Science of Learning Strategy Series: Article 5, Incentivizing Sleep in Continuing Professional Development

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Abstract The science of learning (learning science) is an interprofessional field that concerns itself with how the brain learns and remembers important information. Learning science has compiled a set of evidence-based strategies, such as distributed practice, retrieval practice, and interleaving, which are quite relevant to continuing professional development (CPD). Spreading out study and practice separated by cognitive breaks (distributed practice), testing oneself to check mastery and memory of previously learned information (retrieval practice), and mixing the learning of distinct but related material (interleaving) represent strategies that are underutilized in CPD. Participants and planners alike can benefit from learning science recommendations to inform their decisions. Sleep, the subject of this article and critical to distributed practice, is the ideal circumstance for the brain to process priority information. The authors make the case for sleep as a legitimate part of a learning activity and worthy of consideration in the award of CPD credits.

Keywords science of learning, learning science, distributed practice, continuing education, continuing professional development, sleep

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ABOUT THE SCIENCE OF LEARNING STRATEGY SERIES

Consistent with a 2019 *Journal of Continuing Education in the Health Professions'* editorial by Kitto about informing the continuing professional development (CPD) imagination,[1] the emerging and interdisciplinary field of the science of learning, which concerns itself with how the brain learns and remembers important information, is a compelling but relatively unfamiliar field that stands to inspire CPD participants and planners to think about educational interventions differently. Moreover, the science of learning (learning science) has compiled evidence in support of a set of strategies[2–6] that can help CPD more effectively influence clinician knowledge, skills, attitudes, competence, and even performance. The purpose of the series is to bring attention to evidence-based, learning-science strategies, and to provide some background that might be helpful to CPD stakeholders considering the strategies and related information. The first series' article on "distributed practice" focused on *when* one schedules learning sessions, which should be spread-out to allow participants more time and more opportunities to process important information.[7] The second article on "retrieval practice" focused on *how* one spends time while learning by testing oneself as a way to determine strengths and weaknesses of long-term memory for information that one previously strove to master.[8] In the third article, the authors returned to *when* with a strategy known as "interleaving," which involves mixing related but distinct information during a study or practice session to develop a coherent sense of information by making connections between various priorities.[9] In the fourth article, the authors demonstrated the application of the series' strategies to a common CPD activity, the educational meeting.[10] In this fifth article, the authors address the importance of sleep to learning and memory in CPD, particularly as it relates to distributed practice.

DISTRIBUTED PRACTICE IS AN IMPORTANT LEARNING SCIENCE STRATEGY

This series focuses on three of the most relevant learning science strategies to CPD, specifically distributed practice, retrieval practice, and interleaving. For more details on these strategies, see the previous articles.[7–9] For the purpose of this article, *distributed practice* is the repeated study of priority information from a content area with a cognitive break, ideally a full night's sleep, between study and practice sessions.[7] As an example from the series' article on distributed practice, a nurse practitioner taking a longitudinal course has dedicated 8 hours of study per

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week toward the course. Instead of the initial plan of studying all day on either Saturday or Sunday, the nurse practitioner decides to divide the time, spending 4 hours on Saturday (with a 5-minute break each hour) and 4 hours on Sunday (with similar breaks). Importantly, to ensure distributed practice, overlap exists between the priority information studied on both days.

CPD CREDITS ARE IMPORTANT TO PRACTICING CLINICIANS

CPD refers to clinician participation in structured educational activities designed to maintain and extend professional knowledge, skills, attitudes, competence, and performance required to meet the needs of patients, employers, and society. Various professional organizations accredit members of their group for engagement in CPD activities,[11–13] and joint accreditation for interprofessional activities has been in place for many years.[14] Participation in this life-long process is driven by the professional ethic of nurses, pharmacists, physicians, physician assistants and other health care professionals regardless of whether their job duties include direct patient care or the related activities of leadership, education, and research. Reasons for clinician participation are extrinsically and intrinsically motivated. Extrinsically, CPD participation can be required for licensure, specialty certification, credentialing, and professional society membership. Intrinsically, CPD participation can reflect the motivation to grow personally and professionally; to maximize quality and safety of patient care; to increase confidence, motivation, and job satisfaction; and to be recognized by others.

SLEEP IS ESSENTIAL FOR COGNITIVE FUNCTIONING

As humans, we spend about one-third of our lives sleeping. Sleep is relevant to a significant number of bodily functions, including tissue repair, immunity, hormone regulation, and metabolism.[15,16] However, the most immediate and detrimental consequences of sleep loss are to cognitive functions. Attention, problem-solving, and emotional regulation are all impaired when an individual is sleep deprived.[16–18] Considering how sleep affects all body functions, it is unfortunate that the effects of insufficient sleep (even small amounts) are often underestimated—likely due to a combination of factors such as lack of awareness of the associated reduction in cognitive abilities and impaired emotional regulation, habituation to chronic sleep deprivation, and over-confidence in one's ability to perform well despite the lack to sleep.[19]

The National Sleep Foundation has developed guidelines for the recommended amount of sleep for different age groups, with adults being advised to sleep 7 to 9 hours per day.[20] However, both sleep quantity and quality matter in contributing to an individual's overall well-being. Some factors that influence sleep quality include maintaining a consistent sleep schedule, creating a relaxing bedtime environment, limiting exposure to screens before bedtime, and avoiding caffeine and alcohol close to bedtime. Use of caffeine and alcohol, even occasionally and in moderation, can affect learning and sleep. Caffeine impacts sleep in complicated ways.[21] Caffeine can improve attention and working memory, but this does not translate to better long-term learning.[22] At best, use of caffeine confers no benefit to learning, and at worst, produces over-confidence in one's learning, and this can lead to making less effective learning decisions. In healthy volunteers, while consumption of alcohol can decrease the time it takes to fall asleep (ie, reduction in sleep onset latency), alcohol can delay the first rapid eye movement (REM) period and reduce the total night's REM sleep.[23] As will be described later, sleep stages are important to learning and memory.

To measure sleep quality, Buysse et al[24] developed the Pittsburgh Sleep Quality Index questionnaire. This questionnaire includes 19 statements that lead to seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component is scored, and low scores in even just two of the components can indicate sleep problems. These measures are based on averages, and there is significant inter-individual variability in necessary sleep duration, amount of daytime sleepiness, and vulnerability to the effects of sleep loss.[25] Individuals can also differ in their natural inclination to sleep or to feel alert at certain times each day (chronotype, ie, so-called morning birds or night owls).[26] Still, even with inter-individual differences, sleep quality and quantity are certainly important for those in the health professions, who need to manage the demands of clinical care. However, sleep plays a particularly important role in CPD because sleep is critical to learning and memory.

SLEEP BENEFITS ON LEARNING AND MEMORY

Sleep supports cognitive functioning, including encoding (considering information in working memory) and long-term recall performance (see **Appendix**, **Supplemental Digital Content 1**, http://links.lww.com/JCEHP/A294).[16,27] Importantly, sleep is thought to improve consolidation (storing information in long-term memory), thereby reducing forgetting.[28] In a study published nearly 100 years ago, Jenkins and Dallenbach[29] demonstrated better memory when learning was followed by sleep compared to when learning was followed by an equal length of wakefulness. In a more recent study, Gais et al[30] manipulated when sleep occurred after learning by creating experimental conditions in which participants learned foreign vocabulary at either 8 AM or 8 PM, and then tested at either 8 AM or 8 PM (Fig. 1). Retention intervals of 24 and 36 hours were used to fully cross the time of learning (AM or PM) and the time of testing when learning was measured (AM or PM). Participants were instructed to keep a normal sleep schedule during the experiment, and their sleep logs indicated they slept an average of 7.4 hours per night during the experiment. Thus, those that completed their learning sessions at 8 PM slept soon after learning, whereas those that completed their learning sessions at 8 AM did not.

Results indicated fewer vocabulary terms were forgotten when sleep closely followed learning, regardless of whether the retention interval was 24 or 36 hours.[30] Critically, this means that when participants learned in the evening and slept shortly thereafter, they had better retention of the information 36 hours later than those who learned the following morning and were tested only 24 hours later. In a second experiment, the researchers had all participants learn in the

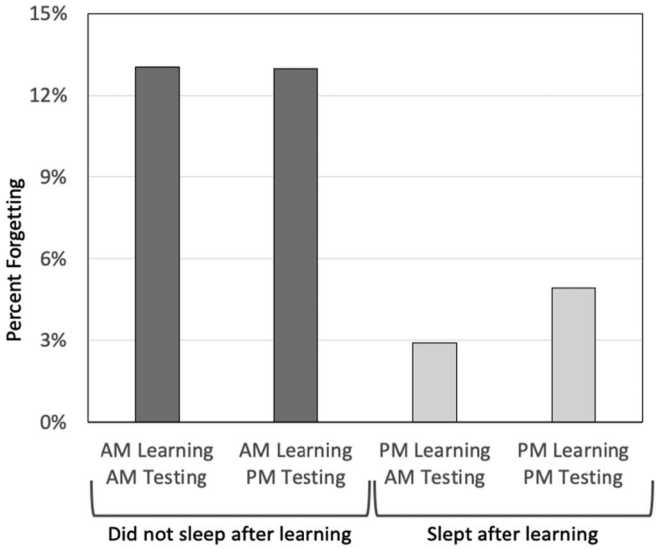

FIGURE 1. Illustration of experiment 1 by Gais et al[30]. Percent forgetting on final test administered 24 or 36 hours after learning for each of the experimental groups. Importantly, two groups did not sleep soon after the learning session, while two groups did sleep after the learning session.

evening, but one group of participants were deprived of sleep after learning. Participants in this sleep deprivation condition were required to stay awake for the night, and then sleep after 6 AM, many hours after learning. On a test 48 hours later, those that slept after learning forgot less than those who stayed awake after learning, demonstrating that learning is not dependent on the time of day, per se, but rather that learning is enhanced by sleep afterward. Other studies have shown similar benefits of sleep for motor learning of procedural skills.[31]

As a person sleeps, they move through multiple sleep cycles, with each cycle typically lasting 90 to 110 minutes. Each sleep cycle contains stages of non-rapid eye movement (NREM) sleep and REM sleep.[32,33] A full night's sleep—involving both NREM and REM—is critical to cognition, with NREM sleep being especially important to strengthening existing memories (consolidation) and preparing the brain for new learning (encoding), and with REM sleep being especially important to extending learning by connecting new information with old (consolidation).[34] Successive sleep cycles differ in the relative amount of time in each of these sleep stages. In the first half of the night, one spends more time in NREM stages, but in the latter half of the night, the REM stage predominates. As such, sacrificing sleep disproportionately affects REM and its associated benefits.

CONSEQUENCES OF INSUFFICIENT SLEEP ON PATIENT CARE AND CLINICIAN HEALTH

Insufficient sleep is a common problem among clinicians, with significant but negative consequences for patient care and clinician health.[35] Insufficient sleep is a contributing factor to medical errors resulting in morbidity and mortality.[36,37] Organizational factors, such as shift work and long hours, increase the risk for shortened sleep duration and sleep disturbances among clinicians. These, in turn, result in fatigue and impairment of various cognitive functions, such as concentration, reaction time, learning ability, memory, mood, communication, emotional coping, and decision-making.[19,38] Since decision-making in healthcare settings is thought to reflect naturalistic decision-making, situational awareness, and effective communication skills, sleep-related cognitive impairments lead to medical and diagnostic errors.[39] In addition to patient harm, insufficient sleep also impacts the health of clinicians. Reviews summarize that over the short term, insufficient sleep is associated with increased needle sticks, workplace injuries, and motor vehicle accidents driving home after work; and, long-term consequences include higher smoking rates, excessive alcohol intake, anxiety, depression, obesity, cardiovascular disease, and a variety of other chronic conditions.[35,36] Appropriately, efforts to mitigate the impact of insufficient sleep on patient safety and clinician health have received national attention.[40,41]

RECOMMENDATIONS FOR AWARDING CPD CREDITS FOR SLEEP

Relying on the honor system that is common in claiming CPD credits, the authors recommend that CPD participants receive credits either directly or indirectly for sleep associated with - before and after (but not during!)—a learning activity. The *direct* approach would involve clinicians' ability to claim CPD credits for the sleep *itself*, such as sleeping ≥7 hours the night *before* an educational activity and ≥7 hours the night *after* the activity. The credit award should be modest but meaningful, and perhaps proportionate (eg, 20%) to the time of the activity proper. With an *indirect* approach, participants would not receive credits for sleep, but they would *only* be eligible for activity credits *if* they attest to having slept adequately (≥7 hours) the night before and after the activity. These are but two examples, among other possibilities, of using CPD credits to incentivize sleep in support of learning.

Conceptually, a precedent for offering CPD credits to incentivize learning through educational activities is the American Medical Association's (AMA) "performance improvement continuing medical education" (PI CME) learning format.[42] The AMA defines PI CME as "... a process by which evidence-based performance measures and quality improvement interventions are used to help physicians identify patient care areas for improvement and change their performance."[42] Available since 2004 and consistent with the editorial described previously,[1] the AMA describes PI CME as a way for planners and clinicians to think differently about CME. PI CME consists of three stages, that is, assessment, implementation, and evaluation. The AMA describes these three stages as learning from: (Stage A) current practice performance assessment; (Stage B) the application of performance improvement to patient care; and, (Stage C) the evaluation of the PI CME effort.[43, p5] With appropriate documentation, clinicians may receive five CME credits for each stage, plus five additional credits (for a total of 20) if they complete all three stages. The last five credits represent an incentive for completing the entire project, as the AMA appropriately recognizes the additional learning-value of the entire *package*. The ability to earn an additional five credits for completing the entire learning activity represents the rough equivalent, in these authors' minds, of receiving credit for sleep associated with preparing to learn (encoding) and with storing what one has sought to learn (consolidation).

RECOMMENDATIONS FOR CPD PARTICIPANTS AND PLANNERS

Any educational activity worth attending is worth learning from, and anything worth learning is worth remembering. Whether associated with credits or not, CPD *participants* attending activities should do their best to obtain a full and quality night's sleep before a CPD activity to prepare their brains to encode priority information. Furthermore, a full night's sleep is equally important following a day of learning to give the brain the opportunity to consolidate as much of that priority information as possible. While many factors are beyond a clinician's control, planning in and around activities is important. Arranging one's call schedule to protect the night before and after an educational activity, particularly a long or intense one, is one example of factors that influence learning and memory. Not having travel, caffeine, or alcohol compromise the amount or quality of sleep represent other examples. To maximize sleep and learning, it is best to avoid caffeine within 6 hours of bedtime[44] and to avoid alcohol entirely.

CPD *planners* should communicate the importance of sleep in recruiting participants to activities and in explaining decisions made to increase the likelihood that participants will be well-rested prior to and following activities. To the extent possible, planners should incentivize learning by making decisions that are consistent with the importance of sleep. In addition to offering CPD credits, directly or indirectly, for sleep, starting and ending activities at reasonable times can increase the likelihood that participants will receive adequate rest. Furthermore, planners and facilitators should model and share appropriate behaviors to ensure sleep. For example, only serving decaf coffee in the late afternoon or evening (with an explanation), and not having late-evening or early-morning events, would reinforce the importance of sleep.

CONCLUSION

Sleep is the ideal cognitive break to support the learning-science strategy, distributed practice, which allows the brain to process priority information between two or more study sessions involving it. Sleep is essential to various physiological functions, including cognitive ones, so obtaining adequate sleep before and after learning activities is important to working and long-term memory and to personal health in general. CPD activities strive to ensure that clinicians maintain and extend their expertise in support of patient care and other professional responsibilities. If clinicians do not have a full night's rest before and after a CPD activity, they will be less likely to grasp and to store such information, no less be able to retrieve such information subsequently in the service of their professional roles. To increase awareness of the importance of sleep, and to incentivize it in the context of CPD, clinicians should receive credits, directly or indirectly, for obtaining adequate rest ($\geq$7 hours) the night before and after an activity. Learning science can inform the imagination of CPD participants and planners alike, and ensuring adequate rest is yet another vehicle to enhance knowledge, skills, attitudes, competence, and performance.

Lessons for Practice

- Clinicians may be relatively well-versed with some of the health benefits of sleep, but many clinicians may not fully appreciate the importance of sleep to learning and memory as it relates to CPD activities.
- Prior to and following an educational activity, a full night's rest is essential to encoding (working memory function) and consolidating (long-term memory function) priority information.
- Explanations about the importance of sleep, and incentives (CPD credits or otherwise) to be well-rested before, during, and after educational activities, are essential, as is emphasizing the distinct but complementary roles that planners and participants have in learning.

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