Can the Perceived Difficulty of a Task Enhance Trainee Performance?

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BACKGROUND: Human understanding of how to efficiently train learners in procedural skills is imperfect. The concept of self-efficacy – confidence in one's ability to successfully complete a task – may be useful to learners. Theories of motivation and instructional design suggest there are specific targets for improving learner success. We aimed to study the effects of induced conceptions of ability on motor learning using both undergraduate and medical students.

METHODS: Forty undergraduate and medical students underwent a 15-minute training session teaching the basics of colonoscopy on a low-cost, moderate fidelity colonoscopy simulation model. Students were then tasked to intubate the cecum of a similarly constructed colonoscopy model with a real colonoscope. Before each task, participants were given a note which either read "90% of your peers completed the task in less than 5 minutes" (positive [+] comparison group) or "10% of your peers completed the task in less than 5 minutes" (negative [−] comparison group). Immediately after receiving the note, participants were then asked to complete a self-efficacy questionnaire, ranking their confidence on a scale from 0 to 10 for successfully completing the task. A NASA TLX was collected to understand the students' mental effort with the task. Participants then underwent stratified randomization into 2 crossover groups (G1 = + note, then − note; G2 = − note, then + note) and again performed the colonoscopy task. Following the session completion, all students had received both notes and crossed over to complete both tasks. Time spent on both tasks and task completion (reaching the cecum) was the measured outcomes.

RESULTS: Self-efficacy (confidence) levels were significantly higher in the positive note condition for both comparison groups in ($p < 0.05$). However, task completion rates were higher in the negative note group in Task 1 ($p < 0.05$) and the same in Task 2 ($p = 0.6$). Time spent by participants in each task was longer in the negative note groups in both tasks ($p = 0.06$ in Task 1; $p = 0.07$ in Task 2). No difference was found between both groups in the mental effort after each task (Table 1).

CONCLUSIONS: This prospective, cross-over study suggests that performance expectancies can be influenced by preinduced conceptions. Performance was enhanced in Task 1 when participants were given a relatively "low success rate prediction." This may be due to an enhanced focus that led to increased performance—while participants who were given the prediction of a "higher success rate" were more confident but performed less well. The crossover groups for Task 2 performed in a similar manner despite different confidence levels. This study supports the idea that self-efficacy expectations are relevant for trainee education and performance. (J Surg Ed 76: e193–e198. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: perceived competency, self-efficacy, colonoscope, simulation, education, assessment

COMPETENCIES: Medical Knowledge, Interpersonal and Communication Skills, Practice-Based Learning and Improvement

INTRODUCTION

Upon entering a surgical residency program, first-year interns are introduced to a gamut of operations that they need to know step by step and eventually their training involves the mastery of numerous technical skills. Although the science of surgical education is imperfect, 5 years of training eventually allows most learners to become competent in many of the facets of general surgery. Ericsson suggests we likely will offer better training and greater progress toward mastery with coaching and

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deliberate practice, voluminous staff feedback, and exceptional drive from trainees.[1] Unfortunately, general surgery programs, trainees, and their staff suffer from a shortage of repetition and coaching time, and a clinical schedule that rarely fits into a deliberate practice scheme; finding ways to enhance the learning they incorporate into long-term memory and skill acquisition would be advantageous.

Surgical residents need to self-regulate their learning, but self-regulated learning is most effective when instructors help provide learning goals and guidance in the selection of training processes.[1] Several theories of learning suggest that one may be able to alter the ability of learners to pick up or learn a task — ideally learning it more effectively and efficiently. Wulf et al.[2] showed that adults who were told that "active and experienced persons *like them*" typically did well on the assigned task — far better than adults who were not given a positive comment prior to performing the task. In this study, a single, spoken sentence, just before embarking on a task, resulted in increased self-efficacy and superior learning. Others have found similar performance alterations with simple preparatory comments: Trempe et al.[3] found that visuomotor adaptation (on the same tasks) was enhanced when participants were given a relatively easy objective (experienced more success during practice) relative to participants who were given a more difficult objective — but given the very same task. Participants offered a simple objective had greater self-efficacy and completed their tasks faster than those given a more difficult objective.[2-4]

We hypothesized that we might similarly affect performance, influence self-efficacy, and decrease mental and physical demands in novice learners trying to perform colonoscopy in a simulated environment.

METHODS

Forty participants from the University of Minnesota (U of M; n = 10 medical students; n = 20 undergraduates), and Saint Olaf College (n = 10 undergraduates) attended a 3-hour long Simulation Session that included a variety of laparoscopic, endoscopic, and open skills training. Students voluntarily signed up for the free session that offered exposure to various medical and surgical procedures. None of the students had prior experience with colonoscopy. This specific study took place during the endoscopic skills portion of the session. The station started with a 15-minute training session on "how to" use the colonoscopy equipment. Then the participants were randomly assigned to either the positive comparison group or negative comparison group. The instructor informed participants in the "positive comparison" group that "90% of their peers complete this task in less than 5 minutes." "Negative comparison" group students were informed that "10% of their peers complete the task in less than 5 minutes." The participants' self-efficacy was assessed through a questionnaire that offered a Likert Scale from 0 (not confident at all in my ability to complete the task) to 10 (extremely confident that I can complete the task); the questionnaire was administered after the practice session and immediately before Task 1. Then, students were asked to perform a colonoscopy on a physical trainer (Task 1) independently within 5 minutes. Upon completion of Task 1, student groups switched rooms and were assigned Task 2 — while crossing over to the opposite comments prior to the task. The positive comparison group was now informed that 10% of their peer completed the task and the negative comparison group was informed that 90% of their peers completed their task. They were asked to complete the self-efficacy questionnaire again and complete Task 2 (Fig. 1). Tasks 1 and 2 were identical to each other but performed on different colonoscopy simulators. The time to reach each polyp (6 polyps total) and task completion (reach the cecum; 110 cm from the anus) were recorded. Participants' mental effort using the NASA-TLX was collected at the end of each task.

Primary outcomes include participants' self-efficacy level prior to each task and time to reach each polyp (6 polyps total) and task completion (reach the cecum; 110 cm from the anus). Secondary outcome includes students' mental effort at the end of each task, using the NASA-TLX.

Data analysis was carried out on de-identified data using JMP 13.0.0. We used a threshold of statistical significance of 0.05. Completion rate, time to reach each polyp, self-efficacy, and mental effort was analyzed in a positive versus negative comparison by groups using analysis of variance for each task.

RESULTS

The 40 students were divided evenly in groups (5 University of Minnesota medical students, 10 University of Minnesota undergraduates, and 5 St. Olaf College undergraduates; in each group). Eighty tasks were attempted with an overall completion rate of 72%.

In Task 1, self-efficacy (confidence) level was higher in the positive comparison group ($p < 0.05$). However, task completion rate was higher in the negative comparison group 1 ($p < 0.05$). Time spent by participants was similar ($p = 0.6$ in Task 1). No difference was found between both groups in the mental demand (Table 1).

In Task 2, self-efficacy (confidence) level was higher in the positive comparison group ($p < 0.05$). Task completion was similar between both groups ($p = 0.6$); time spent by participants was slightly longer in the negative

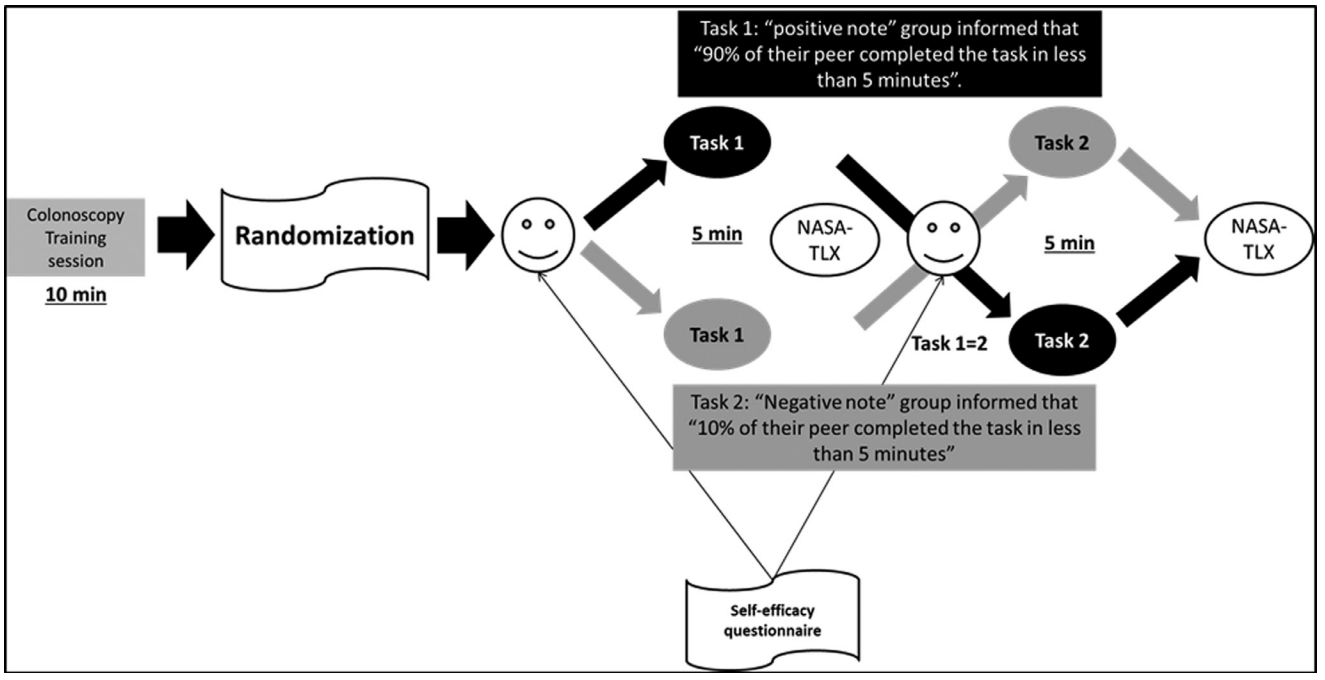

FIGURE 1. Study design.

TABLE 1. Mean Scores for Group 1 Vs Group 2 Students in Task 1

Tasks	Categories	Variables	Group 1 (Positive Comparison)	Group 2 (Negative Comparison)	p value
Task 1	Self-efficacy	Confident (10 pts)	6.2	4.2	0.0009
	Task performance	Success rate (%)	45%	85%	0.02
		Time (seconds)	205 (20)*	222 (26)*	0.6
	NASA-TLX	Mental demand	13	11	0.3
		Physical Demand	9.5	8.4	0.5
		Temporal demand	13	11.3	0.1
		Effort	14.8	12.6	0.1
		Task complexity	15	12.4	0.06

*Time reported as a mean and standard deviation.

TABLE 2. Mean Scores for Group 1 Vs Group 2 Students in Task 2

Tasks	Categories	Variables	Group 1 (Negative Comparison)	Group 2 (Positive Comparison)	
Task 2	Self-efficacy	Confident (10 pts)	4.1	7.6	<0.0001
	Task performance	Success rate (%)	80	80	0.6
		Time (seconds)	177 (14)*	135 (16)*	0.07
	NASA-TLX	Mental demand	10	12	0.1
		Physical Demand	9.8	9	0.6
		Temporal demand	10.6	12.3	0.1
		Effort	12	13.8	0.1
		Task complexity	11.6	12.2	0.7

*Time reported as a mean and standard deviation.

comparison group (p = 0.07). Similar to Task 1, there was no difference between both groups in the mental demand (Table 2).

DISCUSSION

This simple cross-over prospective study shows that performance expectancies can be influenced by preinduced conceptions. This study supports the idea that (1) perceived competency is relevant for trainee education and performance; (2) self-efficacy (confidence level) can be influenced by a simple pretask message; (3) performance was enhanced when participants were given a relatively "low success rate prediction." Students were more cautious and took slightly longer to complete the task when placed in the negative comparison group; (4) no differences in workload was identified for the same procedure type and difficulty; and (5) monitoring students' development in these skills and giving them upfront expectations could be beneficial for the cognitive achievement of students with learning complex surgical skills.

The positive self-efficacy group was inversely correlated with performance, while the negative self-efficacy group outperformed the positive group in our study. We suspect that our novices performing colonoscopy may not have they focused and put forth as much effort when they were told the task was easy as when they were told that it was a hard task. Other studies have similarly found enhanced self-efficacy to be inversely correlated to performance of learners that are working on new tasks.[5] Clanton et al. performed a study examining the relationship between confidence and competence with basic surgical skills (knot tying and suturing skills) among third-year medical students entering clinical rotations. They found that before the students received any training and were complete beginners with the given tasks, the confidence that students had in their abilities was inversely proportional to their performance.[6] Leopold et al. performed a study that measured the relationship between self-efficacy and objective performance with arthrocentesis on a simple task trainer with physicians, nurse practitioners, and physician assistants.[7] This group also found that practitioner confidence in their ability to perform the task was inversely correlated with competence in learners before they received training. Though many of the participants were health professionals, they were still all new to the task, and those that were less confident outperformed those with more confidence. Interestingly, in independent studies by Clanton et al. and Leopold et al., after participants received training, confidence scores and performance were directly correlated.[6,7]

Students who received a negative pretask message had lower levels of confidence compared to receiving a positive task message in our study. The level of perceived difficulty of a task clearly influences that level of confidence – a does so in varied manners based on experience and other factors. A study of nurses with different levels of clinical experience showed that more experienced nurses were actually overconfident for a simulated task while student nurses were under confident on the same task.[8] Ultimately educators need to put trainees in a best mindset to learn tasks and retain this knowledge – there is conflicting data to suggest whether confidence is good or bad for learners. We know from top athletes and musicians that they feel they perform better when their confidence levels are high; but in practice sessions their confidence levels are unknown. Many studies have focused on the relationship between confidence and performance in different industry tasks, but few have investigated how to influence actual confidence.[9,10] Clearly, this is an area for further research.

Perceived task difficulty can influence motivation: the goal-setting theory of motivation proposed by Locke and Latham in 2002 states that goals must be difficult yet attainable to raise performance.[11,12] Learners in our negative comparison group were told that only 10% of their peers were able to complete the task, therefore making the task/goal reachable yet perceived to be difficult and complex.

The negative comparison group took a slightly longer time to complete the task compared to the positive task completion group. This perceived notion of task difficulty may have influenced learners to be more cautious, even though physical and mental demands were similar in both tasks. Depending on the task and metrics assessed, being cautious and taking more time may be good or bad for performance – and or learning. Monitoring students' development in these skills and giving them upfront expectations could be beneficial for the cognitive achievement of students with learning complex surgical skills. A study of general surgery residents learning colonoscopy showed that providing residents with upfront scoring criteria improved performance.[13] A study of students learning Spanish demonstrated the importance of pretask instructions and task completion.[14] Furthermore, a more positive and motivational preinstructions can improve performance, although this had little effect in task completion on our study.[15] Further insight and research is necessary with manipulating self-efficacy for both learning and performing, and doing so on both simple and complex tasks.

Despite the NASA-TLX questionnaire (that participants filled out) showed no statistically significant difference, the mental and physical demands and overall effort

required for the tasks were all higher in the positive comparison group compared to the negative group for both Tasks 1 and 2. It seems that confidence for performing this task affected the workload. NASA-TLX has measured workload estimates for over 30 years.[16] It has been highly correlated with other measures of workload and has also shown reliability.[17,18] Despite, the lack of difference in mental demand between groups in each task, overall higher mental, physical, and effort workloads were documented for the positive comparison group. This observation is intriguing and may be useful to educators looking for ways to decrease the demands of learning.

There are many limitations with this study. This was a single-institution study using a small number of novice learners over 1 training session and assessment. The level of education of the trainees varied from undergraduate to medical student with a vast range of medical knowledge. All participants had no prior experience or exposure to using colonoscopy equipment or the simulator before participating in the study. While grading rubrics were simple and objective (time to reach each polyp with colonoscope, time to reach cecum), the checklist has not been validated.

CONCLUSIONS

This study shows that surgical performance can be influenced by pretask instructions; an inverse correlation between preconceived task difficulty and subsequent completion exists. Our study suggests providing students with a "negative" note ("the task at hand is challenging and that few trainees are capable of completing it in a certain period of time") makes learners more careful/cautious, work harder to perform the skill, and eventually completed the task more successfully. As opposed to giving a trainee a false sense of confidence prior to a procedure with a "positive" note or comment, perhaps offering a "negative" note encourages mental preparation, resiliency/persistence, and to focus more intently on the task at hand. However, negative note may be the answer to better surgical education.

Further work needs to be performed to explore the correlations of motivation, performance, and confidence in surgical education to truly maximize teaching young surgical trainees.

AUTHORSHIP

Authors YA, HS, and NP conceived the study; YA acquired data; YA planned the analysis; and drafted the initial manuscript. All authors were involved in interpreting data and revising the manuscript, and all approved the final manuscript.

ETHICAL APPROVAL

This study was judged Exempt by the Mayo Institutional Review Board.

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