Prevalence of Potentially Distracting Noncare Activities and Their Effects on Vigilance, Workload, and Nonroutine Events during Anesthesia Care

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ABSTRACT

Background: When workload is low, anesthesia providers may perform non–patient care activities of a clinical, educational, or personal nature. Data are limited on the incidence or impact of distractions on actual care. We examined the prevalence of self-initiated nonclinical distractions and their effects on anesthesia workload, vigilance, and the occurrence of nonroutine events.

Methods: In 319 qualifying cases in an academic medical center using a Web-based electronic medical chart, a trained observer recorded video and performed behavioral task analysis. Participant workload and response to a vigilance (alarm) light were randomly measured. Postoperatively, participants were interviewed to elicit possible nonroutine events. Two anesthesiologists reviewed each event to evaluate their association with distractions.

Results: At least one self-initiated distraction was observed in 171 cases (54%), largely during maintenance. Distractions accounted for 2% of case time and lasted 2.3 s (median). The most common distraction was personal internet use. Distractions were more common in longer cases but were not affected by case type or American Society of Anesthesiologists physical status. Workload ratings were significantly lower during distraction-containing case periods and vigilance latencies were significantly longer in cases without any distractions. Three distractions were temporally associated with, but did not cause, events.

Conclusions: Both nurse anesthetists and residents performed potentially distracting tasks of a personal and/or educational nature in a majority of cases. Self-initiated distractions were rarely associated with events. This study suggests that anesthesia professionals using sound judgment can self-manage nonclinical activities. Future efforts should focus on eliminating more cognitively absorbing and less escapable distractions, as well as training in distraction management. **(Anesthesiology 2018; 128:44-54)**

DURING low workload periods, some clinicians may engage in activities not related to patient care (*e.g.*, social conversations, reading personal email, *etc.*), which may be potentially distracting. Anesthesia professionals can experience prolonged periods of time during the maintenance phase of routine clinical cases that are relatively uneventful, characterized largely by the monitoring of a stable patient. Early task analysis studies found that, during routine maintenance periods, the clinician may perform few observable clinical tasks. Such idle periods may occupy substantial parts (up to 40%) of routine cases.[1–3] Such periods appear to be associated with lower cognitive and physical demands.[4,5] As a result, clinicians may become bored and seek to occupy their minds or hands with tasks unrelated to the immediate care of the patient.

In research conducted 15 yr ago at two adjacent academic medical centers on the West coast,[5] we described the incidence of reading during anesthesia care because self-initiated distractions (*e.g.*, reading or listening to music) raise concerns about reduced vigilance, lower care quality, lack of professionalism, and increased medicolegal risk.[5–8] Reading was observed in 35% of cases but exclusively during the maintenance phase when workload was lower. Reading did not appear to affect vigilance, as measured by the providers' response to the illumination of an alarm light.

However, our findings had a theoretical basis. Low workload produces a low arousal state that can impair performance.[9]

What We Know about This Topic

- Anesthesia providers sometimes engage in potentially distracting activity unrelated to patient care

What This Article Tells Us That Is New

- Self-initiated potentially distracting activities were common and largely restricted to stable portions of cases
- Potentially distracting activity did not impair vigilance and was not responsible for any adverse events

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In laboratory-induced boredom, increased effort is necessary to suppress distracting stimuli and a generalized feeling of fatigue,[10] adding tasks to a monotonous job can decrease boredom, and dividing attention among several tasks (time sharing) can improve performance.[11,12] In a simulated driving study, performing a secondary verbal task improved driving quality (*e.g.*, improvements in lane-keeping performance) and neurophysiologic measures of alertness.[13] Nonetheless, a limitation of our operating room (OR) study was the absence of any measure of impact of the self-initiated distractions we observed.

With the evolution of information and communication technology, there appears to be greater opportunities to be distracted in the OR.[14] Anesthesia providers now have access to numerous new electronic ways to be distracted, from desktop computer Web browsing to cell phone tweeting. We therefore sought to replicate our previous study in this new milieu, with three important differences: (1) we conducted the study at a large Mid-South academic medical center where the anesthesia providers had *ad lib* access to the internet on their anesthesia record-keeping system and also all had cell phones and/or tablet computers with them in the OR; (2) we video recorded every study case; and (3) we queried each provider at the end of the case to detect the occurrence of nonroutine events (NREs), which is any event that deviates from expected or optimal care for a specific patient in that specific situation.[15–17]

The goal was to elucidate the nature and incidence of potentially distracting non–patient care activities during anesthesia care in the era of ubiquitous computing and to investigate how such non–patient care activities affect patient care tasks, clinical workload, and vigilance, as well as their relationship to NREs.

Materials and Methods

To delineate the epidemiology of intraoperative distractions and elucidate their potential impact, we conducted intraoperative behavioral task analysis, videotaping, workload and vigilance assessments, and intraoperative internet usage tracking. For purposes of this study, we defined a *distraction* as any observable intraoperative activity that was unrelated to patient care or clinical work activities.

Participants

The focus of this study was the behavior of primary anesthesia providers, anesthesiology residents, and nurse anesthetists at a single academic medical center. In addition to obtaining institutional review board approval, we received approval from our institutional risk management and human resources attorneys. Study data were deidentified and kept secure. As part of the consent process, participants were informed about all aspects of the study except the focus of the study on intraoperative distractions and that we were recording their intraoperative internet use. After primary anesthesia providers gave written informed consent, 364 elective general anesthesia cases were studied from August 2007 to October 2009. On completion of the project's data collection phase, all of the participants were notified (*i.e.*, debriefed) of the nondisclosed aspects of the project and given the opportunity to withdraw their data from the study. Only 3 of 89 participants withdrew (their data) from the study after debriefing.

Direct Structured Observation

Before each study case, participants provided basic demographic data *via* a brief questionnaire that included their overnight sleep history. A single observer (E.S.P.), trained to reliable performance,[18] collected all of the intraoperative data. The observer sat in the OR and categorized each clinician's activities into 79 possible tasks that were bundled into nine larger task categories (manual; observing; conversing; recording; miscellaneous clinical tasks; and electronic communication tasks that were related either directly to the current case, were more generally work related and therefore not considered a nonclinical distraction, or that were a self-initiated personal or educational distraction). We only briefly summarize the procedures for task classification, observation methods, observer training, and reliability assessment, because they have been described in numerous previous publications.[1,2,4,5,18,19] Observations began when the patient entered the OR and ceased when the patient departed the OR. No data were collected when a study participant was on break. The observer categorized observable tasks, noted events (*e.g.*, surgical incision and closure), and initiated (on computer prompt) workload ratings and alarm light latency measurements. Each event or task occurrence was recorded by clicking with a mouse on the appropriate button on the computer display. The software then automatically logged the time and task initiated. If the participants were reading or reviewing paper or electronic case-related materials while in the process of record keeping (medical documentation), then this was categorized as *recording* and not *reading*.

If two tasks occurred simultaneously, multitasking was indicated with start/stop multitasking markers in the task analysis file. The times for all simultaneously performed tasks, as indicated by the multitasking markers, were counted until the end multitasking marker for both tasks. To ensure the correct calculation of the amount of time spent on tasks that were simultaneously performed (*i.e.*, each task within the multitasking markers), the total time for the case (*i.e.*, the denominator used for the percentage time calculations) was extended by the time of the overlapping tasks. All of the tasks within the multitasking markers were also given an additional occurrence to their tallies for the number of occurrences.

End of induction was defined as the time when the patient had been intubated and the endotracheal tube had been secured or when the anesthesia provider had told the surgeons that they could begin operating, whichever occurred first. *Beginning of emergence* was defined as occurring when the anesthesia provider shut off all of the anesthetic agents and began delivering 100% oxygen.

Each case studied was assigned a randomly generated case number to assure anonymity. All of the participant and patient identifiers were removed. Standardized forms were used to capture the relevant case summary data elements. A custom NRE database, written in open-source software, included patient characteristics, anesthesia, surgical and provider variables, and NRE information.

A total of 319 of the original 364 cases were selected for analysis based on the following criteria: a case duration of at least 0.75 h but no more than 6 h, patient American Society of Anesthesiologists (ASA) physical status score of 3 or lower, and complete case data. After this screening process, all cases containing personal or educational distractions were identified. As in our previous study,[5] the distraction cases were further subdivided by time into periods when distractions occurred and periods when there were no distractions. To simplify data analysis, tasks performed during each case were grouped into nine predetermined aggregated categories, including manual, observing, conversing, recording, other clinical, case-related electronic communications tasks (*e.g.*, anesthesia record keeping), work-related electronic communication tasks (but unrelated to the current case), and personal/educational distraction tasks.

Vigilance Measurement

The anesthesia provider's vigilance was measured by the time it took to respond to the random illumination of a red alarm light, based on software prompts at 7- to 15-min random intervals. Depending on the OR and the clinical equipment configuration, the vigilance light was either placed atop the physiologic monitors or between the vital signs monitor and the gas analysis monitor.[1,2] Participants were instructed to, either verbally or by hand signal (participant's preference), indicate their detection of the illuminated light. The calculated response time between light illumination and its detection provided a measure of the response latency to a new (secondary) task demand. Because the illumination prompts occurred within random intervals, the number of response latency measurements depended on case duration.[1,2]

Workload Measurements

Psychologic workload was assessed by the trained observer and by the participants themselves using a visual analog scale, ranging from 6 (no exertion) to 20 (maximum exertion).[1,2] At random 8- to 12-min intervals, the computer prompted the observer to score the participant's workload and then to query the participant as to his or her own workload rating.

Internet Use Tracking

To determine the incidence and nature of intraoperative internet browsing (*i.e.*, nonclinical, case-specific, and/or general/educational clinical searches), excluding online record keeping, documentation, and paging, the browser's history logs were collected from the anesthesia-dedicated workstation, labeled, and archived on a secure server immediately after each study case. Custom software created spreadsheets containing the browser page access history (each visited page's domain, subdomain, and time of access). These data were time linked to other case-specific study data elements, deidentified, and imported into the study database. The browser logs were manually coded by the research team as either clinical/educational (*e.g.*, PubMed) or nonclinical (*e.g.*, ebay.com). Coded browsing data were then used to validate task-analysis data, which provided the actual time spent on internet use *via* direct observation and/or video review.

NRE Data Capture and Review

At the end of each case studied, the Comprehensive Open-ended Nonroutine Event Survey[17] was administered to the anesthesia provider participant by trained observers. Possible NREs, identified based on the clinician's response to nine yes or no questions, were then elucidated using open-ended questions about the nature of and potential contributors to the event. If not volunteered, the trained observers asked the provider about any events that the researcher may have observed during the case.

Two domain experts first independently reviewed each event and determined whether the reported event met the definition of a nonroutine event. If there was disagreement between expert reviewers, they would meet and have an open discussion of that particular event to reach consensus. On the rare occasion that agreement could not be obtained, a third expert reviewed the case and potential NRE. Unanimous agreement was reached for all of the events.

We used a screening process to identify potentially distracting activities that could have affected the occurrence, management, or outcome of identified NREs. We included all types of self-initiated personal/educational distractions (*i.e.*, nonclinical distractions or non–patient care activities). As is detailed further in the Results section, there were 88 cases that contained both nonclinical distractions and at least one NRE. For each event, two clinician investigators (A.N.L. and M.B.W.) reviewed the complete time-sequence case spreadsheet that included all of the relevant tasks, distractions, and NRE information to identify those cases where there was a possibility that a distraction was related to the NRE. The videos of the resulting 42 cases were then reviewed with the results iteratively discussed until the two clinicians reached consensus as to whether any NRE was affected by a distraction.

Sample Size and Statistical Analysis

These data were collected as part of an Anesthesia Patient Safety Foundation–funded (Rochester, Minnesota) research project for which we performed a statistical power analysis based on *a priori* assumptions about the incidence of NREs reported postoperatively and of nonclinical distractions. We evaluated the power to detect an unadjusted association between the occurrence of one or more nonclinical distractions and one or more NREs using the Pearson chi-square test. Based on previous work, we estimated that the incidence of one or more nonclinical distractions was greater than 30% and that the incidence of one or more NREs was 35% among cases with distractions *versus* 20% for cases without distractions. Under these assumptions, approximately 350 cases are required to achieve 80% power at 5% type I error rate. In implementing the study, we collected 364 cases before debriefing subjects about the true nature of the study and ending data collection for the project. Only 319 of these cases met the inclusion criteria for the analyses that we conducted.

All of the quantitative data are summarized using the median, interquartile range, and range. For each task and task category, the percentage of total case time, average task duration, and other quantitative factors were compared by case type (distraction *vs.* nondistraction cases) using the Wilcoxon rank sum test and by distraction *versus* nondistraction periods within distraction cases using the Wilcoxon signed-rank test (*i.e.*, a paired test). The Pearson chi-square test was used to compare categorical factors by case type.

The effects of case type and period type on self-reported workload and vigilance latency (dependent variables) were quantified using mixed-effects regression methods, adjusting for provider months of experience, duration of sleep in the most recent rest period, case duration, surgery type, and patient ASA classification. The effects of provider months of experience, sleep duration, and case duration were modeled using a four-knot natural spline. Two independent, nested random intercepts, indexed by provider and case, respectively, were used to account for heterogeneity in workload ratings and vigilance latencies among providers and cases. Vigilance and workload data were transformed using the natural logarithm to reduce skew. Residual diagnostics were examined to verify that this transformation was sufficient to satisfy the regression assumptions (*i.e.*, residual normality).

P values less than 0.05 were considered statistically significant. Due to the complexity of the correlations between all of the test statistics, we did not attempt to make adjustments to preserve the family wise type I error rate.

Results

The distraction (n = 171; *i.e.*, nonclinical distraction cases) and no distraction (n = 148) case cohorts did not differ significantly by case type or ASA status ($P = 0.705$ and $P = 0.451$, respectively; tables 1 and 2), with the majority of cases involving patients with an ASA status of 2 or 3. The average duration of distraction cases overall, as well as of the maintenance phases, was significantly longer than nondistraction cases ($P < 0.001$ and $P < 0.001$, respectively; table 1). During distraction cases, the periods with distractions (table 1) were much briefer than periods without any distractions ($P < 0.001$). Distractions during care were more common in anesthetics performed by certified registered nurse anesthetists than by anesthesiology residents ($P = 0.005$; table 1).

The occurrence of at least one nonclinical distraction was observed in 54% of the cases, although the distractions accounted for only approximately 2% (median) of total case time and 3% of total maintenance period time. The median activity duration (*i.e.*, dwell time) of each distraction was 2.3 s (25% = 1.0 s; 75% = 4.1 s; table 3) before switching to another task. Almost half (49%) of the distractions were personal in nature, whereas approximately one fourth were educational in nature (the latter being much more common in residents than certified registered nurse anesthetists). The most prevalent type of distraction was internet browsing for personal (0.2 [0.0, 2.1%], 0 to 24% of case time, 14.7 [0.0, 33.9], 0- to 95.0-s dwell time or activity duration) or educational (0.0 [0.0, 0.8%], 0 to 9.3% of case time, 0.0 [0.0, 23.8], 0- to 117.5-s dwell time) purposes and accessing email (see table 3). Other distractions observed, albeit less commonly, included the use of a personal electronic device (*e.g.*, for scheduling activities and viewing reminders), personal phone calls, conversations of a personal (*e.g.*, chatting with nurses and/or surgeons) or educational nature (*e.g.*, talking with the attending physician), answering or sending personal pages, and personal reading.

In every case containing distractions, there were periods (*e.g.*, induction or emergence) without any distractions. If one analyzes the periods in the case, a clearer picture of the role of distractions *versus* other activities emerges (table 4). All of the major types of patient care tasks consumed significantly more case time than any of the distractions (table 4). As seen in previous anesthesia task analysis studies dating back two dec ades,[1,2,17,19,20] observing the physiologic monitors was consistently the most common task (median = 13% of total case), and anesthesia record keeping consumed approximately 12% of case time, albeit lower during periods containing distractions. In the largely episodic periods that contained distractions, approximately one third of case time was consumed with personal distractions, and very little time (median = 0.0%) was spent on educational distractions. During periods and cases with and without distractions, a substantial amount of time was spent on information-gathering activities that were related to work (*e.g.*, checking the schedule to seek information about future cases) but not the current case (table 4).

Vigilance and Workload

In unadjusted comparisons, both participant-reported ($P = 0.003$) and observer-scored workload ratings ($P < 0.001$) were significantly lower during distraction-containing cases than cases without any distractions (fig. 1). Similarly, in cases with distractions, both participant- and observer-reported workload measures were significantly lower ($P < 0.001$ and $P < 0.001$, respectively) during distraction periods than periods without any distractions (which typically included induction and emergence, periods notable for higher workload[1,2]). Adjusting for months of experience, case duration, sleep duration, patient ASA, surgical type, and case type (*i.e.*, distraction *vs.* nondistraction cases), self-reported workload ratings were 11% lower (95% CI, 8 to 14%; $P < 0.001$) during distraction periods *versus* nondistraction periods. There was no evidence of an independent association between case type and self-reported workload ratings after adjusting for distraction *versus* nondistraction periods within a case ($P = 0.302$). In unadjusted analyses, vigilance latency was not different based on either case type ($P = 0.235$) or period type within distraction cases ($P = 0.872$).

Table 1. Study Case Characteristics

	Cases with Distractions (N = 171)	Cases without Distractions (N = 148)
Case duration, min		
Total case*	176 [123, 227] (53–334)	119 [77, 162] (45–313)
Induction	15 [12, 19] (5–34)	15 [12, 18] (6–58)
Maintenance*	148 [94, 193] (23–309)	85 [51, 131] (12–279)
Emergence	12 [10, 17] (5–53)	12 [9, 16] (2–55)
Distraction periods†	9 [2, 25] (0–142)	–
Nondistraction periods†	147 [101, 190] (41–297)	–
ASA, n (%)		
ASA 1	8 (5)	8 (5)
ASA 2	79 (46)	58 (39)
ASA 3	84 (49)	82 (55)
Primary provider, n (%)‡		
Residents (all)	68 (40)	86 (58)
CA1	37 (22)	56 (38)
CA2	25 (15)	19 (13)
CA3	6 (4)	11 (7)
CRNA	99 (58)	59 (40)
SRNA	4 (2)	3 (2)

Data are presented as median [25th, 75th] (minimum–maximum) unless otherwise specified. Twenty-four providers were studied only once, 16 were studied twice, 18 were studied 3 to 5 times, 14 were studied 6 to 8 times, and 7 were studied more than 10 times.

*$P < 0.001$ comparing distraction *vs.* nondistraction cases using Wilcoxon test (case duration) or Pearson chi-square test (ASA and primary provider). †$P < 0.001$ comparing distraction *vs.* nondistraction periods within distraction cases using paired Wilcoxon test.

‡$P < 0.05$.

ASA = American Society of Anesthesiologists' physical status classification; CA = clinical anesthesia; CRNA = certified registered nurse anesthetist; SRNA = student registered nurse anesthetist.

Table 2. Study Cases by Type of Surgery

Type of Surgery	Cases with Distractions (N = 171), n (%)	Cases without Distractions (N = 148), n (%)
Cardiothoracic	6 (4)	11 (7)
General	54 (32)*	38 (26)
Gynecology	1 (1)	1 (1)
Neurosurgery	21 (12)	15 (10)
Ophthalmology	6 (4)	5 (3)
Oral surgery	4 (2)	1 (1)
Orthopedics	11 (6)	13 (9)
Otolaryngology	11 (6)	11 (7)
Plastics	9 (5)†	7 (5)
Urology	42 (25)	35 (24)
Vascular	6 (4)	11 (7)†

*Three general surgery cases also had less invasive concurrent procedures, one by plastics and two by urology; these were counted only in the general surgery category. †Two cases included less intensive concurrent procedures by otolaryngology; these were counted only in the plastics and vascular surgery categories.

However, in adjusted analyses, vigilance latencies were longer by 27% (95% CI, 7 to 49%; $P = 0.004$) among nondistraction cases *versus* distraction cases, but this trend did not attain statistical significance in comparisons of distraction *versus* nondistraction periods after adjusting for case type ($P = 0.069$). Months of experience, case duration, and surgical type were all significantly associated with both self-reported workload and vigilance latency in adjusted analyses (table 5). Provider sleep duration and patient ASA class were not significantly associated with self-reported workload or vigilance latency.

NREs and Distractions

Eighty-eight (52%) of the 171 distraction cases and 105 of the 148 nondistraction cases (71%) contained at least one NRE ($P < 0.001$). Fifty-two distraction cases (30%) and 53 nondistraction cases (36%) contained more than one NRE. The clinician experts determined that three self-initiated personal distractions (*i.e.*, non–patient care activities) were temporally related to NREs (3.4% of distraction cases; table 6), although none of the distractions were believed to contribute to the occurrence of the event. However, one of these distractions occurred concurrently with and could have influenced event management.

Discussion

Both nurse anesthetists and residents in an academic medical center, even when being observed, performed potentially distracting tasks of a personal and/or educational nature in a majority of cases. The most common distraction activity was personal internet use. These distractions almost always occurred during maintenance when clinical workload was lower, especially in longer cases. Vigilance was significantly better in cases with *versus* those without distractions.

Task disruptions apparently occur frequently in other clinical domains[21–23] and may be important contributors to medical adverse events.[22–26] However, one must distinguish self-initiated distractions from externally prompted distractions.[27–29] Although interruptions are common in anesthesia (*e.g.*, the surgeon asking for the OR table to be rotated), our study focused on self-initiated distractions. In our NRE analysis, few self-initiated distractions affected ongoing

Table 3. Percentage of Time Spent on Non–patient Care Activities among Distraction Cases

Task	Percent of All Cases (N = 319) with This Activity	Distraction Cases Only (N = 171)	
		Percent of Total Case Time	Activity Duration, s
Any non–patient care activity	53.6	2.1 [0.7, 4.7] (0–31.2)	2.3 [1.0, 4.1] (0–12.7)
All personal distraction activities combined	49.2	1.5 [0.4, 3.8] (0–27.9)	2.9 [1.2, 5.0] (0–11.4)
All educational distraction activities combined	24.1	0.0 [0.0, 1.0] (0–9.3)	0.0 [0.0, 3.2] (0–23.6)
Specific types of distractions			
Internet, personal	31.0	0.2 [0.0, 2.1] (0–23.9)	14.7 [0.0, 33.9] (0–95.0)
Internet, educational	19.7	0.0 [0.0, 0.8] (0–9.3)	0.0 [0.0, 23.8] (0–117.5)
Email, institutional	16.0	0.0 [0.0, 0.1] (0–15.9)	0.0 [0.0, 12.4] (0–112.0)
Email, personal	9.4	0.0 [0.0, 0.0] (0–6.4)	0.0 [0.0, 0.0] (0–109.0)
Personal electronic device usage	9.1	0.0 [0.0, 0.0] (0–18.1)	0.0 [0.0, 0.0] (0–80.0)
Personal phone call	5.6	0.0 [0.0, 0.0] (0–1.5)	0.0 [0.0, 0.0] (0–79.0)
Personal conversation, nurse	5.3	0.0 [0.0, 0.0] (0–16.9)	0.0 [0.0, 0.0] (0–93.0)
Answering personal page	5.0	0.0 [0.0, 0.0] (0–1.9)	0.0 [0.0, 0.0] (0–43.0)
Personal conversation, surgeon	3.1	0.0 [0.0, 0.0] (0–6.9)	0.0 [0.0, 0.0] (0–19.3)
Reading, personal	3.1	0.0 [0.0, 0.0] (0–4.4)	0.0 [0.0, 0.0] (0–33.6)
Educational conversation, attending physician	2.5	0.0 [0.0, 0.0] (0–7.0)	0.0 [0.0, 0.0] (0–167.0)
Educational conversation, other provider	2.2	0.0 [0.0, 0.0] (0–5.4)	0.0 [0.0, 0.0] (0–149.8)
Sending personal pages	2.2	0.0 [0.0, 0.0] (0–0.9)	0.0 [0.0, 0.0] (0–55.0)
Personal conversation, attending physician	1.6	0.0 [0.0, 0.0] (0–3.9)	0.0 [0.0, 0.0] (0–57.0)
Educational conversation, nurse	1.6	0.0 [0.0, 0.0] (0–1.4)	0.0 [0.0, 0.0] (0–21.0)

Percentage of total case time and activity duration data are presented as median [25th, 75th] (minimum–maximum). Note that 99.6% of non–patient care tasks occurred during maintenance. Task duration is the average dwell time for a task within each case or period.

Table 4. Percentage of Time Spent on Grouped Task Categories

Task Category	Cases without Any Distractions	Cases Containing Distractions	Different Periods during Distraction Cases	
			Case Periods with Distractions	Case Periods without Distractions
No.	148	171		
Personal distraction	0.0 [0.0, 0.0] (0–0.0)	1.5 [0.4, 3.8] (0–27.9)	33.3 [18.7, 65.0] (0–100)*	0.0 [0.0, 0.0] (0–0.00)
Educational distraction	0.0 [0.0, 0.0] (0–0.0)	0.0 [0.0, 1.0] (0–9.3)	0.0 [0.0, 18.1] (0–100)*	0.0 [0.0, 0.0] (0–0.00)
Work-related info gathering	1.5 [0.6, 2.8] (0–26.6)*	4.7 [2.1, 7.5] (0–23.8)	3.7 [0.0, 18.8] (0–80.8)	4.3 [2.0, 6.9] (0–25.1)
Case-related info gathering	0.3 [0.0, 0.8] (0–3.6)†	0.5 [0.1, 1.3] (0–9.7)	0.0 [0.0, 0.0] (0–40.6)*	0.4 [0.0, 1.1] (0–8.6)
Conversing tasks	15.8 [11.8, 20.2] (4.1–53.6)†	13.7 [10.0, 19.5] (3.6–54.2)	0.8 [0.0, 3.8] (0–47.7)*	14.9 [10.4, 21.0] (4.1–57.5)
Manual tasks	33.8 [29.1, 38.4] (10.3–52.3)*	26.2 [21.8, 30.8] (8.5–44.4)	1.8 [0.0, 4.8] (0–38.6)*	25.8 [22.0, 29.9] (8.5–44.5)
Observing tasks	20.9 [16.6, 26.8] (2.7–48.4)†	23.3 [17.7, 31.1] (10.0–59.9)	14.3 [6.5, 24.4] (0–75.0)*	24.1 [18.7, 32.6] (9.0–59.2)
Other tasks	10.4 [7.8, 12.9] (2.6–29.9)*	9.8 [8.0, 11.8] (3.9–27.0)	1.1 [0.0, 3.4] (0–31.0)*	10.9 [8.9, 13.4] (4.3–29.3)
Recordkeeping	12.1 [10.3, 15.5] (0–32.4)	11.8 [9.4, 14.4] (5.0–25.1)	2.8 [0.0, 7.0] (0–35.4)*	12.9 [10.3, 16.1] (4.6–25.4)

Data are presented as median [25th, 75th] (minimum–maximum). Data were compared for distraction *vs.* nondistraction periods and distraction *vs.* nondistraction cases.
†$P < 0.05$. *$P < 0.001$.

clinical tasks. These data suggest that self-initiated escapable distractions during low workload periods when the patient is stable may be less problematic than external interruptions.[30] However, this depends on anesthesia professionals using sound professional judgment.

In the present study, distractions occurred almost exclusively (99.6%) during the maintenance phase, which is commonly characterized by lower workload tasks (*e.g.*, patient monitoring).[1,2] This may explain why vigilance, as measured by the random alarm light located in the monitoring array, was maintained during distraction periods. Similar findings have been seen in other domains, for example, in a 4-h experiment involving unmanned vehicle operators primarily searching for and destroying hostile targets with low task loads (*i.e.*, one target per hour), operators were in a distracted state (*i.e.*, engaged in other tasks such as talking to other participants or eating) for 45% of the time.[31] Yet, the top performers, all of whom were in a distracted state for much of the experiment, did quite well. The authors ascribed this finding to a periodic switching strategy that allowed them to efficiently maintain their vigilance

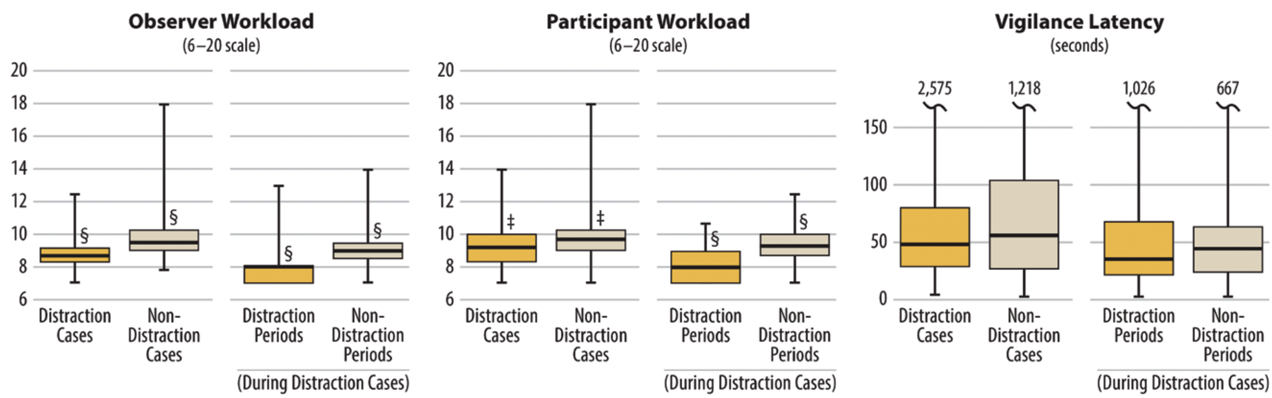

Fig. 1. Workload ratings and vigilance. Psychologic workload was rated on a 6 to 20 scale. Distraction and nondistraction periods: N = 59. Vigilance light response latency is in seconds. Distraction and nondistraction periods: N = 74. All of the data are presented as medians and interquartile ranges. For periods within distraction cases, only cases with data for periods both with and without distractions were analyzed. ‡$P < 0.01$; §$P < 0.001$.

Table 5. Summary of Self-reported Workload and Vigilance Multiple Regression Analysis

	Workload*		Vigilance*	
Factor	Effect (95% CI)	*P* Value†	Effect (95% CI)	*P* Value†
Months of experience‡	–0.05 (–0.08 to –0.02)	< 0.001	–0.30 (–0.49 to –0.10)	0.002
Case duration, h‡	–0.03 (–0.06 to 0.00)	0.010	–0.28 (–0.49 to –0.08)	0.043
Sleep duration, h‡	0.02 (–0.01 to 0.05)	0.307	–0.12 (–0.29 to 0.06)	0.473
Patient ASA class‡	0.01 (–0.03 to 0.05)	0.616	0.12 (–0.13 to 0.37)	0.336
Case type: nondistraction *vs*. distraction	0.01 (–0.01 to 0.04)	0.302	0.24 (0.07 to 0.40)	0.004
Period: nondistraction *vs*. distraction	–0.12 (–0.15 to –0.08)	< 0.001	0.20 (–0.02 to 0.41)	0.069
Surgical type		< 0.001		< 0.001
Cardiothoracic *vs*. general	0.09 (0.03 to 0.15)		0.95 (0.48 to 1.42)	
Gynecology *vs*. general	0.22 (0.12 to 0.32)		–1.10 (–1.80 to –0.40)	
Neurosurgery *vs*. general	0.01 (–0.02 to 0.05)		0.40 (0.17 to 0.63)	
Ophthalmology *vs*. general	–0.04 (–0.10 to 0.02)		–0.13 (–0.55 to 0.29)	
Oral *vs*. general	0.10 (0.02 to 0.19)		0.25 (–0.33 to 0.83)	
Orthopedics *vs*. general	0.04 (0.00 to 0.08)		0.06 (–0.22 to 0.35)	
Otolaryngology *vs*. general	0.05 (–0.01 to 0.11)		0.77 (0.42 to 1.12)	
Plastics *vs*. general	0.00 (–0.05 to 0.05)		–0.11 (–0.43 to 0.22)	
Urology *vs*. general	0.02 (–0.01 to 0.05)		–0.01 (–0.20 to 0.17)	
Vascular *vs*. general	0.05 (0.00 to 0.09)		0.66 (0.32 to 1.00)	

*The ratings for both workload and vigilance were log-transformed before regression analysis; thus, the effects listed above are interpreted with respect to the log-transformed outcome. †For quantitative factors, "effect" represents the difference in the average response associated with the 25th and 75th percentiles of the corresponding factor. ‡The *P* values listed here are those associated with the multiple-degree-of-freedom test for overall significance of the corresponding factor.

and respond effectively when needed.[31] A similar effect has been seen with sleep-deprived anesthesiology residents monitoring for events during long simulated anesthetics.[32]

The present study replicates but also extends the findings from our previous smaller study,[5] which was conducted at a different academic medical center when intraoperative internet access was limited and ubiquitous electronic communication was unavailable. In the present study, every OR had a computer with unrestricted internet access and all of the anesthesia providers had intraoperative access to handheld electronic communication devices. Thus, it is not surprising that, when providers choose to be distracted, their distractions were more likely to be electronic in nature. Although the potential clinical value of various electronic communication technologies is well appreciated,[33–36] their use has unintended consequences, including a greater degree of mental occupation by self-initiated distractions.

In this study, self-initiated distractions were considered temporally related to 3% of the events in distraction-containing cases. Although at least one distraction temporally proximate to an event was considered by the expert reviewers to be untimely, none were deemed to be causal. Similarly, Wax *et al.*[37] reported that 171 anesthesia providers during 1,061 cases spent a median of 14 min (16%) per case on nonanesthesia electronic health record (EHR) computer activities. Greater non-EHR activities occurred in longer cases with a lower ASA status, cases under general anesthesia,

Table 6. Three Cases Where Reported Nonroutine Events Were Deemed to Have Associated Self-induced Distractions

Surgical Procedure	Phase when NRE Occurred	Distraction Related to NRE?	Reviewers' Annotative Comments (Distraction in *Italic* Font)
Varicose vein stripping/repair	Maintenance	Definitely related Probably delayed detection	Patient heart rate drops to 42 beats/min, pressure 100/54. Resident *drawing up drugs for next case*. Rate drops to 38 beats/min. Alarm threshold triggered but electrocardiogram alarm is off. *Resident looking at next patient on EHR*. Pulse alarm goes off and gets resident's attention, attending physician calls simultaneously into room. Resident gives ephedrine *while talking to attending physician on phone*, blood pressure is 81/44.
Bilateral neurostimulator lead replacement	Maintenance	Definitely related No apparent effect on detection or treatment timeliness	Preinduction 116/64 and heart rate 82 beats/min. Attending physician, who is doing patient charting and *checking pager and then checking day planner just prior,* notices low blood pressure (71/38) and bradycardia (47 beats/min) during cycle and decreased desflurane. Treats with 100 µg phenylephrine. No alarm. Cuff fails next auto-cycle.
Laryngoscopy with injection	Maintenance	Definitely related Not causal but during critical time	Patient desaturates to 81% during surgery. Surgeon inserts endotracheal tube and certified registered nurse anesthetist easily bags patient to 100%. *CRNA on phone on case-unrelated matter* while actively intervening.

EHR = electronic health record.

and when attending physicians worked alone. Non-EHR usage time was not associated with significantly greater variability or abnormalities of patient vital signs.

Distractions can differ in terms of how they are initiated (external *vs.* self-initiated) and consequently how quickly and easily they can be ignored, controlled, or terminated.[38–40] Thus, distractions that are under the anesthesia provider's full control (*e.g.*, internet searching and browsing) may be more conducive to multitasking (*i.e.*, time sharing) with lower workload tasks, like monitoring and charting, during uneventful periods. The effectiveness of such a strategy will depend in part on how mentally absorbing the distractions are. More mentally absorbing distractions (*e.g.*, playing a video game on a smart phone) will interfere with effective time sharing, thus degrading performance of essential clinical tasks.

Other Consequences of Distractions

Distractions can have other adverse effects. During clinical tasks, distractions can be disruptive if they require reorientation of attention. When switching from one task to another, the cognitive readjustment between tasks, referred to as a *switch cost*, slows responses and increases the risk of error.[41] After an interruption, it is more difficult and takes twice as long to reorient to (resume) more complex compared with routine tasks.[42] Additional effort is required to ignore distractions and remain attendant to current tasks and goals.[43] According to the cognitive fatigue model, unplanned task disruptions can increase cognitive effort, produce information overload, and lead to fatigue and a more negative mood.[44]

Driving while texting has been put forward as a comparison to texting while administering anesthesiology. One difference is that driving accidents can happen in seconds. In fact, a large proportion of automobile accidents by teen drivers have been found to have associated distractions within 6 s of the accident.[45] The concurrent conduct of nondriving tasks, such as texting, is known to cause life-threatening accidents.[46] Studies show that the human brain cannot perform two conscious activities simultaneously (even if on different sensory channels) but rather switches rapidly between tasks.[47] Consistent with this, texting while driving substantially increases cognitive load and substantially decreases vigilance and response time, leading to performance decrements that are significantly worse than driving while drunk.[48] Consequently, text messaging while driving is banned for all drivers in 46 states.[49] Hand-held cell phone use is banned in 14 states and is banned for novice drivers in 38 states.[49]

Role of Policies and Admonitions

With *ad lib* access to electronic distractions, there is more opportunity for potentially unprofessional behavior. An anesthetist recently self-published a novel in which he thanked the "many tardy surgeons" at his institution who "unwittingly helped [by allowing him to write his book in the OR] by making simple operations last for hours."[50] In a 2012 search of the 5,822 claims of intraoperative adverse events in the ASA Closed Claims database, there were 13 cases in which nonclinical distractions were an associated factor.[51] An updated analysis in late 2016 found two additional cases (Karen Posner, Ph.D., Department of Anesthesiology and Pain Medicine, University of Washington, Seattle, Washington; personal communication). Malpractice carriers generally view all nonclinical distracting activities as risky and have explicitly advised providers to refrain from them.[8] Some anesthesia residency programs forbid intraoperative distractions. The national anesthesiology and nurse anesthesia professional associations both have distraction policies.[52,53]

Why do experienced anesthesia providers routinely initiate distractions during low workload periods of the maintenance phase of anesthesia care? Boredom stems from the need to maintain attention in the absence of relevant task information and is most likely to occur in semiautomatic tasks that prevent mind wandering but are not fully mentally absorbing. In an unpublished survey that we conducted years ago, almost 90% of anesthesia providers admitted to at least occasional boredom while administering anesthesia, presumably during what we called *idle periods* in previous studies.[1,2] Humans typically mitigate boredom by altering tasks or by adding new tasks. Therefore, during idle periods, many anesthesia professionals add clinical or nonclinical secondary tasks to their routine. Given the inherent nature of the job, the performance of non–patient care tasks seems inevitable during idle periods. Thus, if access to electronic media were precluded, providers would likely alleviate boredom in other ways (*e.g.*, listening to music, personal conversations, or reading paper materials).

Some self-initiated distractions (*e.g.*, intraoperatively writing novels, video games, *etc.*) are unprofessional and potentially dangerous. Therefore, the choice, timing, and duration of any self-initiated distraction require good judgment and vigilance.

Study Limitations

This study has limitations. It was conducted in the main ORs of a single academic medical center in which internet connections were required to access the anesthesia EHR. Educational activities, including conversations with attending physicians, accounted for only a small fraction of all distractions. In nonacademic settings, more personal distractions may occur. The study site used a care team model where additional anesthesia providers were readily available to assist and provide regular breaks. The results may not generalize to other sites with different cultural, environmental, or technologic attributes. Future studies should examine the incidence of distractions in nonacademic and solo practice settings.

The results may have been affected by the observer's presence. However, in numerous previous intraoperative observational studies, including those involving video recording of patient care, there has been little evidence of a Hawthorne effect.[1,2,4,17,19,20] Although the providers did not know the purpose of the observations, it is reasonable to assume that the observer's presence did not increase the incidence of distractions.

During the process of expert review and coding, which involved reviewing nonroutine event descriptions from surveys and videos, we may have missed some events. We may have incorrectly identified personal *versus* educational distractions (*e.g.*, conversations that were inaudible).

In conclusion, at least one distraction was observed in more than half of a large corpus of anesthesia cases, with the most common distraction being personal internet use. Distractions only occurred during low workload periods, and a measure of vigilance was not adversely affected. A few NREs were associated with noncontributory distractions. Additional research should delineate the effects of distractions on the quality and safety of perioperative care.

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Competing Interests

The authors declare no competing interests.

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References

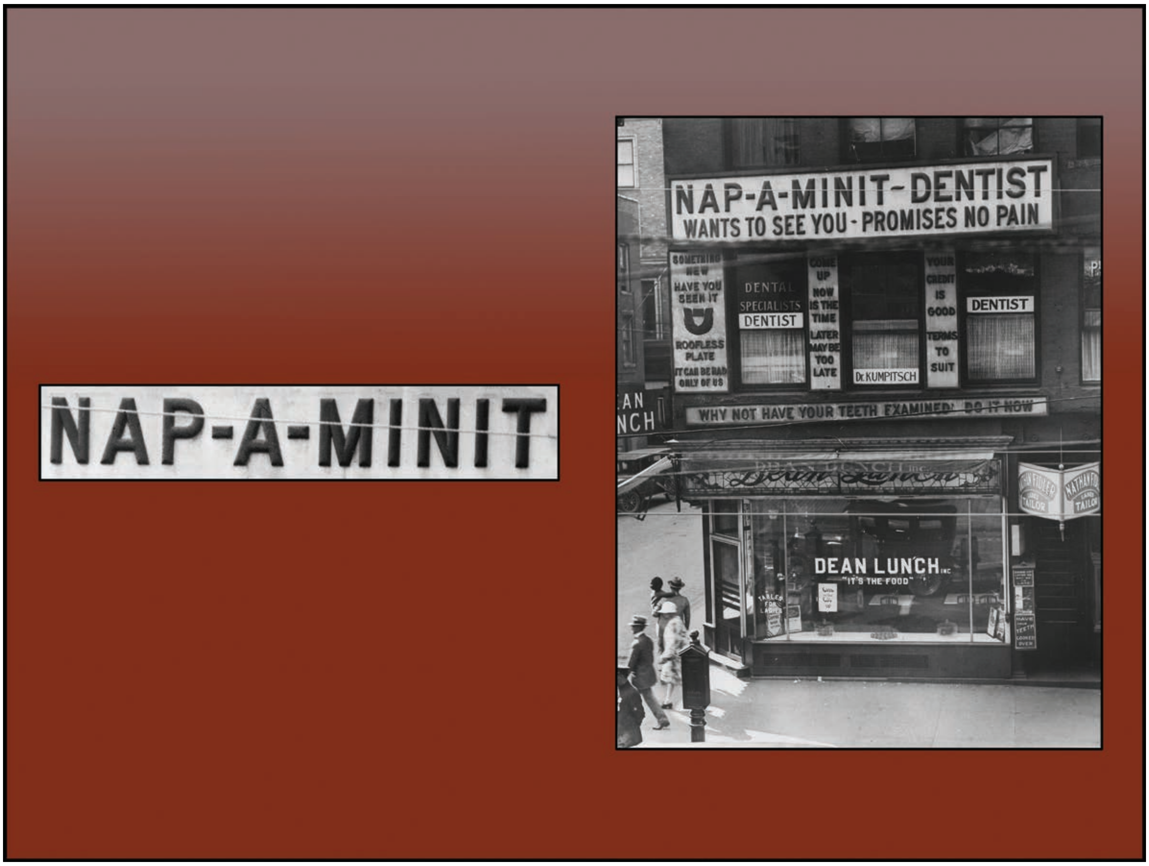
1. Weinger MB, Herndon OW, Paulus MP, Gaba D, Zornow MH, Dallen LD: Objective task analysis and workload assessment of anesthesia providers. Anesthesiology 1994;80:77–92.
2. Weinger MB, Herndon OW, Gaba DM: The effect of electronic record keeping and transesophageal echocardiography on task distribution, workload, and vigilance during cardiac anesthesia. Anesthesiology 1997; 87:144–55; discussion 29A–30A
3. Loeb R, Weinger MB, Englund CE: Ergonomics of the anesthesia workspace, Anesthesia Equipment: Principles and Applications. Edited by Ehrenwerth J, Eisenkraft JB. Malvern, Mosby Year Book, 1993, pp 385–404
4. Weinger MB, Reddy SB, Slagle JM: Multiple measures of anesthesia workload during teaching and nonteaching cases. Anesth Analg 2004; 98:1419–25
5. Slagle JM, Weinger MB: Effects of intraoperative reading on vigilance and workload during anesthesia care in an academic medical center. Anesthesiology 2009; 110:275–83
6. Monk TG, Giesecke AH: Reading in the operating room: Is it acceptable, just because we can? APSF Newsletter 2004; 19:33
7. Riley RH: The MP3 surgeon and the opera fan. Med J Aust 2006; 184:255–6

8. Bristow J, Charles DM, Gorney M, Lofsky AS: Plastic Surgery and Anesthesia: A Claims and Risk Reduction Workshop. Napa, 2005
9. Boadle J: Vigilance and simulated night driving. Ergonomics 1976; 19:216–25
10. Davies DR, Shakleton VJ, Parasuraman R: Monotony and boredom, Stress and Fatigue in Human Performance. Edited by Hockey GRJ. Chichester, John Wiley and Sons, 1983, pp 1–32
11. Gould JD, Schaffer A: The effects of divided attention on visual monitoring of multi-channel displays. Hum Factors 1967; 9:191–201
12. Haskell BE, Reid GB: The subjective perception of workload in low-time private pilots: A preliminary study. Aviat Space Environ Med 1987; 58:1230–2
13. Atchley P, Chan M, Gregersen S: A strategically timed verbal task improves performance and neurophysiological alertness during fatiguing drives. Hum Factors 2014; 56:453–62
14. van Pelt M, Weinger MB: Distractions in the anesthesia work environment: Impact on patient safety? (Report of a meeting sponsored by the Anesthesia Patient Safety Foundation). Anesth Analg 2017; 125:347–50
15. Weinger MB, Slagle J: Human factors research in anesthesia patient safety: Techniques to elucidate factors affecting clinical task performance and decision making. JAMIA 2002; 9(suppl):S58–S63
16. Weinger MB, Slagle J, Jain S, Ordonez N: Retrospective data collection and analytical techniques for patient safety studies. J Biomed Inform 2003; 36:106–19
17. Oken A, Rasmussen MD, Slagle JM, Jain S, Kuykendall T, Ordonez N, Weinger MB: A facilitated survey instrument captures significantly more anesthesia events than does traditional voluntary event reporting. Anesthesiology 2007; 107:909–22
18. Slagle J, Weinger MB, Dinh MT, Brumer VV, Williams K: Assessment of the intrarater and interrater reliability of an established clinical task analysis methodology. Anesthesiology 2002; 96:1129–39
19. Fraind DB, Tubbesing V, Hughes S, Weinger MB: Task analysis of intravenous drug and fluid administration in the operating room. Anesthesiology 2002; 97:139–47
20. Cao CG, Weinger MB, Slagle J, Zhou C, Ou J, Gillin S, Sheh B, Mazzei W: Differences in day and night shift clinical performance in anesthesiology. Hum Factors 2008; 50:276–90
21. Chisholm CD, Dornfeld AM, Nelson DR, Cordell WH: Work interrupted: A comparison of workplace interruptions in emergency departments and primary care offices. Ann Emerg Med 2001; 38:146–51
22. Pape TM, Guerra DM, Muzquiz M, Bryant JB, Ingram M, Schranner B, Alcala A, Sharp J, Bishop D, Carreno E, Welker J: Innovative approaches to reducing nurses' distractions during medication administration. J Contin Educ Nurs 2005; 36:108–16; quiz 141–2
23. Potter P, Wolf L, Boxerman S, Grayson D, Sledge J, Dunagan C, Evanoff B: Understanding the cognitive work of nursing in the acute care environment. J Nurs Adm 2005; 35:327–35
24. Page A, ed.: Keeping Patients Safe: Transforming the Work Environment of Nurses. Washington, DC, National Academic Press, 2004
25. Hicks RW, Becker SC, Krenzischeck D, Beyea SC: Medication errors in the PACU: A secondary analysis of MEDMARX findings. J Perianesth Nurs 2004; 19:18–28
26. Beso A, Franklin BD, Barber N: The frequency and potential causes of dispensing errors in a hospital pharmacy. Pharm World Sci 2005; 27:182–90
27. Brixey JJ, Robinson DJ, Johnson CW, Johnson TR, Turley JP, Zhang J: A concept analysis of the phenomenon interruption. ANS Adv Nurs Sci 2007; 30:E26–42
28. Jett QR, George JM: Work interrupted: A closer look at the role of interruptions in organizational life. Acad Manage Rev 2003; 28:494–507
29. Rivera-Rodriguez AJ, Karsh BT: Interruptions and distractions in healthcare: Review and reappraisal. Qual Saf Health Care 2010; 19:304–12
30. Prajapati S, Yamada K, Unehara M: Self-initiated intermission: A better way of handling interrupting events. Paper presented at: AMBIENT 2014, The Fourth International Conference on Ambient Computing, Applications, Services and Technologies, 2014
31. Cummings ML, Mastracchio C, Thornburg KM, Mkrtchyan A: Boredom and distraction in multiple unmanned vehicle supervisory control. Interact Comput 2013; 25:34–47
32. Howard SK, Gaba DM, Smith BE, Weinger MB, Herndon C, Keshavacharya S, Rosekind MR: Simulation study of rested *versus* sleep-deprived anesthesiologists. Anesthesiology 2003; 98:1345–55; discussion 5A
33. Finegan BA: Access denied; care impaired: The benefits of having online medical information available at the point-of-care. Anesth Analg 2004; 99:1450–2
34. Westbrook JI, Gosling AS, Coiera E: Do clinicians use online evidence to support patient care? A study of 55,000 clinicians. J Am Med Inform Assoc 2004; 11:113–20
35. Magrabi F, Coiera EW, Westbrook JI, Gosling AS, Vickland V: General practitioners' use of online evidence during consultations. Int J Med Inform 2005; 74:1–12
36. Overdyk FJ, McEvoy M: Wireless, handheld computers may aide resident workflow and learning. J Educ Perioper Med 2005; 7:E038
37. Wax DB, Lin HM, Reich DL: Intraoperative non-record-keeping usage of anesthesia information management system workstations and associated hemodynamic variability and aberrancies. Anesthesiology 2012; 117:1184–9
38. Boehm-Davis DA, Remington R: Reducing the disruptive effects of interruption: A cognitive framework for analysing the costs and benefits of intervention strategies. Accid Anal Prev 2009; 41:1124–9
39. McFarlane DC: Comparison of four primary methods for coordinating the interruption of people in human-computer interaction. Human-Comput Interact 2002; 17:63–139
40. Gartenberg D, Breslow L, McCurry JM, Trafton JG: Situation awareness recovery. Hum Factors 2014; 56:710–27
41. Monsell S: Task switching. Trends Cogn Sci 2003; 7:134–40
42. Czerwinski M, Horvitz E, Wilhite S: A diary study of task switching and interruptions. Vienna, Conference on Human Factors in Computing Systems, 2004, pp 175–82
43. Cohen S: Aftereffects of stress on human performance and social behavior: A review of research and theory. Psychol Bull 1980; 88:82–108
44. Zijlstra FRH, Roe RA, Leonora AB, Krediet I: Temporal factors in mental work: Effects of interrupted activities. J Occup Organ Psychol 1999;72:163–85
45. Carney C, Harland KK, McGehee DV: Using event-triggered naturalistic data to examine the prevalence of teen driver distractions in rear-end crashes. J Safety Res 2016; 57:47–52
46. Caird JK, Johnston KA, Willness CR, Asbridge M, Steel P: A meta-analysis of the effects of texting on driving. Accid Anal Prev 2014; 71:311–8
47. Medeiros-Ward N, Watson JM, Strayer DL: On supertaskers and the neural basis of efficient multitasking. Psychon Bull Rev 2015; 22:876–83
48. Drews FA, Yazdani H, Godfrey CN, Cooper JM, Strayer DL: Text messaging during simulated driving. Hum Factors 2009; 51:762–70
49. Governors Highway Safety Association: Distracted driving laws. Available at: http://www.ghsa.org/html/stateinfo/laws/cellphone_laws.html. Accessed November 23, 2016
50. Bowie-Sell D: Anaesthetist claims 'tardy surgeons' enabled him to write novel. Telegraph, March 29, 2013

51. Domino KB, Sessler DI: Internet use during anesthesia care: Does it matter? Anesthesiology 2012; 117:1156–8
52. American Society of Anesthesiologists: Statement on distractions, Committee on Quality Management and Departmental Administration (QMDA). Available at: http://www.asahq.org/quality-and-practice-management/standards-and-guidelines/search?q=distractions. Accessed January 4, 2017
53. American Association of Nurse Anesthetists: Mobile information technology: Position statement. Available at: http://www.aana.com/resources2/professionalpractice/Pages/Mobile-Information-Technology.aspx. Accessed January 4, 2017

ANESTHESIOLOGY REFLECTIONS FROM THE WOOD LIBRARY-MUSEUM

Analgesic Somnoform in Waterbury: "Nap-A-Minit" Adds Chlorides to the Bromide



From the Wood Library-Museum's Ben Z. Swanson Collection, this photograph (*right*) features signage (*left*) from a 1920s "Nap-A-Minit" dentist. From his office corner in Waterbury, Connecticut, Dr. Paul August Kumpitsch (1886 to 1949) was one of a large number of American dentists who so advertised their use of analgesic gas, either Somnoform or nitrous oxide-oxygen. Pioneered in Bordeaux, France, in 1901 by Dr. Georges Rolland, Somnoform was an eclectic mixture of ethyl chloride, methyl chloride, and ethyl bromide, in a 12:7:1 ratio. A topical vapocoolant, Somnoform's general anesthetic properties were revealed when patients began nodding off after the volatile liquid was sprayed on their gums and teeth. As with ethylene, in skilled hands, Somnoform could be administered to provide analgesia without rendering patients completely unconscious. Enthusiasm for using Somnoform waned due to its flammability and to a leading supplier's scandalous omission of ethyl bromide from distributed Somnoform. However, "Nap-A-Minute" persisted as a homonymous branding for oxygenated nitrous-oxide analgesia. (Copyright © the American Society of Anesthesiologists' Wood Library-Museum of Anesthesiology.)

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