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"Surgery interrupted": The effect of multitasking on cognitive and technical tasks in medical students

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ABSTRACT

Introduction: Today's medical learners are Millennials, and reportedly, multitasking pros. We aim to evaluate effect of multitasking on cognitive and technical skills.
Materials and methods: 16 medical students completed a mock page and laceration closure separately on day 1 and day 13, and in parallel on day 14. Suturing was graded using GRS and mock pages scored. Total time, suturing and loading times, and percent correct on mock page were compared.
Results: Percent correct on mock page improved from days 1–13 and 14 ($p < 0.01$ and 0.04). GRS improved from days 1–13 and 14 ($p = 0.04$ and <0.01). Total time suturing was similar on all days. However, time suturing during the mock page on day 14 was prolonged compared to before mock page ($p = 0.01$).
Conclusions: Medical students can complete cognitive and technical tasks in parallel, without compromising acceptability. However, multitasking results in longer times to complete the complex component of the technical task.

1. Introduction

In the current age of technology, distractions are unavoidable-making multitasking a real skill for medical students, residents and attending physicians to master. It is important for surgeons to focus their attention on the technical task at hand, whether in the clinic or emergency room doing a procedure or during surgery in the operating room. However, surgeons are often asked to perform a cognitive task, such as answering a page, requesting additional instruments or calling for the patient for the next case, while completing a technical task. During an operative case, surgeons are interrupted an average of 1.04 time per minute, including all events like door opening, equipment requests, pages, phone calls and requests from external staff.[1] Medical students, residents and attending physicians need to multitask well, in order to avoid any potential negative effects of the distractions on their ability to perform either task.

One of the early challenges of being a multitasking physician is learning to manage the pager. Interns may receive, on average, greater than 50 pages during one on-call shift.[2] Training senior medical students to better handle pages may assist lessen the cognitive burden. Frischknecht et al. showed that a mock page curriculum consisting of 14 simulated pages for senior medical students improved performance on clinical decision making, communication and clinical care.[3] However, few studies have evaluated medical students' or residents' ability to answer pages while performing other tasks, or how well they multitask.

Answering pages while working on the hospital floor requires one to complete more than one cognitive task in parallel. The stakes are raised in the operating room, where the technical task of an operation is often interrupted by the cognitive task of a page or nurse's question. What effect does multitasking have on cognitive and technical skills in medical students in an OR-like environment when completing an operative technical task (suturing) in parallel with a patient-related cognitive task (answering a "mock page")? We hypothesize that performance on the technical task will deteriorate when completed in parallel with a cognitive task.

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2. Materials and methods

This study was approved by the Biomedical Institutional Review Board at the University of Nebraska Medical Center. Participation in the survey was voluntary and without compensation. Participants included 16 fourth year medical students enrolled in surgical "boot camp" at the end of their 4th year at the University of Nebraska Medical Center during April 2015.

2.1. The technical task

A 5 cm full thickness skin laceration was created on the back or posterior thigh of a cadaver in the skills lab using a scalpel. The students were instructed to close the laceration under routine conditions (3-0 suture, interrupted sutures, 5 mm apart, 3 throws per knot). All suturing was videoed for later analysis. Each student sutured a laceration on day 1 (baseline), day 13 (control) and day 14 (test). Surgical faculty were present in the cadaver lab on days 1–13 to provide instruction and feedback on suturing (intervention). On day 14, the "mock page" (cognitive task) took place while suturing, specifically, after the medical student placed the second suture. The students were not notified in advance that the "mock page" would occur during suturing on day 14. Suturing was graded by a single evaluator (ES) using a Global Rating Scale (GRS)- a previously validated instrument described by Hopmans et al.[4] GRS tool used in this study consisted of 5 domains: respect for tissue, time and motion, knowledge and handling of instruments, wound closure and flow of operation. Each domain was graded on a Likert scale of 1 (incompetent) to 7 (proficient), with a score range of 0–35. At the end of suturing, each student was asked to rate their performance on a scale of 1 (incompetent) to 7 (proficient). A single evaluator (ES) also scored the overall suturing task on a scale of 1 (incompetent) to 7 (proficient). Additional data was also obtained from the videos of suturing, including: total number of sutures placed, total number of skin retractions with the instrument, total time spent during technical task on day 1 and 13 (suturing and loading), total time spent suturing, total time spent loading, total time spent during 1st two sutures pre-mock page on day 14 (suturing and loading), and total time spent during the next two sutures during mock page on day 14 (suturing and loading), and total time spent suturing and total time spent loading pre-mock page and during mock page.

2.2. The cognitive task

3 mock pages were created: hyperkalemia, low urine output, chest pain in a post-operative patient. The mock pages included a nurse's script, basic information including vital signs, and a grading grid. The mock pages were created, performed and graded by a single evaluator (CE). Answers to each mock page were graded according to the student's verbal orders based on a 5 point scale: "Must Do" (+2 points), "Should Do" (+1 point), "Could Do" (0 points), "Should Not Do" (−1 point), and "Must Not Do" (−2 points). Scores ranged from −16 to +20. Students completed a mock page on day 1 (baseline), day 13 (control) and day 14 (test). Again, on days 1 and 13, the cognitive and technical tasks were completed at separate times. On day 10, all participants were given a 2 h lecture on "common intern pages" (intervention) - which included the 3 mock pages, along with the correct answers for the mock pages, included in this study. On day 14, the students were informed that a page would occur, but were not told it would occur during the technical task.

2.3. The statistical analysis

PC SAS version 9.4 is used for all summaries and analyses. The statistical level of significance is set at 0.05 for all analyses. Paired t-tests were used to compare mean suturing variables (total number sutures placed, total number skin retractions, total number knots thrown, self quality scores, and author quality scores), mean percent correct on the mock pages (cognitive task), mean GRS score on technical task, and total time (suturing and loading) spent on technical task between day 13 vs day 1, day 14 vs day 1, and day 14 vs day 13. On day 14, paired t-tests were used to compare total time spent suturing, loading, and total time spent on technical task during the 2 sutures pre-page and the 2 sutures during mock page.

3. Results

Sixteen subjects were included in the analysis, 3 other subjects were excluded for failure to complete all tasks. Of the 16 participants, the following is the number entering each of the following fields: 6 entering General Surgery, 2 entering Orthopedics, 2 entering Neurosurgery, 2 entering Radiology, 1 entering Vascular Surgery, 1 entering Urology, 1 entering Plastic Surgery, and 1 entering Family Medicine.

The task variables for the "mock page" and suturing for baseline, control and test days are presented in Table 1. On the "mock page", students' mean percent correct improved from days 1–13 (42.9% vs 57.1%, $p < 0.01$), days 1–14 (42.9% vs 58.6%, $p = 0.04$), and were similar on days 13 and 14 ($p = 0.82$). The mean total number of sutures placed increased from days 1–13 to 14 (6.2 vs 7.3 and 7.6, $p = 0.04$ and 0.01), with no statistical significance between day 13 (control) and day 14 (test) ($p = 0.45$). The mean number of skin retractions with the instrument (18.8 vs 19.8 and 20.6, $p = 0.56$ and 0.32) and number of knots thrown (18 vs 22.9 and 23.8, p=<0.01 and 0.01) also increased from days 1–13 and 14, with no statistically significance between day 13 (control) and day 14 (test) ($p = 0.62$ and 0.54, respectively). Mean GRS improved from days 1–13 (13.6 vs 15.6) and 14 (13.6 vs 16.4) ($p = 0.04$ and $p < 0.01$ respectively), with no significant difference between days 13 and 14 ($p = 0.19$).

The suturing variables pre page and during "mock page" are shown in Table 2. Total time to complete technical task (suturing and loading) was similar on days 1 and 13 (377.9 s vs 409.1 s, $p = 0.32$), days 1 and 14 (377.9 s vs 419.5 s, $p = 0.18$) and days 13 and 14 (409.1 s vs 419.5 s, $p = 0.69$). On day 14, when comparing total time spent (suturing and loading) on the 2 sutures before the mock page and the 2 sutures during the mock page, students spent more total time on the technical task during the mock page (total time spent pre-page: 119.4 s vs during page: 134.3, p=<0.01).

After evaluating how that time was spent, students spent more time suturing during the mock page (total time spent suturing pre-page: 89.38 s vs during page: 104.4, p=<0.01). The time spent loading pre-page and during page was not statistically significant (see Fig. 1).

4. Conclusions

The average age of today's medical student is 24 years old,[5] placing most of today's medical learners in the Millennial Generation. The Millennial Generation, or Generation Y, is comprised of individuals born from 1982 to 2004.[6,7] The characteristics of the Millennial learner include: self-inventive, rewrites rules, irrelevance of institutions, digital natives, accustomed to smart phones and the internet, assumes technology, assimilative learner, and multitasks fast.[8]

As digital natives, millennial learners grew up with multimedia-