Emotionally salient patient information enhances the educational value of surgical videos.

Emotionally salient patient information enhances the educational value of surgical videos

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Running head: AFFECTIVE ENGAGEMENT IN LEARNING

Abstract

Medical students' motivations for choosing a medical career are likely based on and remain tethered to the affectively-laden caring component of doctor-patient interactions. However, this component is rarely presented in educational surgical videos. It is unknown whether affectively engaging students by including patient-related emotionally salient information potentiates or draws focus away from learning a surgical procedure and whether such information affects motivation and attitudes toward the video. Therefore, we investigate whether presenting a patient's emotional state before video surgery enhances or weakens the educational value of that video. In a within-subjects crossover design, second-year medical students (n = 130) viewed video clips of surgeries. These videos, from online medical education platforms, were preceded by the patient's information from the original video or by information about the patient's preoperative emotional preparation. After each video, participants completed a multiple-choice test about the video's content to measure learning, answered a question about their motivation to re-watch the video, and completed an attitude scale regarding the video. Incorporating patient's information into surgical videos significantly enhanced students' acquisition of the technical aspects of surgery procedures ($p <$ .0001), motivation to re-watch the video ($p < .001$), and favorable attitudes toward the video ($p =$ .02). These findings show that incorporating information about patients' emotional states may enhance students' positive attitudes and motivations toward educational videos and may improve their learning of surgical techniques. They also suggest that the role of this factor should be considered when developing guidelines for medical educational video release.

Key words: medical education; medical students; patient information; emotionally salient information; video surgery.

Introduction

Medical education is making impressive moves toward increasing the availability of educational materials and platforms to facilitate learning (Myers et al., 2018). The ongoing and widespread availability of online surgical videos and tutorials represents a remarkable example of this trend. In response to the plethora and heterogeneity of readily accessible medical videos (Sade, 2008; Rapp et al., 2016; Tackett et al., 2018), guidelines for video recording and release are needed to ensure high quality standards from both ethical and educational perspectives (Prigoff et al,, 2016; Celentano et al., 2018; Ritter, 2018; Stefanidis et al., 2007).

In the area of surgery, notable steps forward are being taken thanks to a taskforce of multispecialty trainers who have developed guidelines for educational videos (Celentano et al., 2018). These guidelines emphasize that in addition to ensuring the quality of the video and the demonstration of surgical procedures, attention should be given to presenting information about the patient, such as clinical information and the patient's consent to surgery (Celentano et al., 2018). The recommendation to include patient information is particularly relevant in light of data indicating that patient information is rarely presented in laparoscopic videos, and when it is present, it is mostly limited to the patient's gender and age (Celentano et al., 2017). The patient's emotional state before surgery is even less often presented as a key aspect in educational surgical videos, despite evidence that encoding and retrieval of information relies on learners' affective activation (Tyng et al., 2017).

Given that the effective educational value of surgical videos is strongly related to their quality (Ritter, 2018) and given our experience that a significant number of medical students view online surgical videos as an extracurricular activity, we investigated whether including information about a patient's emotional preparation for surgery would benefit student learning. Addressing this issue is not trivial: the emotional caring component of doctor-patient interactions is an intrinsic motivation for choosing a medical career (Kassler et al., 1991), and it remains robust among medical students

(Tsimtsiou et al., 2007). As the self-determination theory posits, individuals' intrinsic motivation and their personal psychological growth and wellbeing are facilitated by satisfying the primary psychological needs for autonomy, competence, and relatedness (Ryan and Deci, 2000). Thus, from this perspective, medical education might foster intrinsic motivation and internalization of self-regulated learning by supporting students' need for relatedness, which is expressed by the desire to care for patients and connect with others (Ten Cate et al., 2011).

Interest in fostering students' abilities to acknowledge and value patients' perspectives has been increasing (Levinson et al., 2010; Batt-Rawden et al., 2013), and the patient-centered approach has gained prominence in healthcare (Laine and Davidoff, 1996; Robinson and Berian, 2017). However, the potential role of emotionally salient patient information in enhancing or undermining learning and motivation during surgical videos is unknown. It is, thus, natural to wonder whether affectively engaging students by incorporating such information about the patients in surgical videos would facilitate learning and enhance motivation. From the perspective of the control-value theory of achievement emotions (Pekrun et al., 2007; Pekrun, 2006), learning material that encourages emotional engagement would likely affect performance. Considering that cognitive processes stem from and rely on the activation of emotions (Tyng et al., 2017; Artino et al., 2012; Immordino-Yang and Faeth, 2010; Pekrun et al., 2007; Panksepp, 1998), one possible hypothesis is that providing patient information could strengthen the educational value of surgical videos by activating the viewer's emotional engagement, thereby increasing their learning of the surgical procedure. On the other hand, an extraneous cognitive load may negatively affect learning by exceeding the learner's working memory capacity (Van Merriënboer and Sweller, 2010; Sweller et al., 1998). Providing patient information when learning a mere technical procedure could therefore be counterproductive because it could superfluously increase the extraneous cognitive load and interfere with the student's ability to focus on the specific technical details of the surgical procedure.

To address this question, we asked medical students to view video clips of surgeries; the videos were preceded by either the patient's information as presented in the original videos or the addition of further patient information. Previous studies have demonstrated that emotionally relevant information about patients affects physicians' diagnostic accuracy (Schmidt et al., 2017) as well as medical students' learning processes, and educational outcomes (Kremer et al., 2019). To our knowledge, however, no other studies have investigated the effects of patient information on students' learning and attitude in relation to educational surgical videos; therefore, our study adds to the medical education literature on this specific and timely subject.

In line with studies linking emotional engagement and learning (Ten Cate et al., 2011; Immordino-Yang and Faeth, 2010; Pekrun et al., 2007; Immordino-Yang and Damasio, 2007; Panksepp, 1998), we predicted that medical students who received information about the patient's emotional preparation for surgery would learn more details about the surgical techniques and would be more motivated to view the video again to improve their learning.

Methods

Participants and setting

Participants were 130 medical students (M = 20.45, SD = 2.59; 72 women, 58 men, all Caucasian) in their second year of the Medicine and Surgery Degree Program at the University of Bologna's School of Medicine in Italy. At the time of the study, all participants had attended the mandatory courses in anatomy, physiology, pathology, and histology. They had also completed an animal surgery laboratory course, but they were novices to human surgical techniques. Of the 130 students, 41 said they viewed online video surgeries such the ones used as stimuli at least once a week, and 76 said they were willing to follow a career in surgery.

All participants gave informed consent and were fully debriefed at the study's conclusion. The safety and appropriateness of the study procedure was evaluated and approved by the University of Bologna institutional review board (IRB).

Procedure

Prior to viewing the videos, the students were told that the aim of the study was to understand the extent to which presenting surgical videos might be useful in future curricula for second-year students.

In a within-subjects crossover design, all participants viewed a 5-min video clip from the "Minimally Invasive Mitral Valve Repair" video and a 5-min video clip from the "Robotic-Assisted Surgery: Lung Resection" video published on MedlinePlus (www.nlm.nih.gov/medlineplus/surgeryvideos.html) and provided by ORLive, which is certified as reliable and credible by the Health on the Net Foundation Code of Conduct (HONcode). Each video clip presented the initial part of the surgical procedure.

Transcripts of the videos are available in the supplementary material. As in the original videos, the patient's face or patient's whole body were never visible during the surgery. The operating staff appeared in the initial frames (about 5–10 s). Examples of the viewing angles for the surgeries are presented in the supplementary material.

The choice to present videos of lung and heart surgeries was guided by the fact that all students had attended the first-year anatomy course focused on the physiology of the cardiovascular and respiratory systems. The selected videos were validated as appropriate by an external committee that included a surgeon intern. The first 5 min of each video (original length of each video surgery: ~20 min) was either presented as it was originally uploaded to the online library (control condition) or preceded by additional written information about the patient (patient-information condition). This

vignette was created by the authors with the goal of activating students' emotional engagement via a connection to the patient's emotional state. Each participant watched two videos, one from each condition, and the order of presentation of the conditions was fully counterbalanced across participants

In the patient-centered condition, participants read the following text before viewing the video:

> Now you are going to see a 59-year-old patient undergoing the surgery. Before beginning, we want to give you some brief information about the patient. He is employed, married, and has two children. After carefully evaluating his clinical condition, we agreed that the surgery you are going to see was the best option for the patient. We talked with the patient and his relatives, and he understands the importance of this surgery. In the days before the surgery, he was worried and felt unsure. We discussed his concerns with him and provided detailed information about the postoperative period, and today, he faces this surgery with the hope that he will soon return to his regular life and loved activities. He gave consent to the video recording of this surgery in hopes that the video might be useful for future doctors who want to learn this procedure in order to help patients in similar clinical conditions.

No written commentaries were offered during the video presentation. The students were instructed to carefully watch each video and then answer a multiple-choice test regarding the content of the video. They were also asked to answer questions about their motivation to master the surgical procedure by viewing the video again and their attitude toward the video. These were followed by control questions about their engagement and the stimulus material.

Finally, participants were asked how often they viewed surgical videos such as the ones presented, indicating their answers on a Likert scale (1 = never, 2 = once a year; 3 = once a month; 4 = once a week; 5 = daily), and a dichotomous question on whether they were willing to pursue a career in surgery.

Learning, motivation, and attitude

After each video, students completed a multiple-choice test on the technical aspects of the observed technique (6 questions, each with 5 alternative answers, and with higher assessment scores indicating better learning; see S1 for the tests). The questions concerned information extrapolated from the video (6 questions per 5-min video, about 1 question for each minute of the video), and their content was evaluated by a surgeon intern of an external committee. The test was solely focused on the technical aspects of the procedure: for example, students answered questions about the kind of retractor the surgeon used, the direction of the incision, and the number of portals and trocars needed and their functions. Questions about the patient's experience were not included, in order to prevent a premature revealing of the study's objective and any possible related effects on learning and motivation outcomes.

After the multiple-choice test, the students estimated their motivation to watch the same video again. They were asked to rate the degree to which they felt the statement "I am eager to re-watch the video to master the technique" was true, using a 5-point Likert scale (1 = not at all to 5 = extremely).

Participants then responded to 7 questions regarding their attitude toward the video. The attitude scale was developed based on Fishbein and Ajzen's (1975) classic work. Thus, the measurements involved the use of bipolar evaluative adjectives (e.g., positive, negative), instrumental adjectives (e.g., useful, instructive), and experiential adjectives (e.g., pleasant, unpleasant). Specifically, students rated the degree to which they perceived the video as useful, pleasant, unpleasant, instructive, positive, negative, and tedious. For each question, participants responded using a 10-point Likert scale (1 = not at all to 10 = extremely). Responses were averaged to create an attitude measure (Cronbach's $\alpha = 0.78$).

Control questions

As a manipulation check that the vignette actually enhanced students' emotional engagement, the students estimated their engagement during the viewing by rating the degree to which they felt the statement "I could not take my eyes off the video" was true, using a 5-point Likert scale (from 1 = not at all to 5 = extremely). In addition, to exclude possible learning and motivation effects from former exposure to the same video, they were asked to answer a dichotomic question on whether they had ever watched the presented videos before.

Statistical Analysis

Learning, motivation, attitude, and engagement data were analyzed using an ANOVA with the condition (control versus patient-information) as a within-subjects factor. In a preliminary analysis, the order of condition was included as a factor in the statistical model. However, because the effect of this variable was not significant (all $p_s > .05$), it was not considered further. Because preliminary analysis indicated that none of the results was explained by the between-subjects factors "interest in surgical career" and "self-exposure to videos such as those presented" (all $p_s > .05$), these factors were not retained in the model.

Results

Learning

Compared to the control condition, the patient-information condition significantly increased students' assessment scores, $F(1,128) = 20.32$, $p < .0001$; $\eta_p^2 = 0.14$. As depicted in Figure 1, students in the patient-information condition correctly answered 4 out of the 6 questions, on

average, while in the control condition, the number of correct responses was lower (control: M =3.5, SD = 1.3; patient-information: M = 4.2, SD = 1.2).

Attitude and Motivation

Receiving patient information before watching a surgical video affected students' favorable attitudes toward the video, $F(1,128) = 5.85$, $p = .02$; $\eta_p^2 = 0.04$ (control: M = 7.80, SD = 1.56; patient-information: M = 8.11, SD = 1.52) and improved motivation to view the video again, $F(1,128) = 10.58$, $p < .001$; $\eta_p^2 = 0.08$ (control: M = 3.22, SD = 1.15; patient-information: M = 3.51, SD = 1.14).

Control measures

Of the 130 students, none had previously viewed the presented videos. As expected, emotionally salient information about the patients enhanced the degree of engagement during viewing, $F(1,128) = 5.71$, $p = .02$; $\eta_p^2 = 0.04$ (control: M = 3.6, SD = 1.10; patient-information: M = 3.90, SD = 1.21).

Discussion

In a time in which surgical videos are abundantly available online (Rapp et al., 2016; Tackett et al., 2018), it is critical to identify the aspects that make such videos suitable for educational purposes (Stefanidis et al., 2007; Celentano et al., 2018: Ritter, 2018). The present study investigated the extent to which affectively engaging students by including information about the patient's emotional state adds substantial educational value to surgical videos.

Our results show that preceding surgical videos with information about the patient's emotional preparation for surgery significantly increases students' learning of technical aspects of the surgery.

Adding information about the patient does not represent an excessive extraneous cognitive load during learning of a surgical procedure. Indeed, it facilitates learning. This result is in line with previous work indicating that providing information to activate a caregiving schema positively increases medical students' performance (Colonnello et al., 2019) and that having information about people aids the memory process (Mattarozzi et al., 2018). This result is consistent with theories highlighting the central role of emotions in learning process (Ryan and Deci, 2000; Ten Cate et al., 2011; Pekrun et al., 2007).

Our research also shows that providing emotionally salient patient information leads to significantly more favorable attitudes toward the surgical video (i.e., the source of learning) and increases students' motivation, as shown by the increased degree to which students perceived the video as valuable enough to be viewed again. These results are compelling for educational purposes because motivation is a key component of learning (Ten Cate et al., 2011) and the repeated viewing of surgical videos augments medical students' knowledge of surgical techniques (Guerlain et al., 2004; Pilieci et al., 2018). The present findings fit nicely with previous work indicating that contact with potential patients facilitates learning and fosters motivation in students (Spencer et al., 2000; Rickles et al., 2009), presumably by satisfying their primary need for relatedness (Ryan and Deci, 2000; Ten Cate et al., 2011). Of note, previous studies have demonstrated that experiencing positive emotions may enhance cognitive performances (Fredrickson, 2004) and that triggering negative emotions may reduce physicians' diagnostic accuracy (Schmidt et al., 2017) as well as medical students' educational outcomes (Kremer et al., 2019). Thus, it is possible to speculate that students' learning performance might have been influenced by an experimental manipulation-related increase of positive affect.

However, these findings are also tempered by several limitations. Specifically, the study does not address whether presenting information about patient's emotional experience may affect the mastering of perceptuomotor skills or whether it is limited to increasing students' conceptual

knowledge and motivation. In addition, the participants had limited knowledge about the surgical procedures, which limits the generalizability of the findings. Further, because learning assessment was based only on technical information provided in the video clip, the multiple-choice test was composed of a limited number of questions. Thus, these results should be confirmed by studies presenting longer videos and a complex assessment task. Moreover, the study does not explore the effects of repeated exposure to patient-related information on the learning curve over time. Thus, the present findings encourage further studies aimed at testing the extent to which including patient-related information might be effective in the long term.

Of note, for measures of engagement and motivation we did not obtain a large effect size. This is presumably due to the relatively neutral valence of the patient description. Because engagement, motivation, and attitude toward the learning material depend on the affective valence of the educational material (Ten Cate et al., 2011; Pekrun et al., 2007), as future studies might elucidate, larger effect sizes in attitude and motivation might be obtained by manipulating the valence of patient descriptions.

We found that a significant proportion of second-year students regularly watched surgical videos online even though doing so was not an academic requirement. Thus, a natural next step for this research would be to involve medical students in the first stages of developing guidelines for educational surgical videos. For example, they might be involved in focus groups to understand whether they would consider including additional information useful, such as clinical reports drawn from patient's responses to quality of life questionnaires and clinical interviews with psychologists. In addition, given that interactive learning through peer instruction enhances comprehension of physiological concepts (Versteeg et al., 2019), future studies may investigate whether a peer instruction design improves learning from educational surgical videos.

While our findings pave the way to further research, they may already have practical implications in themselves. Our findings contribute to enriching understandings of the relevance of sharing patient-

related emotionally salient information as a driving force for learning, attitude, and motivation. Specifically, they suggest that increasing students' awareness of patients' emotional preparation for surgery can be used as a way to leverage novice surgeons' motivation to learn surgical techniques. In addition, they indicate the importance of considering the affective dimension of learning when developing guidelines for the creation and release of medical educational videos.

Conclusion

Information on a patient's emotional state improves medical students' acquisition and recall of surgical procedures viewed in videos. Thus, patient-information is not an extraneous cognitive load that interferes with the learning of a surgical procedure. The availability of patient-related information for a surgical video also enhances medical students' favorable attitudes toward and motivations to re-watch that video.

Conflicts of Interest: None

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Contributors: VC and PMR designed the study and AA evaluated the video and question contents.VC, KM, AA, PMR wrote the manuscript. All authors approved the final manuscript for submission and have agreed to be accountable for the accuracy and integrity of the work.

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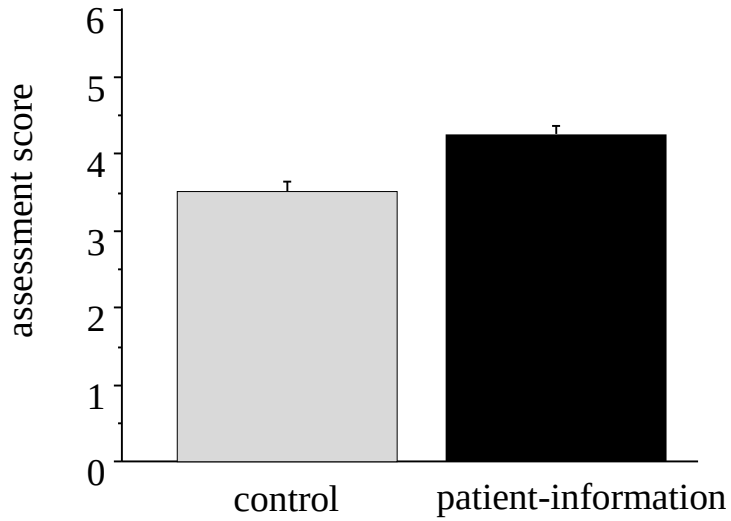
Caption

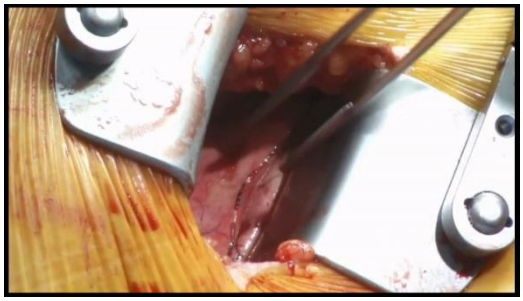
Figure 1. Mean and standard deviation for students' learning of technical aspects of the surgical procedure in the control and patient-information conditions.

Figure 1.



Supplementary Material.

Screenshots and transcript extracted from the video “Minimally Invasive Mitral Valve Repair” (http://nlm.bcst.md/videos/minimally-invasive-mitral-valve-repair?view=displayPageNLM)

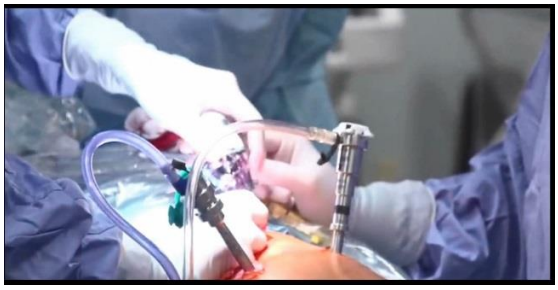


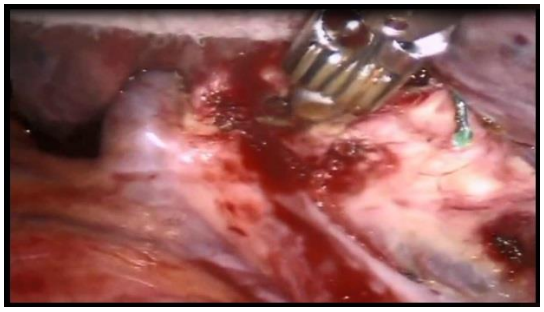
Transcript of the video surgery “Minimally Invasive Mitral Valve Repair” extracted from the website http://nlm.bcst.md/videos/minimally-invasive-mitral-valve-repair?view=displayPageNLM

In a case like this, where he doesn't need coronary surgery, we're able to do a minimally invasive incision on the side of his chest, not having to divide his sternum, spread his ribs, and do his operation that way. The whole key to doing this operation is getting in the right interspace the first time. So we spend a lot of time making sure that we're going to get in the right inner space between the ribs, where we'll have good access to the heart. OK. So we've got to make this incision down to the chest wall. Now, not everybody is a candidate for this operation. You've got to have the right

anatomy that's suitable for it. So now what I'm doing is I'm counting ribs to make sure that I go into the right interspace so that I'll have good visualization of the valve. All right, I think I've identified the correct interspace to go in. So, to be able to see to do this operation, we have to do what's called one lung ventilation. There we go. Yeah, I'm in the chest. This is the retractor we use to spread the ribs with, and it comes with various blades. We just have to pick out the right size blade for the body habitus of the particular patient we're working with. And you can see, there's the patient's right lung. This is his right lung right here. The heart is going to be deep to that. All right, so this is looking inside his chest. We have now deflated his right lung. The object you see beating in there, which is this right here, is the right atrium. This white ribbon right here is the phrenic nerve. And you have to be very careful to avoid damaging the phrenic nerve, because that controls his right hemidiaphragm. And he would not do well if that got damaged. So the next step we're going to do is we're going to open his pericardium, which is the tough sac that surrounds the heart, and start putting retraction sutures in. And that will actually bring the heart towards us. And it'll give us a better idea of what we're able to do. So there is the right atrium. Access to the left atrium is going to be right below that. And we have good-- . All right, so we're in the pericardium. [SUCTIONING]. And the pericardium is kind of a lubricating sac that carries a fluid that we have to get out of our way. But it keeps the heart lubricated as it beats. All right, let's see. Let's see if I can stick that through his mammary artery. [MACHINE BEEPING STEADILY]. All right, let me see a pair of pickups. So now we're just getting the heart positioned to where we want it to get this operation done. And it just requires a little bit of dissection here, a little dissection there, making sure that we can proceed safely with this approach. Of course, if I felt like that we could not proceed safely, then what I would do is just close this up, go to a sternotomy, and do it the traditional way. But I feel pretty confident that we have good visualization. So what we'll do now is go ahead.

Screenshots and transcript extracted from the video **“**Robotic-Assisted Surgery: Lung Resection” (https://www.broadcastmed.com/4919/videos/robotic-assisted-surgery-lung-resection?view=displayPageNLM).





Transcript of the video surgery “Robotic-Assisted Surgery: Lung Resection” extracted from https://www.broadcastmed.com/4919/videos/robotic-assisted-surgery-lung-resection?view=displayPageNLM

The patient is positioned on the side in the operating room, and small port sites, approximately eight millimeters, are created to allow for trocars, or tubes, to be inserted inside of the chest. These tubes will facilitate the placement of robotic instruments into the patient's chest to perform the operation. The placement is done bluntly to minimize trauma to the muscle structures, nerves, veins, and arteries. A camera is used to assist in the port placement. Four ports are typically placed for this operation, three of which are used by the robot. And one port is an accessory port, which is used by my assistant, who stands at the bedside. The robot is then moved into position and docked with the patient, meaning that the robotic arms are locked onto the port sites to ensure that they're stable and that instruments can be inserted in and out of the chest easily. The instruments are then loaded onto

the robotic arms, as is the camera, and all of them are advanced inside of the chest. Typically, a scrub nurse and an assistant are at the bedside. I sit in a console approximately 20 feet away from the operative field and control the robot remotely. The instrument arms move 360 degrees inside of the patient, and enable me to move exactly like I would if I were performing the operation with an open approach. This operation is started by incising the inferior pulmonary ligament, which will allow for mobilization of the lung, and also will allow the lung to expand properly and fill the entire chest cavity to compensate for the removed portion of the lung. As the dissection continues, from a posterior approach initially, the major structures are identified, including the bronchus, the veins, and lymph node structures. Lymph nodes are harvested as the dissection proceeds from an inferior to superior direction. This is resection of a level seven lymph node, which sits beneath the bifurcation of the air tubes. Lymph node staging is critical in the evaluation of a patient with cancer. To stage them properly so adequate treatment can be provided, the lymph nodes are then removed from the chest and sent to the pathology department for analysis. After the posterior portion of the operation is complete, it is then carried superiorly and anteriorly to expose more lymph nodes-- and, once again, to expose the critical structures of the right upper lobe, including the bronchus, which is the air tube, the vein, which drains blood from the right upper lobe, and the pulmonary arteries, which feed the right upper lobe with their needed blood supply. This is resection of a level four lymph node, which sits on top of the right upper lobe. This is a picture of the heart, the diaphragm, and the phrenic nerve, which innervates the diaphragm and powers it. There's a thin layer of tissue called the pleura which overlies the major structures that feed the lung. This area is referred to as the hilum of the lung. The structure that's becoming apparent, which is blue, is the superior pulmonary vein, which drains blood from the right upper lobe.

Questions to test medical students' acquisition of the observed techniques.

Following the video, "Minimally Invasive Mitral Valve Repair", participants completed the following multiple-choice test.

Complete the following statements, choosing the correct alternative from those proposed:

1. The first step to conduct the intervention is to . . .

a) enter the intercostal space and then count the ribs.

b) make an incision on the side of the chest.

c) count the ribs before deciding where to cut.

d) open the side of the chest up to the chest wall.

e) perform the sternotomy and spread the ribs to access the heart.

2. The intervention is described as suitable . . .

a) for all patients, regardless of the patient's morphological constitution.

b) for some patients based on the morphological constitution of the patient.

c) for some patients who need coronary surgery.

d) for many patients; it is nevertheless necessary to adapt the intervention to suit the morphological constitution of the patient.

e) only for some patients, and only after monopulmonary ventilation.

3. The distension of the ribs takes place . . .

a) by monopulmonary ventilation.

b) by means of a single-blade retractor.

c) following the insertion of a trocar with different blades.

d) by means of a retractor with several blades.

e) before inserting a retractor with several blades.

4. Retractable sutures . . .

a) are inserted to make the heart visible.

b) are inserted to stretch the ribs.

c) are inserted before opening the pericardium.

d) are inserted to avoid touching the mammary artery.

e) are inserted to avoid accessing the right atrium.

5. In the video the phrenic nerve is visible . . .

a) after opening the pericardium.

b) above the right atrium.

c) under the right atrium.

d) following the sternotomy.

e) above the right lung.

6. Once the pericardium is reached, it is necessary to . . .

a) ensure that the lubricating fluid of the pericardium keeps the heart lubricated.

b) eliminate the pericardial fluid before passing the heart through the mammary artery.

c) preserve the fluid produced by the structures surrounding the mammary artery.

d) eliminate the lubricating fluid, but only after passing the heart through the mammary artery.

e) ensure that the lubricating fluid flows to the right atrium.

Following the video, “Robotic-Assisted Surgery: Lung Resection”, participants completed the following multiple-choice test.

Complete the following statements, choosing the correct alternative from those proposed:

1. At the beginning of the operation, the ports entered are . . .

a) large (8 millimeters) and are inserted after the trocars or tubes.

b) a few millimeters large and are used to mark the affected area.

c) large (8 millimeters) and serve to avoid inserting trocars and tubes.

d) large (a few millimeters) and serve to avoid opening the pericardium.

e) about 8 millimeters large and used to insert trocars and tubes.

2. Port placement is performed . . .

a) decisively to minimize trauma to the muscular structures.

b) accurately after the robotic arms are locked on the attachment sites.

c) slowly and gradually to minimize trauma to muscle structures.

d) decisively following the incision of the lung ligament.

e) through robotic arms anchored to the patient.

3. During the operation, the surgeon positioned . . .

a) 3 ports, one of which is an accessory for the robot.

b) 4 ports, one of which is an accessory for the assistant.

c) 4 ports, following the insertion of a camera in the chest.

d) 4 ports, one of which is an accessory for the robot.

e) ports equipped with a video camera.

4. At the beginning of the intervention, an incision was made to . . .

a) the inferior pulmonary ligament to limit the movement and expansion of the lung.

b) ligaments of the bifurcation of the bronchi.

c) the posterior pulmonary ligament to make more lymph nodes visible.

d) the lower pulmonary ligament to allow the mobilization of the lung.

e) all the pulmonary ligaments to allow the mobilization and expansion of the lungs.

5. The transaction proceeds in a specific direction, that is . . .

a) posterior-superior-anterior.

b) front-superior-posterior.

c) posterior-anterior, but only when the critical structures of the right upper lobe are visible.

d) following the vein that drains the blood from the right upper lobe and the pulmonary arteries.

e) superior-anterior up to highlight the pulmonary arteries and the thin layer of tissue called pleura.

6. During surgery, resection of the lymph nodes is seen . . .

a) in both level seven and level four before the incision of the lower pulmonary ligament.

b) in all except those of level seven and level four.

c) in both level seven and level four after the incision of the lower pulmonary ligament.

d) in all those present in the concerned area.

e) in those of level seven, five, and four.

Professor Geoffrey Norman,
McMaster University,
Hamilton, Canada
Editor-in-Chief
Advances in Health Sciences Education

Dear Professor Norman,

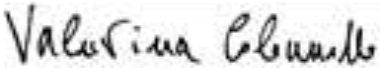
We are pleased to submit our revised manuscript entitled **Emotionally salient patient information enhances the educational value of surgical videos** (AHSE-D-19-00509R2) for consideration as an *Advances in Health Sciences Education* original research paper.

The present version of the manuscript has been revised according to the additional comments provided. We are grateful for the constructive suggestions.

We believe that these revisions have improved the paper significantly and we hope that it now meets the quality standards for publication in *Advances in Health Sciences Education*.

We thank you for your time and consideration and we look forward to hearing from you.

Sincerely,



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December 18, 2019

Comments

Comment 1. Thank you for nicely addressing the suggestions of the reviewers. The revised version of the manuscript is much stronger, with the addition of new theoretical framework.

While the authors have added the references suggested by the EIC in the literature review, this was not revisited in the discussion. The paper would be further strengthened by situating the results of the current within the context of those two studies. Why do you think, based on what we know about emotions, motivation and cognitive skills, that learners in this study did better whereas those in the Kramer and Schmidt studies did worse? Is it because different emotions were triggered?....because the tasks we different?...the relationship between the emotional information and the task was different?

Response 1. We are pleased the associate editor found our revised manuscript stronger.

We are grateful for the additional constructive suggestion. We have now expanded the discussion section.

Given that previous studies have demonstrated that experiencing positive emotions may enhance cognitive performances (Fredrickson, 2004) and that triggering negative emotions may reduce physicians' diagnostic accuracy (Schmidt et al., 2017) as well as medical students' educational outcomes (Kremer et al., 2019), we could speculate that students' learning performance might have been influenced by an experimental manipulation-related increase of positive affect.

Comment 2. I have one comment/question. On page 10, in the first two lines, might the numbers have been inverted? AS currently written, the numbers suggest that the control group had more correct answers "(M=4.2)" than the patient-information group "(M=3.5)". Can the authors clarify this?

Response 2. Thank you for the careful reading. We have now corrected the typo.

Emotionally salient patient information enhances the educational value of surgical videos

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Running head: AFFECTIVE ENGAGEMENT IN LEARNING

Abstract

Medical students' motivations for choosing a medical career are likely based on and remain tethered to the affectively-laden caring component of doctor-patient interactions. However, this component is rarely presented in educational surgical videos. It is unknown whether affectively engaging students by including patient-related emotionally salient information potentiates or draws focus away from learning a surgical procedure and whether such information affects motivation and attitudes toward the video. Therefore, we investigate whether presenting a patient's emotional state before video surgery enhances or weakens the educational value of that video. In a within-subjects crossover design, second-year medical students (n = 130) viewed video clips of surgeries. These videos, from online medical education platforms, were preceded by the patient's information from the original video or by information about the patient's preoperative emotional preparation. After each video, participants completed a multiple-choice test about the video's content to measure learning, answered a question about their motivation to re-watch the video, and completed an attitude scale regarding the video. Incorporating patient's information into surgical videos significantly enhanced students' acquisition of the technical aspects of surgery procedures ($p <$ .0001), motivation to re-watch the video ($p < .001$), and favorable attitudes toward the video ($p =$ .02). These findings show that incorporating information about patients' emotional states may enhance students' positive attitudes and motivations toward educational videos and may improve their learning of surgical techniques. They also suggest that the role of this factor should be considered when developing guidelines for medical educational video release.

Key words: medical education; medical students; patient information; emotionally salient information; video surgery.

Introduction

Medical education is making impressive moves toward increasing the availability of educational materials and platforms to facilitate learning (Myers et al., 2018). The ongoing and widespread availability of online surgical videos and tutorials represents a remarkable example of this trend. In response to the plethora and heterogeneity of readily accessible medical videos (Sade, 2008; Rapp et al., 2016; Tackett et al., 2018), guidelines for video recording and release are needed to ensure high quality standards from both ethical and educational perspectives (Prigoff et al,, 2016; Celentano et al., 2018; Ritter, 2018; Stefanidis et al., 2007).

In the area of surgery, notable steps forward are being taken thanks to a taskforce of multispecialty trainers who have developed guidelines for educational videos (Celentano et al., 2018). These guidelines emphasize that in addition to ensuring the quality of the video and the demonstration of surgical procedures, attention should be given to presenting information about the patient, such as clinical information and the patient's consent to surgery (Celentano et al., 2018). The recommendation to include patient information is particularly relevant in light of data indicating that patient information is rarely presented in laparoscopic videos, and when it is present, it is mostly limited to the patient's gender and age (Celentano et al., 2017). The patient's emotional state before surgery is even less often presented as a key aspect in educational surgical videos, despite evidence that encoding and retrieval of information relies on learners' affective activation (Tyng et al., 2017).

Given that the effective educational value of surgical videos is strongly related to their quality (Ritter, 2018) and given our experience that a significant number of medical students view online surgical videos as an extracurricular activity, we investigated whether including information about a patient's emotional preparation for surgery would benefit student learning. Addressing this issue is not trivial: the emotional caring component of doctor-patient interactions is an intrinsic motivation for choosing a medical career (Kassler et al., 1991), and it remains robust among medical students

(Tsimtsiou et al., 2007). As the self-determination theory posits, individuals' intrinsic motivation and their personal psychological growth and wellbeing are facilitated by satisfying the primary psychological needs for autonomy, competence, and relatedness (Ryan and Deci, 2000). Thus, from this perspective, medical education might foster intrinsic motivation and internalization of self-regulated learning by supporting students' need for relatedness, which is expressed by the desire to care for patients and connect with others (Ten Cate et al., 2011).

Interest in fostering students' abilities to acknowledge and value patients' perspectives has been increasing (Levinson et al., 2010; Batt-Rawden et al., 2013), and the patient-centered approach has gained prominence in healthcare (Laine and Davidoff, 1996; Robinson and Berian, 2017). However, the potential role of emotionally salient patient information in enhancing or undermining learning and motivation during surgical videos is unknown. It is, thus, natural to wonder whether affectively engaging students by incorporating such information about the patients in surgical videos would facilitate learning and enhance motivation. From the perspective of the control-value theory of achievement emotions (Pekrun et al., 2007; Pekrun, 2006), learning material that encourages emotional engagement would likely affect performance. Considering that cognitive processes stem from and rely on the activation of emotions (Tyng et al., 2017; Artino et al., 2012; Immordino-Yang and Faeth, 2010; Pekrun et al., 2007; Panksepp, 1998), one possible hypothesis is that providing patient information could strengthen the educational value of surgical videos by activating the viewer's emotional engagement, thereby increasing their learning of the surgical procedure. On the other hand, an extraneous cognitive load may negatively affect learning by exceeding the learner's working memory capacity (Van Merriënboer and Sweller, 2010; Sweller et al., 1998). Providing patient information when learning a mere technical procedure could therefore be counterproductive because it could superfluously increase the extraneous cognitive load and interfere with the student's ability to focus on the specific technical details of the surgical procedure.

To address this question, we asked medical students to view video clips of surgeries; the videos were preceded by either the patient's information as presented in the original videos or the addition of further patient information. Previous studies have demonstrated that emotionally relevant information about patients affects physicians' diagnostic accuracy (Schmidt et al., 2017) as well as medical students' learning processes, and educational outcomes (Kremer et al., 2019). To our knowledge, however, no other studies have investigated the effects of patient information on students' learning and attitude in relation to educational surgical videos; therefore, our study adds to the medical education literature on this specific and timely subject.

In line with studies linking emotional engagement and learning (Ten Cate et al., 2011; Immordino-Yang and Faeth, 2010; Pekrun et al., 2007; Immordino-Yang and Damasio, 2007; Panksepp, 1998), we predicted that medical students who received information about the patient's emotional preparation for surgery would learn more details about the surgical techniques and would be more motivated to view the video again to improve their learning.

Methods

Participants and setting

Participants were 130 medical students (M = 20.45, SD = 2.59; 72 women, 58 men, all Caucasian) in their second year of the Medicine and Surgery Degree Program at the University of Bologna's School of Medicine in Italy. At the time of the study, all participants had attended the mandatory courses in anatomy, physiology, pathology, and histology. They had also completed an animal surgery laboratory course, but they were novices to human surgical techniques. Of the 130 students,

41 said they viewed online video surgeries such the ones used as stimuli at least once a week, and 76 said they were willing to follow a career in surgery.

All participants gave informed consent and were fully debriefed at the study's conclusion. The safety and appropriateness of the study procedure was evaluated and approved by the University of Bologna institutional review board (IRB).

Procedure

Prior to viewing the videos, the students were told that the aim of the study was to understand the extent to which presenting surgical videos might be useful in future curricula for second-year students.

In a within-subjects crossover design, all participants viewed a 5-min video clip from the "Minimally Invasive Mitral Valve Repair" video and a 5-min video clip from the "Robotic-Assisted Surgery: Lung Resection" video published on MedlinePlus (www.nlm.nih.gov/medlineplus/surgeryvideos.html) and provided by ORLive, which is certified as reliable and credible by the Health on the Net Foundation Code of Conduct (HONcode). Each video clip presented the initial part of the surgical procedure.

Transcripts of the videos are available in the supplementary material. As in the original videos, the patient's face or patient's whole body were never visible during the surgery. The operating staff appeared in the initial frames (about 5–10 s). Examples of the viewing angles for the surgeries are presented in the supplementary material.

The choice to present videos of lung and heart surgeries was guided by the fact that all students had attended the first-year anatomy course focused on the physiology of the cardiovascular and respiratory systems. The selected videos were validated as appropriate by an external committee that included a surgeon intern. The first 5 min of each video (original length of each video surgery:

~20 min) was either presented as it was originally uploaded to the online library (control condition) or preceded by additional written information about the patient (patient-information condition). This vignette was created by the authors with the goal of activating students' emotional engagement via a connection to the patient's emotional state. Each participant watched two videos, one from each condition, and the order of presentation of the conditions was fully counterbalanced across participants

In the patient-centered condition, participants read the following text before viewing the video:

> Now you are going to see a 59-year-old patient undergoing the surgery. Before beginning, we want to give you some brief information about the patient. He is employed, married, and has two children. After carefully evaluating his clinical condition, we agreed that the surgery you are going to see was the best option for the patient. We talked with the patient and his relatives, and he understands the importance of this surgery. In the days before the surgery, he was worried and felt unsure. We discussed his concerns with him and provided detailed information about the postoperative period, and today, he faces this surgery with the hope that he will soon return to his regular life and loved activities. He gave consent to the video recording of this surgery in hopes that the video might be useful for future doctors who want to learn this procedure in order to help patients in similar clinical conditions.

No written commentaries were offered during the video presentation. The students were instructed to carefully watch each video and then answer a multiple-choice test regarding the content of the video. They were also asked to answer questions about their motivation to master the surgical procedure by viewing the video again and their attitude toward the video. These were followed by control questions about their engagement and the stimulus material.

Finally, participants were asked how often they viewed surgical videos such as the ones presented, indicating their answers on a Likert scale (1 = never, 2 = once a year; 3 = once a month; 4 = once a

week; 5 = daily), and a dichotomous question on whether they were willing to pursue a career in surgery.

Learning, motivation, and attitude

After each video, students completed a multiple-choice test on the technical aspects of the observed technique (6 questions, each with 5 alternative answers, and with higher assessment scores indicating better learning; see S1 for the tests). The questions concerned information extrapolated from the video (6 questions per 5-min video, about 1 question for each minute of the video), and their content was evaluated by a surgeon intern of an external committee. The test was solely focused on the technical aspects of the procedure: for example, students answered questions about the kind of retractor the surgeon used, the direction of the incision, and the number of portals and trocars needed and their functions. Questions about the patient's experience were not included, in order to prevent a premature revealing of the study's objective and any possible related effects on learning and motivation outcomes.

After the multiple-choice test, the students estimated their motivation to watch the same video again. They were asked to rate the degree to which they felt the statement "I am eager to re-watch the video to master the technique" was true, using a 5-point Likert scale (1 = not at all to 5 = extremely).

Participants then responded to 7 questions regarding their attitude toward the video. The attitude scale was developed based on Fishbein and Ajzen's (1975) classic work. Thus, the measurements involved the use of bipolar evaluative adjectives (e.g., positive, negative), instrumental adjectives (e.g., useful, instructive), and experiential adjectives (e.g., pleasant, unpleasant). Specifically, students rated the degree to which they perceived the video as useful, pleasant, unpleasant, instructive, positive, negative, and tedious. For each question, participants responded using a 10-

point Likert scale (1 = not at all to 10 = extremely). Responses were averaged to create an attitude measure (Cronbach's $\alpha = 0.78$).

Control questions

As a manipulation check that the vignette actually enhanced students' emotional engagement, the students estimated their engagement during the viewing by rating the degree to which they felt the statement "I could not take my eyes off the video" was true, using a 5-point Likert scale (from 1 = not at all to 5 = extremely). In addition, to exclude possible learning and motivation effects from former exposure to the same video, they were asked to answer a dichotomic question on whether they had ever watched the presented videos before.

Statistical Analysis

Learning, motivation, attitude, and engagement data were analyzed using an ANOVA with the condition (control versus patient-information) as a within-subjects factor. In a preliminary analysis, the order of condition was included as a factor in the statistical model. However, because the effect of this variable was not significant (all $p_s > .05$), it was not considered further. Because preliminary analysis indicated that none of the results was explained by the between-subjects factors "interest in surgical career" and "self-exposure to videos such as those presented" (all $p_s > .05$), these factors were not retained in the model.

Results

Learning

Compared to the control condition, the patient-information condition significantly increased students' assessment scores, $F(1,128) = 20.32$, $p < .0001$; $\eta_p^2 = 0.14$. As depicted in Figure 1, students in the patient-information condition correctly answered 4 out of the 6 questions, on average, while in the control condition, the number of correct responses was lower (control: $M =$ ~~4.2, $SD = 1.2$~~3.5, $SD = 1.3$; patient-information: $M =$ 4.2, $SD = 1.2$~~3.5, $SD = 1.3$~~).

Attitude and Motivation

Receiving patient information before watching a surgical video affected students' favorable attitudes toward the video, $F(1,128) = 5.85$, $p = .02$; $\eta_p^2 = 0.04$ (control: $M = 7.80$, $SD = 1.56$; patient-information: $M = 8.11$, $SD = 1.52$) and improved motivation to view the video again, $F(1,128) = 10.58$, $p < .001$; $\eta_p^2 = 0.08$ (control: $M = 3.22$, $SD = 1.15$; patient-information: $M = 3.51$, $SD = 1.14$).

Control measures

Of the 130 students, none had previously viewed the presented videos. As expected, emotionally salient information about the patients enhanced the degree of engagement during viewing, $F(1,128) = 5.71$, $p = .02$; $\eta_p^2 = 0.04$ (control: $M = 3.6$, $SD = 1.10$; patient-information: $M = 3.90$, $SD = 1.21$).

Discussion

In a time in which surgical videos are abundantly available online (Rapp et al., 2016; Tackett et al., 2018), it is critical to identify the aspects that make such videos suitable for educational purposes (Stefanidis et al., 2007; Celentano et al., 2018: Ritter, 2018). The present study investigated the

extent to which affectively engaging students by including information about the patient's emotional state adds substantial educational value to surgical videos.

Our results show that preceding surgical videos with information about the patient's emotional preparation for surgery significantly increases students' learning of technical aspects of the surgery. Adding information about the patient does not represent an excessive extraneous cognitive load during learning of a surgical procedure. Indeed, it facilitates learning. This result is in line with previous work indicating that providing information to activate a caregiving schema positively increases medical students' performance (Colonnello et al., 2019) and that having information about people aids the memory process (Mattarozzi et al., 2018). This result is consistent with theories highlighting the central role of emotions in learning process (Ryan and Deci, 2000; Ten Cate et al., 2011; Pekrun et al., 2007).

Our research also shows that providing emotionally salient patient information leads to significantly more favorable attitudes toward the surgical video (i.e., the source of learning) and increases students' motivation, as shown by the increased degree to which students perceived the video as valuable enough to be viewed again. These results are compelling for educational purposes because motivation is a key component of learning (Ten Cate et al., 2011) and the repeated viewing of surgical videos augments medical students' knowledge of surgical techniques (Guerlain et al., 2004; Pilieci et al., 2018). The present findings fit nicely with previous work indicating that contact with potential patients facilitates learning and fosters motivation in students (Spencer et al., 2000; Rickles et al., 2009), presumably by satisfying their primary need for relatedness (Ryan and Deci, 2000; Ten Cate et al., 2011). Of note, previous studies have demonstrated that experiencing positive emotions may enhance cognitive performances (Fredrickson, 2004) and that triggering negative emotions may reduce physicians' diagnostic accuracy (Schmidt et al., 2017) as well as medical students' educational outcomes (Kremer et al., 2019). Thus, it is possible to speculate that students'

learning performance might have been influenced by an experimental manipulation-related increase of positive affect.

However, these findings are also tempered by several limitations. Specifically, the study does not address whether presenting information about patient's emotional experience may affect the mastering of perceptuomotor skills or whether it is limited to increasing students' conceptual knowledge and motivation. In addition, the participants had limited knowledge about the surgical procedures, which limits the generalizability of the findings. Further, because learning assessment was based only on technical information provided in the video clip, the multiple-choice test was composed of a limited number of questions. Thus, these results should be confirmed by studies presenting longer videos and a complex assessment task. Moreover, the study does not explore the effects of repeated exposure to patient-related information on the learning curve over time. Thus, the present findings encourage further studies aimed at testing the extent to which including patient-related information might be effective in the long term.

Of note, for measures of engagement and motivation we did not obtain a large effect size. This is presumably due to the relatively neutral valence of the patient description. Because engagement, motivation, and attitude toward the learning material depend on the affective valence of the educational material (Ten Cate et al., 2011; Pekrun et al., 2007), as future studies might elucidate, larger effect sizes in attitude and motivation might be obtained by manipulating the valence of patient descriptions.

We found that a significant proportion of second-year students regularly watched surgical videos online even though doing so was not an academic requirement. Thus, a natural next step for this research would be to involve medical students in the first stages of developing guidelines for educational surgical videos. For example, they might be involved in focus groups to understand whether they would consider including additional information useful, such as clinical reports drawn

from patient's responses to quality of life questionnaires and clinical interviews with psychologists. In addition, given that interactive learning through peer instruction enhances comprehension of physiological concepts (Versteeg et al., 2019), future studies may investigate whether a peer instruction design improves learning from educational surgical videos.

While our findings pave the way to further research, they may already have practical implications in themselves. Our findings contribute to enriching understandings of the relevance of sharing patient-related emotionally salient information as a driving force for learning, attitude, and motivation. Specifically, they suggest that increasing students' awareness of patients' emotional preparation for surgery can be used as a way to leverage novice surgeons' motivation to learn surgical techniques. In addition, they indicate the importance of considering the affective dimension of learning when developing guidelines for the creation and release of medical educational videos.

Conclusion

Information on a patient's emotional state improves medical students' acquisition and recall of surgical procedures viewed in videos. Thus, patient-information is not an extraneous cognitive load that interferes with the learning of a surgical procedure. The availability of patient-related information for a surgical video also enhances medical students' favorable attitudes toward and motivations to re-watch that video.

Conflicts of Interest: None

Source of Funding: This work was supported by University of Bologna RFO funds.

Contributors: VC and PMR designed the study and AA evaluated the video and question contents.VC, KM, AA, PMR wrote the manuscript. All authors approved the final manuscript for submission and have agreed to be accountable for the accuracy and integrity of the work.

Acknowledgments – We are grateful to the medical students who kindly participated in the study and to Dr. Matteo Serenari for external review of video material and questions and to Giovanni Tuozzi and Michele Marzocchi for their valuable help for the preparation of the stimuli.

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Caption

Figure 1. Mean and standard deviation for students' learning of technical aspects of the surgical procedure in the control and patient-information conditions.