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INTRINSIC, EXTRINSIC AND MNEMONIC FACTORS OF METACOGNITIVE MONITORING ACCURACY

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The paper reports upon an investigation of metacognitive monitoring accuracy factors in learning tasks of university students. The experiment explores the contribution of some intrinsic, extrinsic and mnemonic factors such as type of learning material, task type, task complexity, and ease / difficulty of performing to metacognitive monitoring accuracy. The study was conducted among 233 university students. The empirical results show the predominance of metacognitive monitoring accuracy, while underconfidence is a downward trend. MMA (+ +) rates of metacognitive monitoring accuracy can be found in the easiest tasks on recollecting pairs of words and MMA (– –) rates – in general knowledge questions of medium difficulty. Overconfidence appears in the most difficult tasks on the deduction inferences and on the logical analogies. The results confirm the dependence of metacognitive monitoring accuracy on the level of ease / complexity of tasks and ease / difficulty of performing; the level of task complexity affects higher rates of metacognitive judgments' inaccuracies, in particular, in the form of overconfidence. In open-answer questions there is a predominance of MMA (+ +) and MMA (– –) rates of metacognitive monitoring accuracy; underconfidence and overconfidence rates are also higher in open-answer questions. The more complex the task is, the greater is the confidence in the difficulty of performing. The results can be significant in the process of understanding the relationship between metacognitive monitoring accuracy and learning performance of university students.

Key words: *aJOLs, aRCJs, gJOLs, gRCJs, Illusion of Knowing (IK), Illusion of Not Knowing (INK), JOLs, RCJs, learning tasks, metacognitive judgements, Metacognitive Monitoring Accuracy (MMA), overconfidence, performing activity, underconfidence.*

Августюк Марія Миколаївна. Внутрішні, зовнішні та мнемонічні чинники точності метакогнітивного моніторингу

У статті проведено дослідження чинників точності метакогнітивного моніторингу навчальних завдань студентів ЗВО. За допомогою експерименту досліджували деякі внутрішні, зовнішні та мнемонічні чинники, такі як тип навчального матеріалу, тип завдання, складність завдання та легкість/складність виконання, на точність метакогнітивного моніторингу. Дослідження проводилося серед 233 студентів університету. Емпіричні результати показують переважання точності метакогнітивного моніторингу, тоді як недостатня впевненість має тенденцію до зниження. Показники точності метакогнітивного моніторингу «+ +» можна знайти в найпростіших завданнях на запам'ятовування пар слів, а показники точності метакогнітивного моніторингу «– –» – у загальних питаннях середньої складності. Надмірна впевненість проявляється в найскладніших завданнях на дедуктивні умовиводи та логічні аналогії. Результати підтверджують залежність точності метакогнітивного моніторингу від рівня легкості/складності завдань та легкості/складності виконання; рівень складності завдання впливає на вищі показники неточностей метакогнітивних суджень, зокрема у вигляді надмірної впевненості. У запитаннях із відкритою відповіддю переважають судження типу «+ +» і «– –»; показники недостатньої та надмірної впевненості також вищі у запитаннях із відкритою відповіддю. Що складніше завдання, то більша впевненість у складності виконання. Результати можуть бути значущими в процесі розуміння зв'язку між точністю метакогнітивного моніторингу та успішністю навчання студентів університету.

Ключові слова: *aJOLs, aRCJs, gJOLs, gRCJs, ілюзія знання, ілюзія незнання, JOLs, RCJs, навчальні завдання, метакогнітивні судження, точність метакогнітивного моніторингу, надмірна впевненість, виконання завдань, недостатня впевненість.*

Introduction and overview. Metacognitive monitoring accuracy is a significant aspect in the learning activity of university students [25; 23]. Metacognitive monitoring judgements help indicate possible approaches to the correct solution of the learning problem, as well as evaluate the efficiency of learning comprehension [3]. The judgements are based on cognitive mechanisms (metacognitive process of thinking, i.e., the process of mental activity), answers accessibility (subjective ease / difficulty of performing and speed of solving learning problems), learning material / tasks familiarity [11], etc.

The results of the theoretical analysis of the psychological literature show that the processes of metacognitive monitoring accuracy closely correlate with different intrinsic, extrinsic and mnemonic factors. In particular, Koriat et al. [13; 14] highlight three general classes of cues for metacognitive monitoring judgements: intrinsic, extrinsic and mnemonic, which depend on level of difficulty, content, and conditions of processing the learning material performed. Though, these cues do not always have a positive impact on metacognitive judgements as they sometimes can be misunderstood or simply ignored [13].

The first class includes characteristics of the learning items (type of learning material, its style, content of learning material with the criteria of interest and usefulness, length of learning items, task complexity, ease of access and additional general information) [13; 14]. Some authors study metacognitive monitoring accuracy in texts comprehension and statements learning [6; 4], some others study its role in the process of words memorizing [21]. There are findings that overconfidence is higher in statements [1]. Style, length, and content of learning items with necessary comprising the criteria of interest and usefulness are studied scarcely [15; 13]. Nevertheless, some state that criteria of interest can cause overconfidence of understanding and further performing of the learning items [15] as well as mastering lengthier textual items [1; etc.].

The level of task complexity can significantly influence the accuracy of metacognitive monitoring judgements of the learning performing. While performing students are usually prone to underestimation of easier tasks and to overestimation of more difficult tasks. With the increase of task complexity, the number of correct answers decreases, but students' confidence in the correctness of performing increases. In other words, underestimation occurs when the level of performance is higher; whereas overestimation takes place when it is lower [8; 12; 5; 10; 18; 17].

Grieco and Hogarth [7], and others suggest that during performing of a cognitive task there arises a prediction of the so-called 'medium level of probable complexity' and smoothing of dissonance, when the real complexity of the task does not correspond to the expected. As a result, in order to eliminate this contradiction, students begin to change the assessments of their own confidence in favor of the expected [7; 16]. Inaccurate metacognitive monitoring during learning easier material we associate with the mistaken impression that there is no need for cognitive efforts to successfully complete the task. Stimulating additional cognitive effort can be the first step toward improving both the relative accuracy of monitoring and learning performance.

The extrinsic cues class consists of learning conditions (task type, number of times to learn an item, presentation time, massed versus sequential repetition of tasks) and encoding operations performed by the learner (level of processing, interactive imagery, etc.). Both intrinsic and extrinsic cues can affect metacognitive judgements directly [13; 14].

Thus, when analyzing the factors influencing metacognitive monitoring accuracy, we should consider task type. Some scientists [20; 2] showed that higher levels of metacognitive monitoring accuracy are closely related to open-answer questions. This is due to the fact that in multiple-choice questions there exist familiarity cues that can confuse the learners in their choice. Systematic errors in judgments might be caused by the greater tendency of students to choose affirmative answers, as well as the tendency to ignore the answer, which does not coincide with their expectations. Moreover, constant performing of tasks of the same type can cause metacognitive monitoring inaccuracies, such as overconfidence and underconfidence [13].

The third class comprises mnemonic indicators. Mnemonic cues include the accessibility of pertinent information, the ease with which information comes to mind, cue familiarity, the ease of processing of a presented item, ease / difficulty of performing, the memory for its ease of acquisition, and the memory for the outcome of previous recall attempts [13; 14]. Thus, Kahneman [11] supposes that possible causes of errors can be the difficulty of perceiving the so-called 'instructions for the task performing' as the complexity of tasks increases, one should require considerable efforts to effectively switch attention between tasks.

On the basis of intrinsic, extrinsic and mnemonic cues there appear heuristics defined as mental strategies that affect the accuracy of metacognitive judgements and often can lead to metacognitive monitoring errors and inaccuracies. Thus, according to Serra and Metcalfe [24], they can be divided into two groups: heuristics that can produce accuracies in metacognitive monitoring (familiarity heuristics, fluency heuristics, current-knowledge heuristic, association heuristic, heuristics that can cause illusions of knowing) and heuristics that can improve the accuracy of metacognitive monitoring (debiasing incorrect heuristics, retrieval-attempt heuristic, memory for past test heuristic, summarization heuristic, knowledge of test heuristic). Consequently, the authors argue that the accuracy of metacognitive monitoring judgements can be based on heuristic processes that use clues from the task, context or cognitive information processing [13; 9].

Objectives. The research is centred in outlining the relation between metacognitive monitoring accuracy and intrinsic, extrinsic and mnemonic factors in terms of identifying their impact on learning tasks performing activity of university students. Thus, in the current study we continue to examine the effects of such factors as type of learning material, task complexity, task type, and ease / difficulty of performing on metacognitive monitoring accuracy. So, precisely, the main aims are: to investigate the highlighted factors and to explore their contribution to metacognitive monitoring accuracy; to provide the analysis of the empirical results of the peculiarities of metacognitive monitoring accuracy.

Methods and materials. ***Participants.*** The laboratory experiment study was conducted among Ukrainian university students (n = 233), who participated for free and formed one experimental group with intragroup variables. The students fell within the age range of 17 to 21 (M_{age} = 17.8, SD = .72). The participation was voluntary and anonymous, and the sample was formed by the random selection. The participation in the research lasted for up to three hours.

Materials. To test the relationship with the accuracy of metacognitive monitoring we used intrinsic (type of learning material, task complexity), extrinsic (task type) and mnemonic (ease / difficulty of performing or hard-easy effect of performing) variables. Thus, the stimulus materials consisted of 12 statements and 12 pairs of words to memorize set up in 9 test questions (easier tasks according to task complexity), 6 general knowledge questions and 1 task on the illusion of perception (medium difficulty tasks according to task complexity), 7 tasks on the deduction inferences and 7 tasks on the logical analogies (difficult tasks according to task complexity). As for the task type, we used open-answer questions, 'Yes'/'No' questions, and multiple-choice questions. We can regard the number of units of the stimulus material as justified by the optimum for time measures and efforts of the participants' performance in the laboratory settings.

Procedure and design. Primarily, the students had to memorize 12 statements and 12 pairs of words in Ukrainian to be ready to answer first 9 test questions. Afterwards, they answered knowledge test questions set up in Ukrainian. These were total of 30 test questions set up in 9 tasks on checking the ability to memorize previously given statements and pairs of words, 6 general knowledge tasks, 1 task on the illusion of perception, 7 tasks on the deduction inferences, and 7 tasks on the logical analogies. The questions were the same for the three task types; for open-answer questions the participants had to provide their own answers, for 'Yes' / 'No' questions they had to agree or disagree, and for multiple-choice questions each statement was equipped with four answer choices.

Before the test, the participants made predictions about future retrieval success performing prospective judgements of learning about the number of correct answers (known as aJOLs), general prospective judgements of learning about the whole test performance (gJOLs), and prospective judgements of learning about every single test item performance (JOLs). After the test, they made evaluations of past retrieval success performing retrospective confidence judgements about the number of correct answers (known as aRCJs), retrospective confidence judgements about the whole test performance (gRCJs), as well as retrospective confidence judgements about every single test item performance (RCJs).

Prospective and retrospective assessments of the whole test performance the students performed with the help of a scale from 0 (absolutely unconfident) to 100 (absolutely confident). Moreover, upon finishing each task, the students were asked to assess the levels of task complexity and ease / difficulty of performing. The time measures for the test and judgements were not limited but lasted for up to three hours. The procedure of the experiment was computerized. The order of test items' presentation was sequential – from easier to more difficult tasks according to the level of difficulty.

Analysis. The data were processed by using IBM SPSS Statistics 20 and Excel programs, and by means of O/U index, calibration index, etc. The scales of assessment of knowledge monitoring skills by S. Tobias and H. Everson [26] summarize indicators for four types of the assessments, reflecting the relationship between students' assessments of knowledge and test results. The students' claims of knowing and confirming this are regarded as MMA (+ +) rates of metacognitive monitoring accuracy; the students' claims of not knowing and confirming this are MMA (– –) rates of metacognitive monitoring accuracy; the students' claims of not knowing, but successfully demonstrating knowledge is underconfidence or the illusion of not knowing (the INK (– +) rates); and the students' claims of knowing without appropriate confirming are overconfidence or the illusion of knowing (the IK (+ –) rates). The calibration procedure helped define these four average indicators of metacognitive monitoring accuracy. The indicators were determined by O/U index or confidence index as the difference coefficient between subjective assessment of the accuracy of performing (metacognitive judgements rates) and test results. Higher values of metacognitive monitoring accuracy indicators come close to 0.

Results. The results of the received data are described due to the divided groups of factors. University students' prospective judgements of learning about the number of correct answers (known as aJOLs), general prospective judgements of learning about the whole test performance (gJOLs), prospective judgements of learning about every single test item performance (JOLs), retrospective confidence judgements about the number of correct answers (known as aRCJs), retrospective confidence judgements about the whole test performance (gRCJs), and retrospective confidence judgements about every single test item performance (RCJs) are accounted as the diverse means to examine metacognitive monitoring accuracy in the form of analysing the students' ability to assess their confidence in the correctness of performing. To provide thorough and more complex analysis of the highlighted factors we used the results of students' confidence rates performed in JOLs and RCJs, whereas aJOLs, gJOLs, aRCJs and gRCJs served as the indicators of the ability to provide overall predictions about both the number of correct answers and the whole test performing.

1. Metacognitive monitoring accuracy in terms of prospective and retrospective confidence judgements

Assessing confidence about the number of correct answers. 95.5% of the participants committed metacognitive monitoring errors in their aJOLs and 96.1% in aRCJs. The vast majority of them demonstrated overconfidence (the IK) in aJOLs ($M_{predicted}$ = 21.95, SD = 5.16, $p \leq .05$; $M_{received}$ = 14.02, SD = 4.88, $p \leq .05$) and in aRCJs ($M_{predicted}$ = 20.6, SD = 5.05, $p \leq .05$; $M_{received}$ = 14.73, SD = 5.26, $p \leq .05$). Underconfidence (the INK) was demonstrated by 22.5% of the students in aJOLs ($M_{predicted}$ = 13.8, SD = 6.13, $p \leq .05$;

$M_{received}$ = 19.1, *SD* = 4.19, *p* ≤ .05) and by 25.5% of them in aRCJs ($M_{predicted}$ = 12.91, *SD* = 5.04, *p* ≤ .05; $M_{received}$ = 17.29, *SD* = 4.98, *p* ≤ .05). MMA (+ +) and MMA (– –) rates of metacognitive monitoring accuracy showed 4.5% and 3.7% of the participants in their aJOLs and aRCJs accordingly (M_{aJOLs}= 20.16, *SD* = 4.07, *p* ≤ .05; M_{aRCJs} = 16.2, *SD* = 3.7, *p* ≤ .05). The results are shown in table 1.

Assessing confidence about the whole test performance. 99.3% of the participants committed metacognitive monitoring errors in their gJOLs, 76% of them demonstrated underconfidence (the INK) (*M* = -.41, *SD* = .18, *p* ≤ .05), 23.3% – demonstrated overconfidence (the IK) (*M* = .34, *SD* = .39, *p* ≤ .05) and only 0.7% of the students showed metacognitive monitoring accuracy (*M* = .2, *SD* = .*p* ≤ .05). In gRCJs 79.7% of the participants demonstrated underconfidence (the INK) (*M* = -.42, *SD* = .18, *p* ≤ .05). We found overconfidence (the IK) rates in 20.3% of the responses of the participants in their gRCJs (*M* = -.41, *SD* = .42, *p* ≤ .05). There were no metacognitive monitoring accuracy rates in gRCJs. The results are shown in table 2.

Assessing confidence about every single test item performance. 64.7% of the participants demonstrated metacognitive monitoring accuracy in their JOLs; 45% of them showed MMA (+ +) accuracy rates (*M* = .13, *SD* = .16, *p* ≤ .05) and 19.7% – MMA (– –) accuracy rates (*M* = -.47, *SD* = .8, *p* ≤ .05). In RCJs these appeared to be 65.5% of the students. Metacognitive monitoring inaccuracy – underconfidence (the INK) and overconfidence (the IK) demonstrated 35.3% of the participants in JOLs, whereas in RCJs these were 34.5% of those who participated in the experiment. Of 35.5% of those who committed metacognitive mistakes in JOLs vast majority (28.7%) showed overconfidence (the IK) (*M* = .49, *SD* = .36, *p* ≤ .05). Underconfidence (the INK) we found in the answers of 6.6% of the participants (*M* = -.65, *SD* = .23, *p* ≤ .05). In RCJs these were 29.2% (*M* = .51, *SD* = .36, *p* ≤ .05) and 5.3% of such students

Table 1

Average results of metacognitive monitoring accuracy rates in terms of aJOLs and aRCJs

Metacognitive judgements	Metacognitive monitoring accuracy	Predicted results	Total number of answers (%)	Received results
		M (SD)		M (SD)
aJOLs	MMA (+ +)	20.16(4.07)	4.5	20.16(4.07)
	MMA (– –)	–	–	–
	INK (– +)	13.8(6.13)	22.5	19.1(4.19)
	IK (+ –)	21.95(5.16)	73	14.02(4.88)
aRCJs	MMA (+ +)	16.2(3.7)	3.7	16.2(3.7)
	MMA (– –)	–	–	–
	INK (– +)	12.91(5.04)	25.5	17.29(4.98)
	IK (+ –)	20.6(5.05)	70.6	14.73(5.26)

Table 2

Average results of metacognitive monitoring accuracy rates in terms of gJOLs and gRCJs

Metacognitive judgements	Metacognitive monitoring accuracy	M (SD)	Total number of answers (%)
gJOLs	MMA (+ +)	.2(0)	.7
	MMA (– –)	–	–
	INK (– +)	-.41(.18)	76
	IK (+ –)	.34(.39)	23.3
gRCJs	MMA (+ +)	–	–
	MMA (– –)	–	–
	INK (– +)	-.42(.18)	79.7
	IK (+ –)	.41(.42)	2.3

(*M* = -.66, *SD* = .22, *p* ≤ .05). The results are shown in table 3.

2. Effects of intrinsic factors

Metacognitive monitoring accuracy in terms of task complexity. In the tasks diagnosed as easy, 55.3% of the participants of the experiment assessed them as easy and only 44.6% as difficult. At the same time, in easier tasks, most participants (21%) showed underconfidence, and only 5.2% showed overconfidence. The smallest number of the students (only 5.6%) demonstrated overconfidence in the correctness of the test tasks performing which they assessed as difficult, whereas the largest number of them (13.8%) were predisposed to underconfidence. In the medium level of task complexity 52.6% of the participants assessed test tasks as easy and 47.3% as difficult. The vast majority of those students who assessed the tasks as easy ones, demonstrated underconfidence (16.3%), whereas only 9.7% of the students demonstrated underconfidence rates in the same tasks assessed by them as more difficult. 12.6% of the participants showed MMA (+ +) accuracy rates. In the most difficult tasks, however, 54.4% of the participants assessed tasks complexity and 45.5% assessed their ease. The vast majority of the students assessing ease and difficulty of the tasks demonstrated overconfidence. These were 17.5% and 16.5% of them, accordingly. In general, in the more difficult tasks, the share of the students with the rates of overconfidence was higher if to compare with the share in easier tasks. The results are shown in table 4.

Metacognitive monitoring accuracy in terms of the type of learning material. The highest rates of MMA (+ +) metacognitive monitoring accuracy the participants demonstrated in their JOLs while recalling pairs of words (48.3%) (*M* = .08, *SD* = .13, *p* ≤ .05) and performing the task on the illusion of perception (42.3%) (*M* = .1, *SD* = .17, *p* ≤ .17). In RCJs these were 46% (*M* = .07, *SD* = .13, *p* ≤ .05) and 37.8% of the participants accordingly (*M* = .09, *SD* = .17, *p* ≤ .05). A significant proportion of the students showed MMA (– –) accuracy rates in JOLs while answering general knowledge questions (29.1%) (*M* = -.5, *SD* = .32, *p* ≤ .05). In RCJs these were 27.6% of the total number of answers (*M* = -.52, *SD* = .31, *p* ≤ .05). Underconfidence (the INK) rates we found in 33% of the students' JOLs while recalling statements (*M* = -.59, *SD* = .22, *p* ≤ .05). In RCJs such tendency showed 27.6% of the participants (*M* = -.67,

Table 3

Average results of metacognitive monitoring accuracy rates in terms of JOLs and RCJs

Metacognitive judgements	Metacognitive monitoring accuracy	M (SD)	Total number of answers (%)
JOLs	AMM (+ +)	.13(.16)	45
	AMM (– –)	-.47(.8)	19.7
	INK (– +)	-.65(.23)	6.6
	IK (+ –)	.49(.36)	28.7
RCJs	AMM (+ +)	.13(.17)	46.9
	AMM (– –)	-.5(.34)	18.6
	INK (– +)	-.66(.22)	5.3
	IK (+ –)	.51(.36)	29.2

Table 4

Average results of students' assessments of task complexity levels

Level of task complexity	Total number of answers (%)							
	Tasks assessed as easy				Tasks assessed as difficult			
	MMA (+ +)	IK (+ –)	INK (– +)	MMA (– –)	MMA (+ +)	IK (+ –)	INK (– +)	MMA (– –)
Easy	19.6	5.2	21	9.5	12.7	5.6	13.8	12.5
Medium	12.3	11	16.3	13	12.6	12.5	9.7	12.5
Difficult	8.4	17.5	5.6	14	12.3	16.5	13.1	12.5

SD = .25, $p \leq .05$). Overconfidence (the IK) was observed in the answers of the vast majority of the students in their JOLs when performing the tasks on the deduction inferences (40%) (*M* = .49, *SD* = .35, $p \leq .05$) and the tasks on the logical analogies (30%) (*M* = .48, *SD* = .34, $p \leq .05$). In RCJs in the tasks on the deduction inferences these were 39.3% of the participants (*M* = .52, *SD* = .35, $p \leq .05$), whereas in the tasks on the logical analogies these were only 28% of them (*M* = .48, *SD* = .34, $p \leq .05$). The results are shown in table 5.

3. Effects of extrinsic factors

Metacognitive monitoring accuracy in terms of task type. In general, in 'Yes'/'No' questions we noticed the tendency to lower rates of MMA (+ +) metacognitive monitoring accuracy in JOLs and RCJs (M_{JOLs} = .14, *SD* = .16, $p \leq .05$; M_{RCJs} = .15, *SD* = .17, $p \leq .05$), if to compare with multiple-choice questions (M_{JOLs} = .13, *SD* = .16, $p \leq .05$; M_{RCJs} = .11, *SD* = .16, $p \leq .05$). In open-answer questions, the students demonstrated the highest rates of MMA (+ +) metacognitive monitoring accuracy (M_{JOLs} = .09, *SD* = .15, $p \leq .05$; M_{RCJs} = .09, *SD* = .15, $p \leq .05$). MMA (– –) rates appeared to be higher in open-answer questions (M_{JOLs} = -.45, *SD* = .51, $p \leq .05$; M_{RCJs} = -.44, *SD* = .38, $p \leq .05$). Underconfidence (the INK) rates are again higher in JOLs and RCJs in open-

Table 5

Average results of metacognitive monitoring accuracy rates in terms of the type of learning material

Meta-cognitive monito-ring accuracy	Meta-cognitive judge-ments	M (SD)	Total num-ber of ans-wers (%)	Meta-cognitive judge-ments	M (SD)	Total num-ber of ans-wers (%)
Tasks on Statements Memorizing						
MMA (+ +)	**JOLs**	.11(.14)	28.6	**RCJs**	.11(.15)	31
MMA (– –)		-.57(.27)	25		-.57(.29)	27.3
INK (– +)		-.59(.22)	33		-.67(.25)	27.6
IK (+ –)		.46(.31)	13.3		.46(.31)	14.1
Tasks on Pairs of Words Memorizing						
MMA (+ +)	**JOLs**	.08(.13)	48.3	**RCJs**	.07(.13)	46
MMA (– –)		-.45(.33)	19.5		-.39(.34)	20.4
INK (– +)		-.72(.24)	26.8		-.69(.2)	28.5
IK (+ –)		.47(.35)	5.4		.41(.34)	5.1
General Knowledge Tasks						
MMA (+ +)	**JOLs**	.09(.13)	23.7	**RCJs**	.1(.15)	25
MMA (– –)		-.5(.32)	29.1		-.52(.31)	27.6
INK (– +)		-.64(.24)	23.7		-.7(.23)	22
IK (+ –)		.48(.36)	23.4		.49(.36)	25.4
Task on the Illusion of Perception						
MMA (+ +)	**JOLs**	.1(.17)	42.3	**RCJs**	.09(.14)	37.8
MMA (– –)		-.43(.11)	9		-.63(.27)	12.6
INK (– +)		-.75(.22)	21.6		-.47(.28)	26.8
IK (+ –)		.49(.38)	27		.42(.39)	22.7
Tasks on the Deduction Inferences						
MMA (+ +)	**JOLs**	.16(.16)	17	**RCJs**	.16(.17)	16.5
MMA (– –)		-.5(.3)	25		-.51(.31)	23.6
INK (– +)		-.64(.17)	18		-.62(.18)	20.5
IK (+ –)		.49(.35)	40		.52(.35)	39.3
Tasks on the Logical Analogies						
MMA (+ +)	**JOLs**	.18(.18)	18	**RCJs**	.18(.19)	18
MMA (– –)		-.5(.3)	26		-.51(.29)	26
INK (– +)		-.59(.21)	26		-.62(.16)	28
IK (+ –)		.48(.34)	30		.48(.34)	28

Table 6

Average results of metacognitive monitoring accuracy rates in terms of task type

Metacognitive monitoring accuracy	Meta-cogni-tive judge-ments	M (SD)	Total number of answers (%)	Meta-cogni-tive judge-ments	M (SD)	Total number of answers (%)
Multiple-choice questions						
MMA (+ +)	**JOLs**	.13(.16)	41.8	**RCJs**	.11(.16)	42.7
MMA (– –)		-.49(.4)	17.2		-.6(.25)	17.3
INK (– +)		-.66(.21)	9.3		-.65(.2)	8.5
IK (+ –)		.47(.34)	31.6		.49(.35)	31.4
'Yes' / 'No' questions						
MMA (+ +)	**JOLs**	.14(.16)	62	**RCJs**	.15(.17)	64.3
MMA (– –)		-.49(.29)	13.2		-.5(.31)	11,5
INK (– +)		-.57(.28)	5.1		-.64(.27)	3
IK (+ –)		.47(.32)	19.6		.47(.32)	21.1
Open-answer questions						
MMA (+ +)	**JOLs**	.09(.15)	3.8	**RCJs**	.09(.15)	31
MMA (– –)		-.45(.51)	28.8		-.44(.38)	28.8
INK (– +)		-.69(.22)	4.4		-.69(.21)	4.7
IK (+ –)		.53(.39)	35.8		.54(.39)	35.4

answer questions (M_{JOLs} = -.69, SD = .22, $p \leq .05$; M_{RCJs} = -.69, SD = .21, $p \leq .05$), as well as overconfidence (the IK) rates (M_{JOLs} = .53, SD = .39, $p \leq .05$; M_{RCJs} = .54, SD = .39, $p \leq .05$). The results are shown in table 6.

4. Effects of mnemonic factors

Metacognitive monitoring accuracy in terms of ease / difficulty of performing. The MMA (+ +) rates of metacognitive monitoring accuracy there showed 22.3% of the students when performing easier tasks the appropriate ease of performing they assessed, and this share appeared to be the highest among the easier tasks. We recorded rates of underconfidence in 16% of the participants, while overconfidence rates we found only in the answers of 6% of the students who assessed the ease of performing. The largest number of the participants – 14.8% and 11.5% – assessed difficulty of performing easier tasks (MMA (+ +) and MMA (– –) accuracy rates). The majority of the students, who assessed the level of medium difficulty of performing, showed underconfidence (13.4%), a lower number of the participants – 13.2% and 13.1% – demonstrated MMA (+ +) and MMA (– –) accuracy rates. The largest share of the students who assessed difficulty of performing showed overconfidence (12.8%) and MMA (– –) accuracy rates (12.6%). In more difficult tasks, on the contrary, the majority of the students (52.3%) assessed difficulty of performing tasks, and 47.7% – the corresponding ease of performing. 15.7% of the participants assessed ease of performing more difficult test tasks and showed overconfidence, while 15.6% of the participants assessed difficulty of performing such tasks and also showed overconfidence. The least number (7.4%) of those who participated in the experiment and who assessed ease of performing of more difficult tasks, showed MMA (+ +) accuracy rates. 11.3% of the students who assessed difficulty of performing showed MMA (– –) accuracy rates. The results are shown in table 7.

Discussion. The paper is devoted to the study of metacognitive monitoring accuracy factors in learning tasks of university students. The research is centred in exploring the contribution of some intrinsic, extrinsic and mnemonic factors such as type of learning material, task type, task complexity, and ease / difficulty of performing to metacognitive monitoring accuracy.

The results showed the predominance of the share of students with overconfidence in metacognitive judgments of confidence about the number of correct answers. For metacognitive judgments of learning

Table 7

Average results of students' assessments of ease / difficulty of performing

Level of task complexity	Total number of answers (%)							
	Assessed ease of performing				Assessed difficulty of performing			
	MMA (+ +)	IK (+ –)	INK (– +)	MMA (– –)	MMA (+ +)	IK (+ –)	INK (– +)	MMA (– –)
Easy	22.3	6	16	8.3	11.5	6	15	14.8
Medium	13.2	12.4	13.4	13.1	11.8	12.8	10.6	12.6
Difficult	7.4	15.7	10.3	14.3	13.3	15.6	12.1	11.3

to evaluate the whole test performing, the most typical is the predominance of underconfidence in the correctness of performing.

In metacognitive judgments of learning to evaluate every single test item performing, students are more prone to MMA (+ +) rates of metacognitive monitoring accuracy, whereas the least typical for them appear to be the rates of underconfidence. Nevertheless, in general, the results show the predominance of metacognitive monitoring accuracy. Comparing the results to the average values of metacognitive monitoring accuracy in terms of the whole test performing confidence, we may indicate that in the case of assessment of each task there increase MMA (+ +) rates of metacognitive monitoring accuracy, while underconfidence, on the contrary, is a downward trend.

The findings demonstrate that the students show MMA (+ +) rates of metacognitive monitoring accuracy in the easiest tasks on recollecting pairs of words due to the diagnosed difficulty and MMA (– –) rates of metacognitive monitoring accuracy, we can find in general knowledge questions of medium difficulty. Thus, there is a greater tendency of the participants with underconfidence in JOLs in the tasks on recollecting statements, as well as in RCJs in the tasks on the logical analogies. Overconfidence appears in the vast majority of students in metacognitive judgments of confidence in the most difficult tasks on the deduction inferences and on the logical analogies.

In the tasks on the deduction inferences and on the logical analogies, which were diagnosed as the most difficult in the test, the vast majority of the participants were inaccurate in the indicators of metacognitive monitoring judgements in the form of overconfidence. The share of students with MMA (+ +) rates of metacognitive monitoring accuracy in such tasks was the lowest. That is, such rates can be more typical for easier tasks. MMA (– –) rates of metacognitive monitoring accuracy, on the other hand, are more relevant in easier tasks, as well as in tasks of medium difficulty.

The findings are in line with the results of previous studies [8; 19; 18], stating that overconfidence is more relevant to more difficult learning material items, and less relevant to easier tasks (underconfidence takes place here). In other words, learners are characterized by overconfidence in metacognitive judgments, which depend on the level of task complexity; the more complex the task is, the higher is the inaccuracy of metacognitive monitoring. The results confirm the dependence of metacognitive monitoring accuracy on the level of ease / complexity of tasks and ease / difficulty of performing; the level of task complexity affects higher rates of inaccuracy of metacognitive judgments, in particular, in the form of overconfidence.

A noteworthy finding is that in open-answer questions we can observe a tendency to the predominance of MMA (+ +) and MMA (– –) rates of metacognitive monitoring accuracy. At the same time, underconfidence and overconfidence rates are also higher in open-answer questions.

As in our study of the illusion of knowing in metacognitive monitoring of students' learning activity [1], current results can correlate with the results of studies by other authors. In particular, Pallier et al. [20], de Carvalho Filho [2] and others explain this by the fact that when searching for the correct answer from a number of proposed options, familiarity of information in the form of familiar words can activate certain associative connections, which, in turn, can contribute to higher accuracy of metacognitive judgments. The results also confirm that task type can significantly affect the accuracy of metacognitive monitoring judgments. Students are more likely to use lower-level thinking skills while preparing for multiple-choice tests; whereas they use higher-level metacognitive skills to prepare for essay exams. In order to improve the way students' assess their confidence in learning and performing, one should add some short essay questions to multiple-choice tests [22, etc.].

MMA (+ +) rates of metacognitive monitoring accuracy are more typical for easier tasks (estimated ease of performing). MMA (– –) rates of metacognitive monitoring accuracy can occur in more difficult tasks (estimated ease of performing) as well as in easier tasks (estimated difficulty of performing). Overconfidence can occur in more difficult tasks, while underconfidence – in easier tasks. Thus, it is possible to draw conclusions about the levels of tasks complexity and ease / difficulty of performing, when metacognitive monitoring accuracy is affected by task complexity: the more complex the task is, the greater is the confidence in the difficulty of performing.

We are aware that our research may have some limitations. The first is that the data analysed were made in the form of the laboratory experiment; consequently, we need further research to consider the factors of metacognitive monitoring accuracy in the real learning process. The second is that gender differences were not among the primary concerns taken into account in the study. Nevertheless, we believe it is possible that these limitations could not have significantly influenced the results obtained. Thus, further data collection would be needed to determine the notions mentioned. Despite these limitations, our findings would seem to be useful in outlining the peculiarities of metacognitive monitoring accuracy of the learning activity of university students.

Conclusions and final remarks. The research studies metacognitive monitoring accuracy factors in learning tasks of university students. The analysis takes into account the effects of such intrinsic, extrinsic and mnemonic factors as the type of learning material, task type, task complexity, and ease / difficulty of performing. The results expand an investigation of metacognitive monitoring accuracy factors. Hopefully, the results point to the likelihood that these implications are significant for the learning performance of university students.

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