

# University students' awareness of their metacognitive competence

## Abstract

The awareness of one's own performance (metacognitive judgments) is important for the successful regulation of learning activities in higher education. According to studies about self-regulated learning, achievement and metacognition are related to each other, but metacognitive judgments usually are not completely precise in relation to achievement. The investigation of the awareness of metacognitive judgments (meta-metacognition) also sheds light on the generation of metacognitive judgments. The aim of the present study is to investigate the underlying processes while students provide meta-metacognitive judgments and to what extent such judgments rely on the preceding metacognitive judgment, the accuracy of this judgment, or on the preceding performance. We analyzed data from  $N = 116$  university students in a multilevel approach. The final model revealed effects of the metacognitive judgment, its accuracy, and also of performance, with the largest effect of the metacognitive judgment. Implications for the successful regulation of learning activities will be discussed.

Keywords: Learning, metacognition, self-regulation

## Theoretical Framework

Learning in the higher education context is characterized by a high level of self-regulation compared to learning in the school context, where students are strongly guided by their teachers. For the successful regulation of learning activities, university students need to monitor their learning processes and to make decisions about which contents they already understand and which contents they need to study further. Metacognitive judgments about achievement and their respective awareness give insight into students' monitoring of their learning processes. For example, it could be shown that especially low-performing learners overestimate their achievement (unskilled and unaware effect, Kruger & Dunning, 1999). Recent studies went further and investigated the unskilled and unaware effect with meta-metacognitive judgments; that means, students were also asked to provide judgments about their metacognitive judgments. The analysis of these judgments revealed that low-performing learners are aware that their metacognitive judgments might be less reliable in comparison to the other students in the sample (Händel & Fritzsche, 2015; Miller & Geraci, 2011). Thus, it might be more difficult for low-performers to effectively regulate their learning processes. To gain more insight into students' metacognitive processes, finer-grained analyses of (meta-)metacognitive judgments with university students are necessary. The population of students in higher education seems to be very suitable for research in this area, as for these students self-regulation is especially important compared to school students.

As already stated, previous research revealed that metacognitive judgments are not necessarily appropriate. Whether metacognitive judgments are appropriate can be computed with measures of calibration. There are several ways to compute measures for calibration (Budescu & Johnson, 2011; Lichtenstein, Fischhoff, & Phillips, 1982; Schraw, Kuch, & Gutierrez, 2013). Many of these measures to analyze calibration rely on the framework of signal detection theory (SDT) (Barrett, Dienes, & Seth, 2013). According to SDT, students' metacognitive judgments can be classified in relation to the correctness of an item (having solved it correctly or not) and the metacognitive judgment of the respective item (believing to have solved the item correctly or not). Thus, there are four possible combinations: solving an item correctly and believing to have solved it correctly (hit), solving an item

correctly and believing to have a wrong solution (miss), having a wrong solution and believing to have a correct solution (false alarm) and finally having a wrong solution and believing to have a wrong solution (correct rejection). For successful self-regulation, appropriate metacognitive decisions like hits and correct rejections are favorable to misses and false alarms and they should be followed by higher meta-metacognitive judgments than misses and false alarms.

Nevertheless, it remains problematic to disentangle achievement and metacognitive skills under the SDT approach. It is especially problematic that measures get unstable if a person has almost only correct or incorrect answers (Barrett et al., 2013). To overcome drawbacks of measures in the framework of SDT, Murayama, Sakaki, Yan, and Smith (2014) propose to follow a multilevel approach for analyzing metacognitive judgments. The framework of a multilevel analysis offers the advantage to investigate variations in (meta-)metacognitive judgments on the fine-grained level of single judgments also taking person- and item-characteristics into account (Budescu & Johnson, 2011). To disentangle underlying processes of students' metacognitive awareness, we will follow a multilevel approach. We aim at disentangling if meta-metacognitive judgments rely more on the accuracy of metacognitive judgments (what they are supposed to) or on students' metacognitive judgments or achievement (of which they could be independent).

## **Method**

Data from  $N = 116$  undergraduate education students who voluntarily participated (76% female) were analyzed in this study. Students were recruited from different advanced courses in educational psychology. They were enrolled in different terms, most of them (78%) in the third to fifth term.

A test with 32 multiple-choice questions (4 options, single select) about educational psychology topics served as indicator for students' performance (Cronbach's  $\alpha = .60$ ). A sample item was: "What kind of learning strategy is the actualization of prior knowledge? A) An organizational strategy, B) An elaboration strategy, C) A self-regulatory strategy, or D) A resource strategy" (the correct answer is "B) An elaboration strategy"). After each test item, students were asked to indicate whether their answer was correct or not, resulting in 32 performance judgments (Cronbach's  $\alpha = .88$ ). The implemented question was: "Do you think your answer is correct?" Students had to tick one of two boxes labeled "yes" or "no". For each item, students were asked how confident they were about their performance judgment (operationalized via a 5-point Likert smiley scale, with the frowning face on the left representing low confidence (1) and the smiling face on the right representing high confidence (5)). The 32 meta-metacognitive judgments revealed high reliability (Cronbach's  $\alpha = .90$ ).

The study was conducted as a laboratory study in which students were tested in groups of 10 to 20 persons. Lasting about 45 minutes, each session was guided by one of the researchers. The participating students were asked to complete a performance test covering educational psychology topics. Performance judgments as well as respective meta-metacognitive judgments were collected after each test item.

Data were analyzed descriptively and within a multilevel approach. The multilevel approach consists of several models building on each other. At first an empty model is computed to investigate how much variance in the meta-metacognitive judgments can be traced back to item or person characteristics. At second, predictor variables are added to the model to analyze their effects on the meta-metacognitive judgments.

## Findings

The test about educational psychology was of medium difficulty ( $M = 15.15$ ,  $SD = 3.93$ , out of 32 items). Students were optimistic about their achievement ( $M = 19.95$ ,  $SD = 6.66$ ). Meta-metacognitive judgments were also quite positive ( $M = 3.41$ ,  $SD = 0.50$ ). The accuracy of performance judgments was coded “1” for an accurate judgment and “0” for an inaccurate judgment. Accuracy was also good with  $M = 18.01$  items ( $SD = 3.35$ ) out of 32 possible correctly judged items.

According to the empty model of multilevel analyses, 20% of the variance can be traced back to the individual level and 5% of the variance can be traced back to the item level. Seven further multilevel models were computed with the metacognitive judgment, the performance and the accuracy of judgments as predictors on the individual level. Firstly, each predictor was investigated solely. Secondly, all combinations of two variables were investigated, and finally a model with all three predictors was computed. This allowed us to investigate the single effects of the predictors as well as their effects above and beyond the other predictor variables.

In general, the models showed that students’ meta-metacognitive judgments are affected by all three predictor variables. In the model with all predictor variables, the effect of the performance judgments was highest with 0.62 ( $SE = 0.03$ ) compared to the effect of the performance (0.12;  $SE = 0.03$ ) and the effect of the accuracy (0.19;  $SE = 0.03$ ). The estimate for the intercept was 2.86 ( $SE = 0.06$ ). In general, students who think they solved an item correctly show higher meta-metacognitive judgments. Students also show higher meta-metacognitive judgments when they in fact chose the right answer or when they provided an accurate performance judgment.

## Conclusion

The aim of our study was to gain insight into students’ meta-metacognitive processes. The approach of multilevel analyses revealed that the variance in meta-metacognitive judgments can be traced back to features of the students, the items, and a large percentage of error variance as well as variance resulting from the interaction of students with the items.

The model with all three predictor variables revealed that the effect on meta-metacognitive judgments was higher for the performance judgments compared with the performance or the accuracy of the performance judgments. For self-regulated learning, it would be favorable if meta-metacognitive judgments mostly rely on the accuracy of performance judgments. So the results of the model with all three predictor variables are contrary to our expectations, as we expected that the accuracy of the metacognitive judgments should have the highest impact on meta-metacognitive judgments (being favorable for self-regulated learning). Analyses of meta-metacognitive judgments in the model with performance judgments and performance as predictors allowed classifying meta-metacognitive judgments according to SDT. This showed that meta-metacognitive judgments are as expected highest for hits. It was an unexpected result that correct rejections were followed by lower meta-metacognitive judgments than false alarms.

From a practitioners’ perspective, it remains to be investigated in further studies if and how students rely on their metacognitive and meta-metacognitive judgments when regulating their learning process.

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