EFFECTS OF METACOGNITIVE PROMPTS AND FEEDBACK ON SELF-REGULATED LEARNING

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SELF-ASSESSMENT AND TASK SELECTION

- Self-assessment and learning-task selection are key self-regulated learning (SRL) skills but difficult for many students in secondary and tertiary education
    - Bjork et al. (2013)
- Increased accuracy of self-assessment and learning-task selection could help students choose learning activities that in terms of complexity and instructional support are optimal given their level, thereby improving learning
    - Kostons et al. (2012)

EARLIER EXPERIMENTS IN OUR GROUP

- Two earlier experiments ($N = 41$ and $N = 57$ high school students, to be submitted soon) on facilitating SRL using metacognitive checklists: students have difficulties selecting tasks that match their current level
    - Based on work by Sibbald et al. (2013) and (in line with findings from) Kostons et al. (2012)
- In those experiments, students self-assessed their performance in all conditions while feedback on task performance was given in none of the conditions

CURRENT EXPERIMENT

- What about the (combined) effect(s) of self-assessment prompting and task performance feedback on task selection?

- *N* = 230 bachelor in psychology/education students
- Design: 2 (performance self-assessment prompt: yes/no) x 2 (performance feedback: yes/no) x 2 (repeated measurement: first and second task)
- Experiment in Qualtrics (10-20 minutes)
- Solving a conditional probability problem in five steps (2x)

CONDITIONAL PROBABILITY PROBLEM

Factory X has twenty Chinese and eighty Russian employees. Sixteen Chinese employees and sixty-four Russian employees speak English. Based on this information, we can calculate the following two probabilities:

[I.] The probability of a Chinese employee, given that the employee does not speak English;

[II.] The probability of a Russian employee, given that the employee does not speak English.

How many times larger is probability [II.] in relation to probability [I.]?

CONDITIONAL PROBABILITY (STEP 1 OF 5)

Step 1: What probabilities are asked?

A: Under [I.] the probability of a non-English speaking Chinese employee in the group of a hundred employees, and under [II.] the probability of a non-English speaking Russian employee in the group of a hundred employees

B: Under [I.] the probability of a non-English speaker in the group of Chinese employees, and under [II.] the probability of a non-English speaker in the group of Russian employees

C: Under [I.] the probability of a Chinese employee in the group of non-English speaking employees, and under [II.] the probability of a Russian employee in the group of non-English speaking employees

D: A, B, and C are all incorrect

CONDITIONAL PROBABILITY (5 STEPS)

Step 1: What probabilities are asked?

Four choices (A, B, C, or D "none of ABC")

Step 2: How many non-English speaking employees are there?

0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

Step 3: How large is probability [I.]?

0.01, 0.04, 0.16, 0.20, 0.40, 0.50, 0.60, 0.80, 0.84, 0.96, 0.99

Step 4: How large is probability [II.]?

0.01, 0.04, 0.16, 0.20, 0.40, 0.50, 0.60, 0.80, 0.84, 0.96, 0.99

Step 5: How many times larger is probability [II.] in relation to probability [I.]? 0, 0.25, 0.5, 0.67, 0.8, 1, 1.25, 1.50, 2, 4, 10

EXPERIMENTAL MANIPULATION

- Depending on the condition randomly allocated to, participants received
  - (A) performance feedback after each step ('correct' or 'incorrect'; $n = 54$),
  - (B) a prompt to self-assess learning task performance after each problem (expected number of steps performed correctly; $n = 63$),
  - Both (A and B; $n = 57$)
  - None (control condition; $n = 56$)

ACROSS CONDITIONS (1): COGNITIVE LOAD

- Intrinsic and extraneous cognitive load rated after each problem
  - As in Leppink et al. (2014)

All of the following six questions refer to the task you just completed. Please take your time to read each of the questions carefully and respond to each of the questions on the presented scale from 0 to 10, in which '0' indicates not at all the case and '10' indicates completely the case: [show integer response options '0' to '10' with each question]

This task addressed a very complex topic. [Choice: 0-10]
This task required the use of very complex formulas. [Choice: 0-10]
The steps in this task were very complex. [Choice: 0-10]

The instructions and explanations in this task were very unclear. [Choice: 0-10]
The instructions and explanations in this task were full of unclear language. [Choice: 0-10]
The instructions and explanations in this task were very ineffective. [Choice: 0-10]

ACROSS CONDITIONS (2): TASK SELECTION

- Task performance and manipulation
- Intrinsic and extraneous cognitive load rating
- Next, in all conditions (on 11-point scale)
  - Complexity next task: -5 = much easier, + 5 = much more complex, 0 = same
  - Support next task: -5 = much less, +5 = much more, 0 = same

HYPOTHESES

We expected participants' complexity and support choices ...

- H1: ... to become more accurate with self-assessment prompting and/or performance feedback (additive effects of manipulations),
- H2: ... to be positively related to actual performance (higher performance resulting in higher complexity and/or less support)
- H3: ... to be related to self-rated intrinsic and extraneous cognitive load (higher load scores resulting in less complexity and/or more support)

Tested with multilevel analysis (cf. Leppink & Van Merriënboer, 2015)

PERFORMANCE AND TASK SELECTION

Outcome	Performance	Chosen complexity	Chosen support
First round			
No treatment	1.63 (1.14)	-2.23 (2.63)	1.73 (2.60)
Feedback	1.41 (1.13)	-1.83 (2.98)	2.22 (2.59)
Self-assess	1.67 (1.21)	-1.95 (2.72)	1.57 (2.66)
Both treatments	1.82 (1.21)	-2.54 (2.58)	2.12 (2.67)
Second round			
No treatment	1.73 (1.24)	-1.57 (3.25)	1.95 (2.88)
Feedback	1.93 (1.41)	-1.63 (3.25)	2.41 (2.75)
Self-assess	1.81 (1.27)	-2.11 (2.86)	1.70 (2.79)
Both treatments	2.14 (1.48)	-2.46 (2.98)	1.95 (3.06)

PERFORMANCE AND COMPLEXITY CHOICE

Condition	No self-assess prompt	Self-assess prompt
Correct (out of 5)	Point est. (95% CI)	Point est. (95% CI)
0 steps	-1.274 (-2.202; -0.345)	-1.874 (-2.770; -0.978)
1 step	-2.247 (-3.068; -1.427)	-2.848 (-3.594; -2.101)
2 steps	-1.290 (-2.104; -0.475)	-1.890 (-2.641; -1.139)
3 steps	-1.243 (-2.246; -0.239)	-1.843 (-2.786; -0.900)
4 steps	**0.437 (-0.743; 1.617)**	-0.163 (-1.284; 0.958)
All 5 steps	1.473 (0.295; 2.651)	**0.872 (-0.262; 2.007)**

PERFORMANCE AND SUPPORT CHOICE

Condition	No performance feedback	Performance feedback
Correct (out of 5)	Point est. (95% CI)	Point est. (95% CI)
0 steps	2.127 (1.235; 3.018)	2.721 (1.827; 3.615)
1 step	1.541 (0.761; 2.321)	2.135 (1.354; 2.915)
2 steps	1.243 (0.471; 2.014)	1.837 (1.050; 2.623)
3 steps	1.924 (0.988; 2.860)	2.518 (1.585; 3.451)
4 steps	**-0.354 (-1.454; 0.746)**	0.240 (-0.837; 1.317)
All 5 steps	-0.757 (-1.871; 0.357)	**-0.163 (-1.278; 0.952)**

PERFORMANCE AND COGNITIVE LOAD

Condition	Intrinsic cognitive load	Extraneous cognitive load
Correct (out of 5)	Point est. (95% CI)	Point est. (95% CI)
0 steps	5.976 (5.414; 6.537)	5.162 (4.549; 5.776)
1 step	5.459 (5.068; 5.849)	5.201 (4.773; 5.629)
2 steps	4.836 (4.452; 5.220)	4.663 (4.242; 5.084)
3 steps	4.722 (4.118; 5.325)	5.209 (4.550; 5.867)
4 steps	**3.236 (2.432; 4.039)**	**2.879 (2.004; 3.754)**
All 5 steps	2.451 (1.538; 3.364)	2.368 (1.370; 3.365)

COGNITIVE LOAD AND TASK SELECTION

Intrinsic cognitive load significantly predicted both chosen complexity ($b = -0.263$, $p < 0.001$) and chosen support ($b = 0.296$, $p < 0.001$).

Extraneous cognitive load significantly predicted chosen instructional support ($b = 0.174$, $p < 0.001$) but not chosen complexity ($b = 0.053$, $p = 0.338$).

In other words: while higher extraneous cognitive load may mainly lead to a preference towards more support, higher intrinsic cognitive load may result in a choice for lower complexity and/or more support.

IN A NUTSHELL

Chosen complexity tends to ...

- ... become somewhat more in line with actual performance when learners are prompted to self-assess their performance (H1)
- ... increase with performance (H2), and
- ... decrease with intrinsic cognitive load (H3)

Performance feedback and extraneous cognitive load appear to influence chosen support but not complexity, whereas self-assessment prompting appears to influence chosen complexity but not support.

FUTURE RESEARCH

- Future studies on task-selection skills should consider different self-assessment prompts and different performance feedback cues

- What if learners actually performed the kind of task they indicated (in terms of more/less/same complexity/support)?

THANK YOU!

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