ELSEVIER

Encyclopedia of Sleep (2nd Edition) - CONTRIBUTORS' INSTRUCTIONS

PROOFREADING

The text content for your contribution is in its final form when you receive your proofs. Read the proofs for accuracy and clarity, as well as for typographical errors, but please **DO NOT REWRITE**.

Titles and headings should be checked carefully for spelling and capitalization. Please be sure that the correct typeface and size have been used to indicate the proper level of heading. Review numbered items for proper order – e.g., tables, figures, footnotes, and lists. Proofread the captions and credit lines of illustrations and tables. Ensure that any material requiring permissions has the required credit line and that we have the relevant permission letters.

Your name and affiliation will appear at the beginning of the article and also in a List of Contributors. Your full postal address appears on the non-print items page and will be used to keep our records up-to-date (it will not appear in the published work). Please check that they are both correct.

Keywords are shown for indexing purposes **ONLY** and will not appear in the published work.

Any copy editor questions are presented in an accompanying Author Query list at the beginning of the proof document. Please address these questions as necessary. While it is appreciated that some articles will require updating/revising, please try to keep any alterations to a minimum. Excessive alterations may be charged to the contributors.

Note that these proofs may not resemble the image quality of the final printed version of the work, and are for content checking only. Artwork will have been redrawn/relabelled as necessary, and is represented at the final size.

DESPATCH OF CORRECTIONS

PLEASE KEEP A COPY OF ANY CORRECTIONS YOU MAKE.

Proof corrections should be returned in one communication to Justin Taylor (slscproofs@elsevier.com), by 21-Jul-2011 using one of the following methods:

1. **PREFERRED**: Corrections should be annotated (marked-up) in the PDF file and sent to Justin Taylor in the Elsevier MRW Production Department at **slscproofs@elsevier.com**.

2. Listed in an e-mail or in a Word document and sent to Justin Taylor in the Elsevier MRW Production Department at **slscproofs@elsevier.com**.

The e-mail should state the article code number in the subject line. Corrections should be consecutively numbered and should state the paragraph number, line number within that paragraph, and the correction(s) to be made.

3. Marked-up hardcopy by courier to **Justin Taylor, Elsevier MRW Production Department, The Boulevard, Langford Lane, Kidlington, Oxford, OX5 1GB, UK.** If it is not possible to courier your corrections, please fax the relevant marked pages to the Elsevier MRW Production Department **(fax number: +44 (0)1865 843974)** with a covering note clearly stating the article code number and title.

Note that a delay in the return of proofs could mean a delay in publication. Should we not receive corrected proofs within 3 weeks, Elsevier may proceed without your corrections.

CHECKLIST

Author queries addressed/answered?	❏
Affiliations, names and addresses checked and verified?	❏
Permissions details checked and completed?	❏
Outstanding permissions letters attached/enclosed?	❏
Figures and tables checked?	❏

If you have any questions regarding these proofs please contact the Elsevier MRW Production Department at **slscproofs@elsevier.com**

SLSC: 00076

Non-Print Items

Abstract:

This article addresses the function of napping from a variety of approaches including the historical/cultural perspective; the possibility of an underlying biological drive; the effect of napping in specialized populations and conditions (e.g., sleep-deprived people and nightshift), and the benefits of napping for well-rested subjects. Exploiting the short and discrete nature of naps, as well as better methodological controls compared with nocturnal sleep studies, recent work has isolated the benefit of specific sleep stages on a variety of memory processes. Thus, napping has been shown to be an effective fatigue management tool as well as a performance enhancer for a wide range of memory processes in nonsleepy populations.

Keywords: Alertness; Circadian; Fatigue; Learning; Memory; Nap; Rapid eye movement (REM); Sleep; Sleepiness; Slow-wave sleep (SWS); Stage two

Author and Co-author Contact Information: Au3

Sara C. Mednick
Department of Psychiatry
University of California, 9116a
3350 La Jolla Village Drive
San Diego
CA 92116
USA
E-mail: smednick@ucsd.edu

Author Query Form

Book: Encyclopedia of Sleep (SLSC)
Article No.: 00076

Dear Author,

During the preparation of your manuscript for typesetting some questions have arisen. These are listed below. Please check your typeset proof carefully and mark any corrections in the margin of the proof or compile them as a separate list. Your responses to these questions should be returned within seven days, by email, to MRW Production, email: SLSCproofs@elsevier.com

Query	Details Required	Author's response
AU1	Please provide a Glossary of unfamiliar or technical terms.	
AU2	Please provide a brief biography and color photograph of yourself.	
AU3	Please check the full affiliations for accuracy. These are for Elsevier's records and will not appear in the printed work.	
AU4	The last part of the sentence ''Exceptions to this are. . .'' has been deleted as it is a repetition of the first part of the sentence. Please approve or reword.	
AU5	Please provide a list of articles within this Encyclopedia for the See Also section. A full table of contents is available on EMSS or on the project website.	
AU6	Please provide volume number for the reference "Carskadon and Dement (1986)".	
AU7	As per style, "et al." is allowed in references only if the number of authors in a reference is >6. Please provide the complete list of author names for all "et al."-type references if the number of authors is <6.	
AU8	Please provide names for the websites.	

a0010 # Naps

Au1,2,5 **S C Mednick**, University of California, San Diego, CA, USA

s0010 ## Napping from a Historical/Cultural Perspective

p0010 Daytime sleep, or napping, has a long history in Southern regions of the globe in the form of a siesta. By the first century BC, the Romans had coined a word for the afternoon break: *meridiari*, derived from the Latin word for *midday*. Later, the church divided the day into periods designated for specific activities, such as meals, prayer, and rest. Midday became known as *sexta*, as in the sixth hour (noon by their way of counting), a time when everyone would take rest and pray. The word has survived as the familiar term, *siesta*. This postprandial sleep disappeared in northern Europe with the industrial revolution, but remained a strong tradition in southern Europe and many Latin American cultures where people would shutter their businesses for a few hours to return home, eat a meal, sleep, and then return to work from 16.00 until 21.00. While the 'siesta' culture continues today, enthusiasm for the siesta has decreased substantially in these regions.

p0015 Currently napping is most popular in highly industrious cultures such as Japan and Germany, whereas countries such as Spain or Italy have begun phasing out the practice. Current beliefs about midday rest are being reassessed perhaps due to the changing needs of modern culture. The increase in 24-h work cycles, the regularity of international travel and communication with global markets, long work days, and longer commutes have brought on a host of secondary problems that require attention. Reports show continual decreases in nocturnal sleep, increases in sleep disorders, and increases in sleepiness-related accidents. The nap is thus being increasingly investigated as an inexpensive, noninvasive, short period of sleep strategically implemented for sleepiness and fatigue management, sustained productivity and alertness, and optimal cognitive processing.

p0020 This article will summarize this emerging body of research, covering its possible biological basis, implementation during nightshift and sleep deprivation studies, and the promising new directions investigating the dose- and sleep stage-dependent benefits possible through targeted napping schedules designed to improve performance on a wide variety of behavioral measures.

s0015 ## Definitions and Demographics of Napping

s0020 ### What Is a Nap?

p0025 Naps, at least as discussed herein, are defined as intended periods of sleep that can last anywhere from 3 min to 3 h and can be taken anytime during the day or night. Meta-analysis of surveys and diary studies of American populations shows that naps range usually between 0.5 and 1.6 h. Naps should be distinguished from microsleep, which is a brief, involuntary period of sleep lasting from seconds to minutes. In addition, naps should be distinguished from 'major' sleep periods that typically occur overnight and typically last at least 5 h or more (of course, in nightshift workers, these major sleep periods occur during the day).

Changes in Napping Behaviors Across the Life Span s0025

Napping patterns shift throughout life. In infancy, two basic types of sleep emerge: quiet sleep and active sleep. These are the infant equivalent of non-rapid eye movement (NREM) and rapid eye movement (REM) sleep seen in adults. Over 50% of neonate sleep is active (while premature babies can achieve levels as high as 80%), but that number will drop to 30% by the end of the first year. Infants have shorter sleep cycles than adults, with the typical cycle lasting 50–60 min as opposed to 80–100 min in adults. Interestingly, infants also commonly show sleep-onset active sleep, especially after feeding – a sleep pattern considered pathological in adults. By the age of two, REM sleep occupies 20% of total sleep – a figure that remains relatively common throughout the rest of life. Napping emerges after 3 months of age, when sleep coalesces into a nocturnal sleep period, a shorter nap (0.5–1 h) in the morning around 10.00, and a longer nap (1–3 h) in the afternoon. Eventually napping consolidates into one long afternoon nap and then the nap disappears in most children around age four, reappearing in teenage years and into college years, where up to 60% of students report regular napping habits. p0030

A 2009 Pew Center for Research study reported that one in three adults report napping in the past 24 h. Although there are sex differences in nap habit, this varies with age. More than 4 in 10 (41%) men aged 50 and older say they napped in the past day, compared with just 28% of women of the same age. Below the age of 50, men and women are about equally likely to say they napped in the past day (35% vs. 34%). On average, men's nocturnal sleep appears to be less efficient, so men may simply need a nap more than women. Specifically, studies of young adults show that males not only spend more time in bed awake compared to females, but also enjoy less slow-wave sleep (SWS) and REM sleep than females. Troubled sleep occurs in women as well, of course, but typically begins later in life, resulting in part from hormone fluctuations that occur across a woman's lifetime. p0035

In general, napping behavior changes as a function of aging. Older adults nap more frequently (more than half) and later in the day compared with younger adults. There may be multiple underlying causes for these differences, including nocturnal sleep deterioration, weaker circadian rhythm and circadian phase advance, or simply that the elderly have more time to practice elective napping. Some studies have shown that napping in older adults is related to decreases in slow-wave activity and reduced sleep efficiency, whereas napping was not related to nocturnal sleep parameters in normal adults or insomniacs. p0040

A number of studies have investigated interference from napping on nocturnal sleep parameters, likely due to the relieving p0045 of sleep pressure, the biological drive to go to sleep that increases as a function of time awake. In general, naps are reported to not interfere with nocturnal sleep. Exceptions to Au4 this are that naps can decrease slow-wave activity in subsequent sleep episodes (1) when naps are taken within a 2–3 h window from nocturnal sleep, bedtime, and (2) when naps are taken during a nightshift.

p0050 The Pew study reported that napping habits vary across race and income groups. Specifically, half of the black adults in the survey reported napping in the past 24 h, compared with a third of whites and Hispanics. Napping is more common at the lower end of the income scale; 42% of adults with an annual income below $30 000 report they napped in the past day. As income rises, napping declines. However, at the upper end of the scale (adults whose annual income is $100 000 or above) the tendency to nap revives and reverts to the mean.

s0030 Is Napping a Natural Part of Our Circadian Rhythm?

s0035 The Timing of Naps

p0055 When napping is examined in the laboratory the consistent finding is that daytime sleepiness is a regularly occurring phenomenon. The afternoon 'nap zone,' first proposed by Broughton, is a period between 14.00 and 16.00 when daytime sleep propensity is highest. Such a propensity for diurnal sleep has been demonstrated in a variety of different experimental milieus, including with removal of all temporal constraints or 'free-running' conditions during ultrashort routines, in which sleep–wake schedules occur over a 90-min period, and as evidenced in the classic 'M-shaped' time of day function in studies of sleep propensity using the Multiple Sleep Latency Test (MSLT: a test in which the time it takes to fall asleep, sleep onset latency, is measured at regular intervals across the day). Even in studies when subjects are specifically asked not to nap, resistance to daytime sleep has been weakest during these afternoon hours. Due to the time of day, increased sleep propensity occurs as well as the historical development of napping behaviors, which has been (perhaps misleadingly) termed 'the postprandial dip.' Studies have shown, however, that the energy slump occurs even in the absence of lunch and/or without knowledge of the time of day.

s0040 Physiological Evidence for 'Nap Zone'

p0060 A fluctuation in core body temperature (CBT), a fundamental measure of circadian rhythms, represents the best physiological marker to correlate with increased afternoon sleep propensity. Generally speaking, there is a rise in temperature across the daytime and a decrease during the night. The falling temperature traditionally has been considered an important trigger for onset and method of sustainment for nocturnal sleep. CBT starts to fall prior to habitual bedtime and reaches its lowest point approximately 2 h prior to habitual wake time (typically between 03.00 and 05.00 in most adults). Though circadian fluctuation of CBT can be fitted with a simple sinusoid function spread across the 24-h period, further investigations have found that CBT is better described by adding a 12-h bi-circadian component to the model, which corresponds to a robust finding of a dip in temperature in the afternoon. The afternoon dip in temperature corresponds to the time when subjects show a greater sleep propensity. Although decreases in CBT are temporally correlated with increases in sleepiness, a direct mechanistic link has yet to be discovered. Sedative-hypnotics such as melatonin and benzodiazepines decrease CBT and increase peripheral heat loss, which has been directly related to sleep onset latency. In contrast, agents such as caffeine, amphetamines, nicotine, and cocaine decrease sleep propensity and increase CBT. Further, studies have shown that the best predictor of sleep onset (better than melatonin) was the distal–proximal skin gradient, an index of peripheral heat loss. Thus, it is likely that a decrease in temperature (CBT and peripheral heat) is a trigger for sleep in general, and possibly also for afternoon naps. The duration of a sleep episode may also be related to the direction of change in CBT, that is, long nocturnal sleep occurs during an extended period of decreased temperature while short sleep occurs when CBT increases. Studies have found that increases in CBT are related to more frequent awakenings. Further research is needed to disentangle the causal relationship between changes in CBT and daytime sleep onset.

Behavioral Markers for the 'Nap' Zone s0045

Anecdotal evidence for behavioral measures of the 'nap' zone p0065 can be easily found in any typical workplace, with decreased productivity and increased caffeine consumption during the afternoon, as well as in increased traffic accidents during this time of day (even after taking into account the increased number of cars on the road). On the other hand, it has been more difficult to find consistent laboratory evidence for behavioral markers. Two factors are most likely the cause. First, there may be specific cognitive processes that are vulnerable to circadian peaks and troughs, while others are not. For example, tasks that rely on continuous performance show dips in the afternoon, such as card sorting, serial search, a variety of signal detection tasks, and physical exertion such as sprinting. Memory tasks and perceptual tasks, on the other hand, have not shown a strong circadian component. Second, individual differences are likely to produce a large source of variation. Intriguing findings of individual differences in vulnerability to a mid-afternoon performance deficit on a monotonous visual vigilance task demonstrated that only half of the subjects showed the 14.00 performance dip. Monk and colleagues compared the CBT of the 'dippers' to the 'nondippers' and showed that performance decreases coincided with a flattening of the CBT in the dippers, whereas CBT in the nondippers continued to increase in a linear manner during this period.

Monk proposed that an individual's propensity for midday p0070 decreases in performance may be predicted by a combination of the individual's endogenous circadian pacemaker and the length of time the individual has been awake (i.e., magnitude of sleep pressure). Specifically, "the size (or timing) of the 12-h temperature rhythm component might be predictive of the size (or presence) of a postlunch dip in performance" (p. 126). Further research investigating other biological and genetic determinants of midday dip vulnerability, such as morningness and eveningness measures proposed by Horne, will be extremely interesting pieces of information for answering these questions.

s0050 What Is the Function of Naps?

p0075 Now that we have provided evidence in favor of naps being a natural part of sleep–wake cycles, at least in some individuals, we turn our attention to the possible function of naps. As stated in the opening of the article, the concept of 'function' can take many forms. For example, one can ask whether the function of a nap is the same as the function of sleep in general, or if it serves a purpose separate from that of the major sleep period. While we do not yet fully understand why we sleep, we do know that there is a variety of molecular, genetic, and physiological processes that occur exclusively, or primarily, during sleep. For the most part, research has not examined whether these same changes occur during naps. What has been examined, though, are the behavioral and cognitive benefits of a nap under a variety of conditions. In other words, research has examined how naps help individuals function better. Thus, it is this more operational definition of 'function' that we shall discuss here.

s0055 Sleepiness Versus Fatigue Countermeasures

p0080 In the broadest sense, naps are used operationally as either sleepiness countermeasures or fatigue countermeasures. The distinction between sleepiness and fatigue is one that is, unfortunately, often blurred or confused, but is an important distinction to keep in mind. Sleepiness is the physiological propensity to fall asleep, either intentionally or unintentionally. As discussed earlier, the circadian rhythm of the CBT is one traditional biomarker of sleepiness. When naps are used as a sleepiness countermeasure the intended function is to increase arousal and alertness. This increased alertness level may, in turn, produce better performance. In contrast, fatigue refers to a decrease in physical or cognitive efficiency related to time-on-task and workload, independent of whether or not someone has a propensity to fall asleep. When naps are used as a fatigue countermeasure, the intended function is to directly boost performance. Most often, the term 'fatigue countermeasure' is incorrectly used to cover both functions (of not only naps, but interventions such as caffeine) when used in operational settings.

s0060 Napping in Sleep-Deprived Conditions

p0085 Until recently, napping research has focused primarily on treating sleepiness during extended work periods, such as long-haul truck driving, transatlantic airplane routes, and NASA spaceflight, as well as during nontraditional work schedules such as nightshift. In these circumstances sleepiness due to sleep deprivation is a common danger and has been implicated as contributing to accidents during work and transit from work to home, as well as to increased health problems in these workers.

p0090 Nightshift work is particularly vulnerable to extreme performance decrements due to unintentional sleep, increased sleepiness, and decreased performance for most skills including vigilance, reaction time, serial addition/subtraction, spatial orientation, and flight-simulator operation. Critical hours for increased errors and slowness are between 03.00 and 05.00 (coinciding with CBT nadir). The two main sources of reduced alertness and performance during night work are (1) the circadian rhythm of sleepiness and alertness (as discussed earlier); and (2) increased homeostatic sleep pressure. Contributing to this difficulty with nightshift work is the poor adaptability of circadian regulated processes such as endocrine, sleep, CBT, adrenaline, alertness, and other physiological rhythms to even long-term (2–3 months) reversal of sleep–wake cycles. Even workers on permanent nightshift schedules do not show a change in the timing of the circadian system and continue to show reduced performance and increased mistakes after years on the nightshift. Thus, the need to find sleepiness and fatigue management solutions for this population is imperative.

Work-related napping strategies have categorized three p0095
types of naps: 'prophylactic napping' (taken in anticipation of sleep deprivation), 'compensatory napping' (taken after sleep deprivation has begun), and 'operational napping' (napping during working hours). Overall, prophylactic napping taken just before the work night seems to best enhance performance overnight, although a combination of prophylactic napping and caffeine may work even better. With respect to operational napping, it has been found that both pilots and truck drivers unofficially nap during nightshifts and long-haul transportation trips. Research has shown that a 20-min operational nap between 01.00 and 03.00 significantly improved speed of response on a vigilance task measured at the end of the shift compared with a control condition. The potential problem with napping during the night is that there is increased risk for waking with sleep inertia. Sleep inertia is the feeling of slowness, irritability, and poor decision-making ability that can occur during the first 20–30 min after waking from deep sleep, although this period may be shorter with naps than with longer sleep periods. Methods for combating sleep inertia, however, have been proven successful, including exposure to bright light, washing the face, exercise, and a dose of caffeine. Apart from performance on specific measures, napping has been shown to generally improve alertness, productivity, and mood, and this may be especially so under sleep-deprived conditions, during nightshift work, and during prolonged periods of driving.

Cognitive Benefits of Napping Linked to Specific Stages of Sleep s0065

In the turn of the twenty-first century, naps began to be inves- p0100
tigated as an experimental tool to understand cognitive processing. Studies utilizing nocturnal sleep reported that at least 6 h of sleep were required between training and test on a perceptual learning task to show improvement, compared with sleep-deprived controls or controls tested across 12 h of daytime. As these control groups were nonoptimal (i.e., fatigue effects, and time of day testing confounds), naps appeared to be an alternative method of studying the effects of sleep on memory consolidation. This is due to the fact that nappers are compared with subjects who do not nap, and both experimental groups are tested at the same time. Recent studies investigating the impact of napping on a variety of memory consolidation measurements have in fact provided evidence for nap-dependent performance on a range of memory tasks. Furthermore, these studies have related these napping-related improvements to specific sleep stages.

p0105 Another important methodological aspect of napping that has been exploited by these studies is that sleep during naps can be titrated to have specific stages without disturbing the napper's sleep. This is accomplished primarily by manipulating the duration and timing of the nap. Such manipulations have been attempted during nocturnal sleep studies by depriving subjects of sleep during the first or the second half of the night, in order to isolate SWS or REM sleep. Although selective cognitive benefits have been shown, this method does not actually isolate stage 2, SWS, or REM sleep. Naps, on the other hand, have shown a high degree of specificity in performance between stage 1 alone and stage 1 and 2 combined, and between naps with SWS alone and SWS and REM sleep combined.

p0110 Hayashi et al. demonstrated the recuperative power of napping for sleepiness and alertness measurements even with a 5-min nap limited to stage 1 sleep. They reported that performance improvement on a visual detection task and digit symbol task, as well as decreases in slow eye movements during testing, required a nap with stage 2 sleep. Walker demonstrated that a nap can improve performance on a motor-learning task to the same degree as a full night of sleep, with stage 2 sleep playing an important role.

p0115 Naps rich in SWS have been shown to improve declarative memory for pictures or word pairs after a nap, as well as prevent deterioration in performance that develops across the day. Mednick and colleagues have reported a series of studies establishing the efficacy of naps in combating performance deterioration. These studies utilized a visual perceptual task in which individuals reliably show significant decreases in performance with repeated testing across the day, even when the test is only given twice. Importantly, they found that a 60-min midday nap rich in SWS can reverse perceptual deterioration and restore performance to baseline with long-lasting benefits to performance.

p0120 Naps including both SWS and REM sleep actually led to an improvement in perceptual performance equivalent to that following a full night of sleep. Furthermore, when subjects are tested after a nap and a full night of sleep they demonstrate as much benefit as two nights of sleep, indicating that sleep-dependent learning is similarly effective whether it is from daytime naps or nocturnal sleep. Moreover, the benefits from napping and nocturnal sleep are additive.

p0125 It should be emphasized that these sets of studies examined performance after a normal night of sleep, rather than following a period of sleep deprivation. Thus they showed that naps can enhance performance beyond even 'normal' levels.

p0130 Cai and colleagues addressed a long-standing question about the relationship between dream-rich REM sleep and creativity. Using a creativity task called a Remote Associates Test (RAT), subjects were shown three words (such as cookie, heart, sixteen) and asked to find a fourth word that can be associated to all three words (sweet, in this example). The researchers manipulated various conditions of prior exposure to elements of the creative problem, and controlled for memory. Participants grouped by REM sleep, non-REM sleep, and quiet rest were indistinguishable on measures of memory. Despite the quiet rest and non-REM sleep groups receiving the same prior exposure, they displayed no improvement on the RAT. However, the REM-sleep group improved by almost 40% above their morning performances. The authors hypothesize that the formation of associative networks from previously unassociated information in the brain which leads to creative problem solving is facilitated by cholinergic and noradrenergic neuromodulation during REM sleep.

Summary s0070

In examining the function of naps it appears that modern culture has redefined its function to suit the needs of an increasingly 24-h society. The amount of nocturnal sleep continues to decrease as labor demands increase in duration as well as an increase in around-the-clock work schedules. Thus the nap serves as both a fatigue and sleepiness countermeasure. Some studies demonstrate that napping in the afternoon may in fact be an inherent part of our natural sleep–wake cycle, as evidenced by physiological and performance decreases during the afternoon that temporally coincide with increased propensity to sleep. Most research on napping has examined either alertness or specific cognitive benefits. An important consideration that has emerged from this body of research is that specific stages of sleep can confer specific benefits to performance. Overall, naps seem to provide a number of possible benefits to memory, and are a methodologically strong approach to examining the contributions of sleep stages to memory consolidation, but this area of investigation is still young. Important areas for future research concerning the function of naps will include the medical, physiological, and psychological benefits of napping that have been reported to occur with nocturnal sleep. p0135

Further Reading

Cai DJ, Mednick SA, Harrison EM, Kanady JC, and Mednick SC (2009) REM, not incubation, improves creativity by priming associative networks. *Proceedings of the National Academy of Sciences of the United States of America* 106: 10130–10134.

Carskadon MA and Dement WC (1986) Effects of a daytime nap on sleepiness during sleep restriction. *Sleep Research* 15–69. Au6

Dinges DF and Broughton RJ (eds.) (1989) *Sleep and Alertness: Chronobiological, Behavioral and Medical Aspects of Napping*, pp. 171–204. New York: Raven Press.

Hayashi M, Motoyoshi N, and Hori T (2005) Recuperative power of a short daytime nap with or without stage 2 sleep. *Sleep* 28(7): 829–836.

Mednick SC, Cai DJ, Kanady J, and Drummond SPA (2008) Comparing the benefits of caffeine, naps and placebo on verbal, motor and perceptual memory. *Behavioural Brain Research* 193: 79–86.

Mednick SC, Nakayama K, Cantero JL, et al. (2002) The restorative benefit of naps on perceptual deterioration. *Nature Neuroscience* 5(7): 677–681. Au7

Mednick SC, Nakayama K, and Stickgold R (2003) Sleep-dependent learning: A nap is as good as a night. *Nature Neuroscience* 6(7): 697–698.

Monk TH, Buysse DJ, Carrier J, et al. (2001) Effects of afternoon "siesta" naps on sleep, alertness, performance, and circadian rhythms in the elderly. *Sleep* 24(6): 680–687.

Monk TH, Buysse DJ, Reynolds CF 3rd, et al. (1996) Circadian determinants of the postlunch dip in performance. *Chronobiology International* 13(2): 123–133.

Rosekind MR, Gander PH, and Dinges DF (1991) Alertness management in flight operations: Strategic napping, SAE Technical Paper Series, 912138.

Stampi C (ed.) (1992) *Why We Nap, Evolution, Chronobiology, and Functions of Polyphasic and Ultrashort Sleep*. New York: Springer; ISBN: 0817634622.

Walker MP and Stickgold R (2005) It's practice, with sleep, that makes perfect: Implications of sleep-dependent learning and plasticity for skill performance. *Clinics in Sports Medicine* 24(2): 301–317; ix.

Relevant Websites Au8

www.nationalsleepfoundation.org
www.takeanap.info