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ORIGINAL ARTICLE

The role of metacognition, type of feedback, and kind of incentives for motivation to learn

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BACKGROUND
Two experiments were designed to investigate the motivational role of the metacognitive self (MCS, meaning self-awareness of biases) and kind of feedback (success vs. failure vs. control group) in willingness to learn. We predict that the condition of failure enhances motivation to learn. Predictions relate to the first experiment and social incentives, not to spatial ones.

PARTICIPANTS AND PROCEDURE
Three hundred ninety-eight participants were individually (in front of a computer with E-Prime) and randomly assigned to experiment 1 of a social task or experiment 2 of a spatial task. Each experiment included three groups: success, failure, and control. The independent variables were metacognitive self (MCS) and type of feedback (success vs. failure vs. control). The dependent variable was the willingness to learn. Logistic regression was applied to investigate the hypothesis that the higher the level of MCS is, the more likely it is that the participants will try to learn.

RESULTS
As predicted, MCS was positively related to searching for self-diagnostic information in the first experiment. Furthermore, according to expectations, the experiment with a social task showed the main effects of both MCS and type of feedback. The spatial experiment did not reveal significant effects.

CONCLUSIONS
MCS is positively related to motivation to search for self-diagnostic information, and students are more willing to learn in the face of failure. According to expectations, the experiment with a social task substantiated the motivational role of MCS and the role of negative feedback in willingness to learn.

KEY WORDS
metacognition; motivation; experiment; feedback; incentives

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BACKGROUND

The way that people select, process and remember information concerning their own selves, and the way they react to the information, depend on different motives. Motives not only shape the manner of how people search for the information about themselves, but also they judge its origin and reliability. In their models of human motivation, many noted researchers (Kruglanski, 1975; Wright & Gendolla, 2012; Lun et al., 2007; Weiner, 1972) show how important it is for a human being to get to know and to understand the surrounding reality and one's self. However, the ability to perform an accurate self-evaluation that leads to a better recognition and understanding of one's self is neither an easy, nor a common process.

METACOGNITION AND METACOGNITIVE SELF

A special type of motivation is, being the core of metacognition, the need to be accurate when it comes to one's judgement and opinion (Brycz, 2004; Cornwell & Higgins, 2017). Metacognition is defined as thinking about the course of one's thinking (Dunlosky & Metcalfe, 2009; Jain et al., 2017), as being aware of one's thinking, active monitoring of one's cognitive processes and using heuristics as a means to help organize the methods needed to solve one's problems (Hennessey, 1999). Bar-Tal et al. (2019), on the other hand, define metacognitive self (MCS) as self-awareness of biases. Biases, or rather some of the tendencies in human behavior (e.g., the reciprocity rule or leniency illusion), when recognized accurately in one's own behavior, play an adaptive role. Using tendencies such as heuristics in day-to-day life allows one to function efficiently in the social world (Hahn & Gawronski, 2019; Nisbett & Ross, 1980) and conditions one's mental wellbeing (Dutt et al., 2018; Taylor & Brown, 1988). Accurate recognition of biases in one's own behavior is generally difficult for people (an average of 18% of 129 biases were accurately recognized in oneself), although it is quite simple to notice it in others (an average of 80% of 129 biases were accurately recognized in others) (Brycz, 2004; Hannah & Carpenter-Song, 2013).

MCS predisposition is a certain level of self-awareness of biases. It means that people may be highly aware, moderately aware, or almost unaware of their cognitive biases. It is plausible to assert that individuals with low metacognitive self are not aware of seeing themselves in a tendentious way, while people with high metacognitive self perceive themselves more accurately, showing self-awareness of biases. The differences in MCS are rooted in various cognitive, and emotional-motivational modes, and personality traits. High MCS persons, contrary to their low MCS colleagues, show a higher level of extraversion, conscientiousness and agreeableness (Brycz et al., 2019). High MCS individuals also experience more positive feelings and possess greater hedonic capacity than low MCS counterparts (Szczepanik et al., 2020). The personality traits mentioned above and emotion regulation are very adaptive in social functioning and facilitate motivation and self-regulation. The research shows that high MCS participants are focused on achieving desired goals in the future and understanding the past significantly more than low MCS individuals (Brycz et al., 2019). Such an attitude demands intrinsic motivation, and cognitive engagement. Cognitive mode characteristics for high MCS (contrary to low MCS) participants are shown via the results of experimental studies, indicating that the MCS relation to the occurrence of explicit biases in real behavior is moderated by the impact of a low ability to achieve cognitive structuring (Bar-Tal et al., 2019). It means that high MCS individuals need more time to understand a present situation than their low MCS counterparts. The need for closure is a different phenomenon in relation to a low ability to achieve cognitive structuring (Bar-Tal, 1994). Both pieces of evidence shed light on the cognitive functioning of high MCS individuals. High MCS counterparts – more than their low MCS ones – prefer to take time over choosing any activity. According to the famous Kahneman (2011) distinction – cognitive strain vs. cognitive ease – it seems that a high MCS person, in comparison to a low MCS one, pays more conscious attention to the information presented (more frequently using piecemeal processing), even when information about the self is negative. High MCS means better ability to switch the state of cognitive strain: use System 2 instead of System 1. In other words, a strong MCS should result in the aspiration to achieve diagnostic information about oneself – diagnostic meaning broadening the (accurate) knowledge about oneself and promoting self-improvement. Thus, we hypothesized that MCS would be positively related to greater eagerness to gain diagnostic information about oneself. Ramirez and Lindhard (2018) pointed out the impact of inner self on motivation to learn.

Gender and age have been previously found to be related to other variables in the investigated model. Previous studies showed a main effect of gender, meaning that women in general (nationwide group) present a slightly higher MCS level than men (Brycz & Konarski, 2016). Women also show a higher punishment sensitivity (Cross et al., 2011). The information about the failure in a task is a form of punishment stimulus. Also, first- and third-year students were previously found to differ in terms of metacognitive skills (Veenman & Spaans, 2005). The study was conducted among undergraduate students. Because of these patterns of relationships among variables, gender and age need to be included as covariates in the model. The calculated model is explained in detail in the empirical part. In short, the model of our study was: MCS, kind of incentives (social vs. spatial vs. control), feedback (positive vs. negative), as independent measures, covariates: age, gender for behavioral choice (learning vs. leisure) and searching for diagnostic information about the self.

MOTIVES OF THE SELF AND SEARCH FOR FEEDBACK

Motives related to the self are important factors that determine the ability of an individual to perceive oneself in an accurate manner. The motives developed in the course of evolution serve as adaptive mechanisms allowing one to obtain information necessary to survive and reproduce (Sedikides & Skowronski, 1997, 2003).

Motives of the self influence relations between an individual and the environment, protecting the individual from destructive forces of the external information. They serve as proof that a human being is a focal point of a social environment, and the way one perceives oneself significantly shapes the process of perceiving and judging other people. What is more, the motives affect the process of a search for feedback. According to the results of the research (Trope & Liberman, 1996), three of the motives of the self greatly influence the process of searching for information about oneself.

According to Sedikides (1993), there is an important motive of the self, called self-understanding (self-assessment), and it aims to search for accurate and reliable knowledge about oneself. Individuals driven by the need for self-diagnosis prefer true information about themselves, whether it is positive or not. Therefore, they tend to be more objective, aspiring to procure an adequate self-image rather than just a satisfying one. The results of multiple experiments show that respondents value tasks that are highly diagnostic more and they prefer them to those tasks that do not allow them to obtain objective information about themselves (Meder & Mayrhofer, 2017; Trope, 1979). Consequently, respondents are more eager and motivated to solve highly diagnostic tasks rather than those that are less diagnostic (Trope & Ben-Yair, 1982). The operationalization of this motive in our research is a subscale of the Self-Diagnostic Motive Scale (SDMS), named: Own Results Information (ORI).

Among motives of the self that strongly affect the search for feedback, one can also identify self-improvement (Taylor et al., 1995). It is a motive of one's endeavor, according to which people want to better themselves, and broaden their personalities and abilities (Sedikides & Hepper, 2009). Elicitation of self-improvement helps to get the feedback needed to implement the motive. The given feedback contains specific facts, useful and critical suggestions, imposed social comparisons (in our research the SDMS subscale, named Comparison Information – CI), as well as any data that allow one to define both a current situation and progress on the way to achieve intended goals. Individuals' preference for feedback focused on self-improvement highly probably depends on the access to resources such as positive experiences, self-affirmation, and internal sense of control (Lindhard, 2020). They serve as a shield that allows searching for feedback that, for the moment, can be perceived as negative when in relation to one's self, but could actually, in the long run, result in self-improvement. Trope and Neter's (1994) research concerning the role of positive experiences while searching for feedback was based on a procedure during which the participants were told they had failed or succeeded in a certain task, or they were put in a good or bad mood.

As the research showed, participants who were told they had failed, or put in a negative mood, subsequently preferred to get more encouraging feedback further on, while those who were told they had succeeded or were put in a positive mood showed a tendency to exaggerate their own flaws and ask for constructive feedback, as a basis for further improvement. Psychological development, expansion of the self, and gaining or perfecting various abilities are just a few of many advantages of self-improvement (Csikszentmihalyi & Graef, 1980; Deci & Ryan, 1991; Elliot & Thrash, 2001; Meece et al., 2006; Sedikides & Hepper, 2009; White, 1959), for self-improvement is an integral need of an individual striving to achieve one's goals (Fiske & Berdahl, 2007; Guinote, 2007; Sedikides & Hepper, 2009; Sedikides & Skowronski, 2000). The operationalization of this motive in our research is a subscale of the Self-Diagnostic Motive Scale (SDMS), named: Self Improvement Information (SII) (Brycz et al., 2018b).

Multiple processes, such as the search for information about one's self, remain under the influence of the motives and needs mentioned above. At the same time, the key to explain the process of making an accurate self-evaluation is understanding the work of particular situational factors, as well as individual differences that regulate activation and dynamic cooperation of the motives (Sedikides & Strube, 1997).

CURRENT STUDY

The aim of the current research was to verify the hypothesis of a positive influence of a high level of MCS on the process of searching for accurate and diagnostic information about the self, particularly in a social task. The model of our study was: MCS, kind of incentives (social vs. spatial vs. control), feedback (positive vs. negative), as independent measures, covariates: age, gender, all independent variables for dependent variables: behavioral choice (learning vs. leisure) and searching for diagnostic information about the self.

MCS is the level of self-awareness of cognitive biases anchored in social functioning. Positivity bias (Weinstein, 1980), for example, is an unrealistic prediction that the given personal future outcome and future state of health will be more favorable than in the case of an individual. Cognitive biases resulting from heuristics include availability bias, and hindsight bias (Kahneman, 2011). Other examples are memory biases, e.g., choice-supportive bias (remembering a chosen option better than a rejected one; Mather et al., 2000). MCS predisposition consists of self-awareness of biases crucial for social functioning. Social conditions and pro-social positive emotions foster deepening of self-awareness of biases (Szczepanik et al., 2020). According to Kahneman (2011), the process of self-knowledge acquisition always employs System 2. It involves a person paying attention in order to be accurate at emotional face recognition as well as geometric shapes recognition (type of incentives: social vs. spatial). However, being accurate at social tasks (e.g., what emotion does the face really express?) is more important for self-awareness of cognitive, social biases than being perfect at geometric figure recognition. That was the reason to use two different (social vs. spatial) stimuli when planning experimental design. Thus, good social functioning obtained via emotional recognition accuracy may be more important for high MCS individuals than being accurate at geometric tasks. The main effect of feedback was also predicted (feedback: positive vs. negative). The main effect of feedback for social incentives is supposed to show that people value negative feedback as important information and tend to choose learning instead of leisure. Assuming that the MCS is related to higher motivation to switch from System 1 to System 2 during task execution, we may predict that low MCS participants may prefer to skip the feedback and concentrate on leisure.

In other words, we predict that social incentives and negative feedback are more important for high MCS than for low MCS individuals. If so, high MCS participants will express stronger motivation to learn (behavioral choice: learn or watch a video) and stronger motivation for self-diagnostic information than low MCS individuals.

PARTICIPANTS AND PROCEDURE

PARTICIPANTS

Participants were undergraduate students recruited via convenience sampling from the Faculty of Humanities and Faculty of Social Sciences of the University of Gdansk. Afterwards, each participant was randomly assigned to the experimental conditions: type of task, type of feedback. All of the students participated in the experiment individually.

Sensitivity analysis showed that with 80% power, α level of .05, two-tailed tests, Pr(Y = 1|X = 1) H0 of 0.2, and a sample size of at least 180, the required effect size is OR = 1.7 or OR = 0.58, depending on the direction of the relationship between predictor and dependent variable.

The first experiment (social) was completed by N = 188 students (80 males, 108 females, mostly equally distributed among each of the three conditions, aged M = 23.07, SD = 3.47), while the second experiment (spatial) was completed by N = 210 participants (95 males, 115 females, n = 70 for each of the three conditions, aged M = 22.10, SD = 2.65).

PROCEDURE AND EXPERIMENTAL MANIPULATION

At the beginning, every participant in each of the groups filled in the Metacognitive Self Questionnaire (MCSQ-21; Brycz et al., 2019).

The experimental research was conducted in electronic form, using the E-Prime program (E-Prime 2.0; Zuccolotto et al., 2012), which allows the reaction time of test subjects to be measured. The research was divided into two separate experiments conducted in the same way but concerning different content of the tasks – the first experiment concerned social abilities, while the second one focused on testing spatial abilities of the test subjects. The second, spatial experiment serves as a control study, according to our hypothesis indicating stronger motivation to learn among high MCS (vs. low MCS) participants rather in social conditions, not spatial. The respondents were randomly assigned to study groups – a group with a social stimuli (experiment 1) vs. a control group (comparing pairs of pictures), and a group with a spatial task (experiment 2) vs. a control group. During the first experiment, the respondents were shown pictures of faces with various emotional facial expressions, and they were supposed to choose the most accurate one out of three suggested answers vs. the control group. In experiment 2, the subjects of the study group were shown different kinds of shapes and geometrical figures on a computer screen, and they were asked to have a good look at the pictures, and to match the shapes to their names (one of three suggested) on the following slide vs. control group. The time needed for the respondents to answer was measured, e.g., the subjects were shown a circle, a square, a triangle, and a diamond. While randomly assigning the subjects to their experimental groups (both experiments: social vs. spatial incentives), the computer also randomly qualified the respondents (who were unaware of that fact) to a "success" and a "failure" groups. Therefore, in the regression analyses, success and failure were dummy coded as separate dichotomous variables, and the control group was left out as a part of the comparison group. Trope and Neter (1994) introduced the negative vs. positive feedback experimental manipulation procedure. We implemented the manipulation procedure in the current study. According to Trope and Neter (1994) different feedback was given to a randomly chosen "failure" or a "success" participant. Subsequently, after having finished the experiments (social and spatial), but before obtaining the "success" or "failure" information, both groups were asked to judge how well they had performed and how certain they were of it. Then they were presented fictitious results. The participants from the "success" group, no matter the actual result, found out that they had done very well and were placed among the best 10% in the result distribution, while the respondents from the "failure" group (irrespective of the actual results) were informed that they had performed poorly, within the lowest 30% in the result distribution among students. Simultaneously, the control groups were asked to partake in an exercise based on comparing similarities between images picturing animals or still life. The participant's answer was to state "similar" or "dissimilar". The participants received no feedback based on the results. Time was measured as well as the correctness of answers within all experimental and control groups. Each participant selected the accuracy, according to her/him, of her/his own answers and went to the other slide. Respondents from the experimental groups, after having received the results ("failure" or "success"), were asked to estimate on a scale from 0 (*very bad*) to 10 (*very good*), based on their opinion, how correct the computer feedback was. The latter serves as a dependent measure for experimental check. The theoretical background for this manipulation check lies in attribution theory. People attribute their success to themselves, and are certain of it, and attribute their failure to external circumstances (Nisbett & Ross, 1980). Thus, individuals should overestimate the correctness of the computer feedback when it is positive, and underestimate the accuracy of the feedback when it is negative in the last part of the research.

Afterwards, every respondent from each group was supposed to choose between two options – further practicing the abilities tested earlier (called "learn") or watching a movie about animals. The dependent variable was learning (further practice vs. video). Finally, everyone filled in the Self Diagnostic Motive Scale (SDMS; Brycz et al., 2018b), consisting of three subscales: Own Results Information (ORI), Comparison Information (CI), and Self-Improvement Information (SII).

The protocol of this study was approved by the Ethics Board for Research Projects at the Institute of Psychology, University of Gdansk, Poland (decision no. 17a/2013). There was a small snack as a reward for participation. Each participant at the end of the experiment was thanked and fully debriefed.

MATERIALS

Two questionnaires were employed: one (MCS) was completed before the main experiment, and the other (SDMS) was filled in after the experiment.

Metacognitive Self Questionnaire. The MCSQ-21 (Brycz et al., 2019) contains 21 items describing situations reflecting common biases (e.g., accessibility heuristic: "A view of a murder victim's body influences my attitude towards the perpetrator more than factual information that a fascist killed thousands of people during the Second World War" (Nisbett & Ross, 1980); positivity bias: "I tend to judge other people positively rather than negatively" (Weinstein, 1980). Items are rated on a six-point Likert scale from 1 (*totally disagree*) to 6 (*totally agree*), reflecting the extent to which each behavior applies to them. The model-based omega reliability coefficient (McDonald, 1999; Zinbarg et al., 2005) for the general MCSQ-21 factor in the calibration sample was .77. The internal consistency of the MCSQ-21 in the whole sample (N = 398) throughout the study was satisfactory; the Cronbach's α and McDonald's ω values were .80 and .81, respectively.

Self-Diagnostic Motive Scale. The Self-Diagnostic Motive Scale (SDMS; Brycz et al., 2018b), based on the Self-Motive Items by Gregg et al. (2011), was created to indicate the motivation to look for self-diagnostic information. The SDMS contains 6 items. All items were straightforward sentences or questions about the given motive with a response scale from 1 (*definitely not*) to 6 (*definitely yes*). Always 2 items comprise one factor, e.g. factor one: looking for one's own good and bad effects of solving the task (own results information – ORI); the second factor – asking for self-improvement information (self-improvement information – SII) e.g. "What can I do to make my results better?"; the third factor – searching for diagnostic information about the self by comparing one's own results to those of others (comparison information – CI) e.g. "In what aspects of the task did I perform worse than the group?". In fact, the three first-order factors loaded (with equal loadings) on a second-order factor that we called the self-diagnostic motive (SDM). This means that two items for each of the three motives can be summed up or averaged within each of the three motives or that the three researched motives themselves can be summed up or averaged, which includes all six items on the SDMS scale. The internal consistency of the SDMS in our sample throughout the study was satisfactory; the whole sample (N = 398) Cronbach's α and McDonald's ω values were .87 and .91, respectively.

STATISTICAL ANALYSES

Means, standard deviations, percentages and correlation coefficients were calculated. Multivariate logistic regression was conducted to investigate the predictors of time, choosing "learn" vs. video, evaluation of own results, evaluation of computer, the main SDMS score. Odds ratios (ORs) for risk factors with 95% confidence intervals (CIs) were calculated. The metacognitive self and experimental manipulation (success vs. failure) were the main independent variables. The covariates included in the model were age, gender, and SDMS factors: ORI, SII, CI, and the accuracy of self-perception (measured: self-evaluation of own results was subtracted from the real outcome). Two interaction terms were calculated: (1) between metacognitive self and gender, (2) between metacognitive self and the condition of failure. Stepwise logistic regression was used. There was no violation of the assumptions of logistic regression. All analyses were conducted in IBM SPSS.25. All tests were two-tailed, and the significance level was set to $\alpha = .05$.

The experimental manipulation check (success vs. failure vs. control) showed expected results in both experiments. To assess the manipulation check we compared how people evaluated accuracy of the feedback in both groups: success vs. failure. The theoretical background is described in the section *Procedure and experimental manipulation*. Thus, individuals should overestimate the correctness of the computer feedback when it is positive, and underestimate the accuracy of the feedback when it is negative in the last part of the research. This was confirmed in the social experiment: $F(2, 185) = 57.93$, $p < .001$, M/success = 77.60 vs. M/failure = 43.65, $t = 7.60$, $p < .001$ as well as in the spatial experiment: $F(2, 209) = 44.98$, $p < .001$, M/success = 75.89 vs. M/failure = 47.17, $t = 6.70$, $p < .001$. We found that the predictions of own correctness before obtaining feedback were similar in both experiments and conditions: for the social experiment: M/success = 66.69% vs. M/failure = 64.48%; and for the spatial experiment: M/success = 67.46% vs. M/failure = 66.40%.

RESULTS

DESCRIPTIVE STATISTICS

Table 1 presents mean scores and standard deviations for all the studied variables as well as their interrelationships.

EXPERIMENT 1 – SOCIAL INCENTIVES

A logistic regression analysis was conducted to predict whether participants will chose task (preferably) vs. video, using gender, age, MCS, experimental manipulation: success vs. failure, SDMS, ORI, SII, CI, the accuracy of self-perception, interaction term between MCS and gender, and interaction term between MCS and only the condition of failure, as predictors. A test of the full model against a constant only model was statistically significant, indicating that the predictors distinguished between task (meaning "learn") vs. video ($\chi^2 = 31.65$, $p = .001$ with $df = 11$). Nagelkerke's R^2 of .19 indicated a moderate relationship between prediction and grouping (further learning vs. watching video) (Tabachnick et al., 2017). Prediction success overall was 70.5% (89.0% for video and 36.5% for task). The model does clearly better in predicting participation than a constant only model. The Wald criterion demonstrated that the condition of failure ($p < .001$), ORI ($p = .031$), and CI ($p = .045$) made a significant contribution to prediction (Table 2). The correlation between MCS and SDMS was: $r = .15$, $p = .010$; between MCS and SII, $r = .22$, $p = .002$.

EXPERIMENT 2 – SPATIAL INCENTIVES

A logistic regression analysis was conducted to predict whether participants will choose task (preferably) vs. video in experiment 2 (spatial indices) using gender, age, MCS, feedback: success vs. failure, SDMS, ORI, SII, CI, the accuracy of self-perception, interaction term between MCS and gender, and interaction term between MCS and only condition of failure as predictors. A test of the full model against a constant only model was not statistically significant ($\chi^2 = 16.99$, $p = .108$ with $df = 11$) (Table 3). The correlation between MCS and SDMS was $r = .27$, $p = .002$; between MCS and ORI, $r = .21$, $p = .002$, CI = 0.21, $p = .002$, SII, $r = .22$, $p = .001$.

DISCUSSION

The main goal of the study was to investigate whether metacognitive self (self-awareness of cognitive biases), especially in a social context, and in the presence of negative feedback, which in fact is frequent during the learning process (Scott et al., 2019), may lead to the preference of task (learning) over the video, and accordingly the willingness to learn over the preference for leisure time. We predict this effect to appear in the social experiment in the first place. Houle-Johnson et al. (2019) found that negative feedback is recognized with greater accuracy, regardless of depression or anxiety, when it concerns social incentives, such as verbal expressions. We predicted higher MCS in the case of negative feedback, the more participants will choose to learn (another task) than look for pleasure (video), especially in the social experiment.

Table 1

Mean scores and standard deviations, percentages, and correlations between study variables

	M (*SD*)/ Percentages (1, *N* = 188)	*M* (*SD*)/ Percentages (2, *N* = 210)	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. Gender[a, b]	57% women	54% women	–	−.07	.07	.08	.07	.02	.13	.09	.03	−.10	−.16*	−.03	−.02	.17	.17*
2. Age	21.64 (2.56)	22.68 (3.39)	−.16*	–	.00	−.03	.08	.04	−.02	.04	.06	−.02	−.21**	−.09	.05	.13	.02
3. Task	0.69 (0.47)	0.65 (0.48)	.01	−.12	–	−.14	−.14	−.14	−.05	−.14	.08	−.15*	.01	-	.07	.17	.02
4. MCS	4.25 (0.36)	4.25 (0.41)	.12	−.02	.01	–	.09	.04	.22**	.15*	−.09	−.06	−.03	−.23	.11	−.07	.01
5. ORI	4.91 (0.94)	5.00 (0.91)	.10	.16*	−.12	.22**	–	.47**	.42**	.77**	−.01	−.05	−.05	−.05	.02	−.01	−.02
6. CI	4.72 (1.09)	4.70 (1.07)	.08	.14*	.06	.21**	.39**	–	.49**	.83**	.06	−.11	−.07	.03	.02	.02	.00
7. SII	4.98 (1.05)	5.16 (0.92)	.05	.15*	−.02	.21**	.46**	.47**	–	.80**	−.12	−.07	−.20**	−.19	.01	.05	.06
8. SDMS	4.87 (0.82)	4.95 (0.77)	.10	.19**	−.02	.27**	.76**	.81**	.80**	–	−.03	−.10	−.14	−.09	.02	.03	.02
9. Success	0.33 (0.47)	0.33 (0.47)	.05	−.08	.10	−.02	.02	.08	.10	.09	–	−.50**	.16*	.17	.01	.57**	−.12
10. Failure	0.34 (0.47)	0.33 (0.47)	.03	.11	−.28**	−.05	.05	.04	.05	.05	−.50**	–	.22**	.28*	−.09	−.57**	−.15*
11. Average reaction time (1)	3058.43 (1785.91)	2843.21 (1968.60)	−.01	−.05	−.10	.07	−.03	−.07	.04	−.03	.24**	.06	–	.82*	−.07	−.27**	−.20**
12. Average reaction time (2)[c]	2405.51 (1593.37)	2426.89 (1582.51)	.04	−.17	-	.18	.13	.13	.13	.16	.46**	−.17	.69**	–	−.16	−.28	−.20
13. 1 prediction of own results	66.58 (17.34)	68.61 (16.97)	.01	.05	.01	−.02	.04	.03	.06	.05	−.05	−.09	−.10	.10	–	.11	−.64**
14. 2 evaluation of computer's evaluation	60.49 (30.14)	61.53 (29.09)	−.02	−.10	.19*	−.01	.07	.10	.07	.11	.50**	−.50**	−.14	−.03	.04	–	.08
15. Accuracy	−0.05 (0.26)	−0.08 (0.26)	−.02	−.05	.03	.07	−.07	−.10	−.01	−.08	−.09	−.11	.01	−.29*	−.63**	−.02	–

Note. *p < .05, **p < .01; [a] 1 – men, 2 – women; [b] the correlation coefficients are point-biserial correlation coefficients; [c] N = 59 in the first condition, N = 74 in the second condition. Above the diagonal are the results for the first condition, and below the diagonal are the results for the second condition. MCS – metacognitive self; ORI – motive to look for information about self as "own results information"; CI – motive to look for information about self as comparing own results vs. others; SII – motive to look for information about self that allows for self-improvement; SDMS – a self-diagnostic motive scale that comprises ORI, CI, and SII.

Table 2

*Results of logistic regression analysis of choosing a task vs. a video as a function of gender, age, MCS, experimental manipulation: success vs. failure, SDMS, ORI, SII, CI, self-esteem accuracy, the interaction of MCS*gender, and interaction of MCS*failure. Experiment 1 – a social task*

Variables	B	Wald χ^2	*p*	Odds ratio	95% CI for odds ratio	
					Lower	Upper
Gender[a]	0.30	0.76	.383	1.35	0.69	2.65
Age	0.02	0.11	.744	1.02	0.89	1.17
MCS	−1.02	4.30	.038	0.36	0.14	0.95
Success	0.00	0.00	.998	0.10	0.42	2.37
Failure	−0.82	3.85	.050	0.44	0.19	0.10
CI	−0.33	2.67	.102	0.72	0.49	1.07
SII	0.18	0.79	.374	1.20	0.80	1.79
ORI	−0.29	1.71	.191	0.75	0.48	1.16
Level of accuracy	−0.15	0.05	.817	0.86	0.23	3.18
MCS*gender	0.45	0.21	.650	1.56	0.23	10.79
MCS*failure	−0.82	0.15	.695	0.67	0.09	5.12
Constant	2.42	1.67	.197	11.26		

Note. *$p < .05$, **$p < .01$; [a] 1 – men, 2 – women; $N = 188$. MCS – metacognitive self; ORI – motive to look for information about self as "own results information"; CI – motive to look for information about self as comparing own results vs. others; SII – motive to look for information about self that allows for self-improvement; SDMS – a self-diagnostic motive scale that comprises ORI, CI, and SII.

Table 3

*Results of logistic regression analysis of choosing a task vs. a video as a function of gender, age, MCS, experimental manipulation: success vs. failure, ORI, SII, CI, self-esteem accuracy, the interaction of MCS*gender, and interaction of MCS*failure. Experiment 2 – a spatial task*

Variables	B	Wald χ^2	*p*	Odds ratio	95% CI for odds ratio	
					Lower	Upper
Gender[a]	−0.01	0.00	.987	0.99	0.52	1.90
Age	−0.06	1.60	.206	0.94	0.86	1.03
MCS	0.01	0.00	.982	1.01	0.44	2.33
Success	−0.48	1.33	.248	0.62	0.28	1.39
Failure	−1.49	13.44	< .001	0.23	0.10	0.50
CI	0.36	4.03	.045	1.44	1.01	2.05
ORI	0.06	0.07	.790	1.06	0.70	1.59
SI	−0.49	4.67	.031	0.61	0.39	0.96
Level of accuracy	−0.29	0.22	.641	0.75	0.23	2.49
MCS*gender	−1.37	2.54	.111	0.26	0.05	1.37
MCS*failure	1.56	3.86	.059	4.76	0.94	24.06
Constant	2.75	3.42	.065			

Note. *$p < .05$, **$p < .01$; [a] 1 – men, 2 – women; $N = 210$. MCS – metacognitive self; ORI – motive to look for information about self as "own results information"; CI – motive to look for information about self as comparing own results vs. others; SII – motive to look for information about self that allows for self-improvement; SDMS – a self-diagnostic motive scale that comprises ORI, CI, and SII.

As predicted, only the social experiment (experiment 1) revealed the expected results. The hypothesis of the motivating role of MCS, and separately the motivating role of failure, was supported. The higher the MCS, the more individuals wanted to take part in the task again instead of watching a video. In contrast, low MCS persons in a condition of failure chose the video instead of the task. High MCS individuals seek diagnostic feedback and want to learn more about themselves. Simultaneously, they are characterized by strong self-improvement, and self-comparison motives, which makes them look for diagnostic feedback more often than low MCS persons. They want to learn more about their mistakes and improve their results. High MCS people are more focused on achieving the goal, regardless of the course of the process. Negative feedback, moreover, results in paying additional attention to the task and choosing the task, meaning learning over a video. Our results appear to agree with research by Fong et al. (2019). The authors found a motivational role of negative feedback in comparison to neutral feedback. The motivational role of negative information is well known in social cognition (Higgins & Kruglanski, 2000).

However, as predicted, in the case of the second experiment when spatial incentives were taught, the model appeared to be insignificant.

The differentiation between special vs. social experiment, and the role of incentives for willingness to learn should be highlighted.

Since the MCS itself has a social dimension, and as biases relate to social functioning, it is likely that the factor that increases motivation to choose the task over the video in the social experiment (vs. spatial), emotions expressed via human faces, enhanced the atmosphere of the presence of others during the task. This factor is not present in the spatial experiment, in which the cognitive task is based on an abstract form of expression – geometric figures. The type of incentives seems to be significant for the process of learning when metacognition is considered. It is reported in the literature that images of human faces influence the sense of social presence (Lee et al., 2011). In this course of reasoning, the sense of social presence, even despite negative feedback about the results of one's own activity, sustains the drive to continue the activity.

In other words, high MCS means self-awareness of biases. Therefore the social domain may be of greater interest to high MCS individuals than the spatial one. It would explain why the role of MCS, and the role of failure, are significant in the first experiment but not in the second one.

In fact, the interaction effect MCS × failure appeared to be insignificant in both experiments. MCS, and separately failure, motivate participants to choose a task in the first experiment (main effects: MCS, failure), and the same pattern of results was insignificant in the second experiment. Thus, cautiously, we claim that self-awareness of biases (MCS) motivates individuals to try again, and failure motivates them to learn, but only when social incentives are processed.

Moreover, as we expected, the results revealed a significant role of metacognition. A discrepancy between simple correlations of questionnaires and behavioral measure is observed here. While a positive correlation between metacognitive self and the Self-Diagnostic Motives Scale (SDMS) was observed for all participants (two experiments together), $r = .25$, $p = .001$, different patterns were present when MCS served as a predictor and SDMS as the dependent variable.

The impact of MCS and "failure" feedback on behavioral choice indicates the role of MCS in searching for self-diagnostic information, for social incentives (as predicted). High MCS participants, using piecemeal processing significantly more frequently than their low MCS colleagues, underwent another task instead of watching a video (behavioral dependent measure), and were looking for self-improvement information that might help improve performance in the future.

Also, the role of feedback and the kind of incentives was significant. A significant impact of negative feedback on behavioral choice – task over video – was observed only for the first experiment and social incentives. Separately the three independent variables – metacognition, type of feedback, and kind of incentives – impact motivation to learn. Participants who possessed strong MCS, obtained negative feedback, and mentally processed social incentives chose learning activity over leisure (watching a video).

IMPLEMENTATION OF THE OUTCOME

We suggest some practical implications of our results. It should be noted that the conducted research indicates only a certain phase of involvement in the task under the influence of the obtained feedback, a phase that can be a part of the process of maintaining attention during an uncomplicated cognitive analysis of objects. However, it might be supposed that the results are promising for the improvement and effectiveness of the learning process. Procrastination is a great challenge among students. The motivational facet of MCS seems prospective. Based on previous research (Kleka et al., 2019) the importance of MCS for an effective learning process was supported via longitudinal study. MCS predisposition was an individual factor of growth during three years of studies. Moreover, the MCS predisposition promotes self-concentration and self-improvement, increases striving for a goal, helps to achieve reasonable goals, and supports the pursuit of autonomy (lower MCS involves working under supervision; Brycz et al., 2018a). Longitudinal studies indicated that low MCS participants showed motivational deficits during three years of studies (Kleka et al., 2019). Among these subjects (low MCS at the beginning of the studies), the authors observed a further decline in MCS, deficiency of self-awareness of the mistakenness that directs attention. It indicates incorrect cognitive processes and avoiding undertaking activities, meaning lack of motivation that would encourage one's development.

What is more, perhaps using MCS measurement (MCSQ-21) can be helpful in teaching processes. The measurement used prior to the beginning of a course would allow for the identification of a group of learners with low MCS, i.e., inclined to interrupt a task, redirect attention, or de-concentration. For the educator, it would be information about the need for additional support for the identified group of learners in order to achieve efficiency of learning.

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