journal of Commerce and Management, 5.

Mesmer-Magnus, J., Bruk-Lee, V., Sanderson, K. 2014. Personality correlates of preference for multitasking in the workplace. Florida International University Assess Systems, 14(1).

Nannerup, N., Olsen, K.K. 2014. Multitasking and performance measurement. Discussion Papers on Business and Economics, Working Paper 20. University of Southern Denmark.

Nesterak, J. 2018. The application of eye tracking in the optimisation of an IT system - Selected research findings. Business and Non-profit Organizations Facing Increased Competition and Growing Customers' Demands, 17, 293-303.

Nesterak, J., Radziszewski, P., Śliwa, K. 2018. The use of eye tracking technology in research on improvement of business processes conducted in ERP system. Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, 513.

Nielsen, J., Pernice, K. 2010. Eyetracking web usability. Berkeley: New Riders.

Pernice, K., Nielsen, J. 2009. How to conduct eyetracking studies. Nielsen Norman Group.

Poole, A., Ball, L.J. 2005. Eye tracking in human-computer interaction and usability research: Current status and future prospects. In C. Ghaoui (Ed.,), Encyclopedia of Human-Computer Interaction. Pennsylvania: Idea Group, Inc.

Srna, S., Schrift, R.Y., Zauberman, G. 2018. The illusion of multitasking and its positive effect on performance. Psychological Science, 29(12).

Świda, J., Kabaja, B. 2013. Wykorzystanie technik neuromarketingowych do badań postrzegania opakowań produktów. Marketing i Rynek, 11.

Takahashi, S. 2011. How multi-tasking job designs affect productivity: Evidence from Australian coal mining industry. Industrial and Labor Relations Review, 64(5).

Young, L.R., Sheena, D. 1975. Survey of eye movement recording methods. Behavior Research Methods & Instrumentation, 7(5), 397-429.

Zika-Viktorsson, A., Sundström, P., Engwall, M. 2006. Project overload: An exploratory study of work and management in multi-project settings. International Journal of Project Management.