WORKPLACE INTERVENTIONS

LITERATURE REVIEW

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INTRODUCTION

The average adult spends about 90,000 waking hours at work in their lifetime. As such, not engaging in healthy behaviors at work can have seriously undermine one's wellbeing.

Workplace behavior change interventions, or workplace nudges, are strategies used to encourage people to act in their own self-interest. These interventions can be made possible with the help of digital technology, such as mobile applications or email, as well as choice architecture design in the physical environments of the workplace, such as posters, objects or furniture arrangement. To this end, we are going to focus on walking, napping, and eating.

First, we will examine general workplace wellness programs - what other researchers have tried, how employees reacted to the programs, and their impact. Then, we will go into further detail about interventions related to our three focus areas.

The average adult spends about 90,000 waking hours at work in their lifetime.

WORKPLACE WELLNESS

Workplace wellness programs study.

MATTKE ET AL. (2013) found that through utilizing the RAND Employer Survey, ²/₃ of employers with at least 50 employees and workplace wellness programs use financial incentives to encourage program completion, and 10% use incentives that are tied to health-related standards. About half of employers with wellness programs offer incentives directly to employees, while 31% administer through group health plans. 20 percent administer incentives both directly and through their plans. Larger employers are more likely than smaller employers to administer their own incentive schemes. Incentives are framed as rewards, with 84% of all employers using rewards over penalties. Incentives are offered in financial form (cash or health insurance premium surcharges) and t-shirts or gift cards (50% of employers use this method).

Gym discounts (42 percent) and cash incentives (21 percent) were cited as common ways to reward program participants for health-related behaviors. 4/5 employers in the meta-analysis studies reported using some form of financial incentive, and all five employers used novelties (t-shirts, tickets to events) to engage employees. Employers use incentives to increase employee participation in wellness screening activities (31 percent for HRA completion and 20 percent for clinical screenings) and encourage employees to join intervention programs (30 percent for lifestyle management and 4 percent for disease management). Employers who use incentives for screening activities had significantly higher participation rates than those who do not (63% vs. 29% for HRA completion and 57% versus 38% for clinical screenings).

CCA data shows incentives for HRA completion are effective, above a threshold of $50. The incentive amount for HRA completion had a significant effect on HRA completion rates in that an increase in the HRA incentive by $10 is associated with a 1.6% point increase in the HRA completion rate for incentives in the range of $0–$100.

Cost-effective analysis.

UK and US governments have increased support for using financial incentives to encourage healthier lifestyle choices, however, there is little evidence for the cost-effectiveness of these interventions. **DALLAS ET AL. (2013)** perform a cost-effectiveness analysis of a quasi-experimental trial, through looking at the use of financial incentives to increase employee physical activity levels, from both a healthcare and employer's perspective.

Employees used a 'loyalty card' to monitor their physical activity at work over 12 weeks. There were two groups, the *Incentive Group* (n=199) in which they collected points and received rewards for minutes of physical activity completed and also the *No Incentive Group* (n=207) self-monitored their physical activity only. Through a baseline and 6-month follow up, the Quality of life (QOL) and absenteeism were measured. QOL scores were transformed into productivity estimates using an algorithm. The additional costs of the *Incentive Group* were divided by the additional quality adjusted life years (QALYs) or productivity gained to calculate incremental cost effectiveness ratios (ICERs). Cost-effectiveness acceptability curves

(CEACs) and population expected value of perfect information (EVPI) was used to characterize and value the uncertainty in our estimates.

Overall, the results showed that the *Incentive Group* performed more physical activity over 12 weeks and by 6 months had achieved higher gains in QOL/ productivity. The confidence intervals surrounding these ICERs were wide, CEACs showed a high chance of the intervention being cost-effective at low willingness-to-pay (WTP) thresholds. Thus, the Physical Activity Loyalty card (PAL) scheme is potentially cost-effective from both a healthcare and employer's perspective.

EMPLOYEE OPINIONS OF WELLBEING INTERVENTIONS

SPENCE (2015) examines participation rates in workplace wellbeing programs and proposes several explanations for why participation may be low, based on results from a pilot employee "WorkWell" program. Spence also notes that in the US, many wellbeing programs are bolstered by incentive systems, implying that employees are not intrinsically motivated to participate in these programs. From a theoretical perspective, the author proposes several reasons for low participation, including: "service-needs misalignment, time and work pressures, access to resources, individual change readiness, personal locus of responsibility and/or perceptions about the balance of responsibility for change."

As part of a pilot wellbeing program, 60 employees from two companies, one relatively small (96 employees) and the other relatively large (3,000 employees) were interviewed and qualitatively analyzed. Specifically, questions were aimed at what companies could do to improve employee wellbeing. Of the 60 interviews, 26 participants listed improved communication as the most desired change to enhance job satisfaction. Somewhat surprisingly, better pay was the most desired change for only 7% of the interviewees. The authors suggest that companies will need to focus on basic psychological needs ("supporting the autonomy, competence and relatedness needs of employees") in order to build effective wellbeing programs with strong participation.

RONGEN ET AL. (2014) examined employees needs and preferences for health promotion programs (HPPs), finding that HPPs aimed at physical health and those organized via the employer were the most favored. 738 employees of 2 companies participated in a study in which they provided information regarding their needs and preferences for HPPs at baseline, and were measured for participation in HPPs 6-months later. The authors independently determined the level of agreement between preferred and provided programs, and determined the effect of this agreement level on participation. Specifically, interviews asked about which programs employees felt were needed (physical activity, healthy nutrition, smoking cessation, stress management, general health), what structure they favored (organized by employer vs. at their own discretion), which method of delivery was preferred (group vs. individual), desired level of intensity (single vs. multiple meetings), and preferred content structure (information provision vs. assignments).

Analysis showed that 55% of participants reported need for an HPP aimed at physical activity, compared to 33% for healthy nutrition and 7% for smoking cessation, among other proposed needs. On the whole, 59% of employees preferred programs organized through their employer, 67% favored individual-focused programs vs. group programs, and 62% favored a multiple-meeting format. Programs that were judged to be in more "agreement" with employee needs/preferences were more likely to elicit participation, and participants with a higher level of agreement across all HPP categories/components had an odds ratio of 2.36. However, no statistical significance was found for the relationship between need-HPP agreement and actual program participation, perhaps due to the relatively low participation rates overall.

HANNON ET. AL. (2012) conducted a study on stakeholder perceptions of workplace health promotion, finding that midsize, low-wage employers face the largest barriers to implementing workplace health promotion. The study consisted of five, 1.5 hour focus groups with representatives of mid-sized workplaces in Seattle. These representatives were all HR professionals in charge of workplace health promotion in low-wage industries, including manufacturing, education, and accommodation/food services. Most of them said that workplace health promotion was appropriate, but **many said they thought it might be intruding on workers' personal lives.** Other barriers included cost, time, logistics, and unsupportive culture. They also said that workplace health promotion should be extended to workers' partners, but were unsure how to do so. Overall conclusions included that workplace health promotion vendors must offer inexpensive and easy-to-adapt programs.

SHEPHARD (1999) conducted a meta-analysis of studies on high-profile work-site wellness programs, finding that, in general, these programs improve wellness and productivity. However, he finds that these programs attract employees who already have a favorable attitude toward health. Other effects include reduced absenteeism and employee turnover, and reduced healthcare costs. He identifies the biggest challenge as sustaining long-term participation in wellness programs. It may be useful to think about what kind of employees companies have: are they generally ones who are already very health-conscious, and thus more likely to react favorably to wellness programs? And on the other side, how should companies persuade non-health conscious people to participate when they may not be inclined to do so?

IMPACT OF WORKPLACE WELLBEING PROGRAMS

Meta-analysis on ROI for workplace health programs.

Given previous studies finding a positive return on investment for workplace health programs, **BAICKER, CUTLER, AND SONG (2010)** conducted a meta-analysis on studies that examined costs and savings associated with workplace health programs. They limited their analysis to 32 publications (and 36 studies) that had a well-defined intervention, treatment and comparison group, and intervention. These studies all had a health risk assessment in the beginning, voluntary participation in the program at treatment sites, and other screening tests to measure for risk factors. Overall, these studies provided educational material,

individual or group counseling, and incentives to increase health factors like weight loss/fitness, smoking, and obesity.

For those studies which directly reported the savings for the employer, the researchers found that all studies reported a positive return on investment. However, studies reported this in different ways: an average calculated return on investment for the 15 studies which explicitly reported their savings and costs was 3.37, while other studies reported a 2.73 return on investment by comparing change in money lost to absentee days to the cost of the program.

Workplace health program decreases disability days.

BERTERA (1990) examined whether workplace health promotions could decrease absenteeism in full-time blue-collar workers. 41 intervention sites with 29,315 workers (82.7% male, 41% over 40 years old) and 19 control sites with 14,573 workers received this health program, which included workshops, health risk surveys, multiple week-long classes, healthier options at cafeterias and vending machines, and incentive programs. The researcher received annual mean number of disability days per employee from the corporation for a baseline year and for the two years during and after the intervention. He found that disability days had dropped at the end of the second year by 14% at the intervention sites compared to only 5.8% at non-program sites. These findings suggest that workplace health programs do increase workplace attendance, which in turn produces a return on investments of $1.45 for each $1 spent on the intervention.

Impact of a rewards-based incentive program on promoting fruit and vegetable purchases in lower income families (I < $60k).

PHIPPS ET AL. (2015) conducted a 4-phase study with intervention (which was randomized) and waitlisted control groups in Philadelphia, PA, from December 2010 - October 2011. The majority of participants were African American (95%) and women (81%) and the average age of the sample was 50.4 years. The average household size was 3.8 persons, with an average of 1.7 children living in the household. Annual income was $25 000 or less in 69% of households.

The intervention provided a rebate of 50% of the dollar amount spent on fresh/frozen fruit and vegetables, reduced to 25% during a transitioning phase, then removed. The primary outcome measures were the number of servings of fruit & of vegetables purchased per week. Households assigned to the intervention purchased an average of 8 (95% [CI]=1.5, 16.9) more servings of vegetables and 2.5 (95% CI=0.3, 9.5) more servings of fruit per week than did control households. In long-term price-adjusted findings, when the incentive was reduced and then discontinued, the amounts purchased were similar to baseline they collected. Investigation of the financial costs and potential benefits of incentive programs to supermarkets, government agencies, and other stakeholders are still necessary for sustainable interventions.

Dietary interventions and quality of life: A systematic review of the literature.

CARSON ET AL. (2013) systematically reviewed 24 studies to examine whether there is enough research describing the effects of dietary intervention on quality of life (QOL) independent of weight loss, to assess which tools are being used to measure

nutrition-related QOL, identify lags in the literature, and suggest future directions. The Short Form–36 Health Survey was the most widely used instrument to assess QOL, which measures both physical and mental health. Other disease-specific instruments were used. Several different dietary approaches (low carbohydrate, low calorie, low fat, combinations) were recommended. Across studies, QOL on average improved after participating in behavioral weight loss interventions, but findings revealed a lack of evidence to definitively determine whether reported changes in QOL were a result of weight loss or independent of it. For example, though there is no direct effect, the adoption of a healthier dietary pattern may lead to increased personal satisfaction associated with successful implementation of a behavior change leading to increased QOL, which motivates weight-loss.

IMPACT ON BIOLOGICAL MARKERS AND COST

Workplace interventions help health care costs and cardiac risk factors.

To assess the impact of workplace wellness interventions on cardiac risk factors and the one-year cost of health care, **MILANIE AND LAVIE (2009)** recruited participants from two work locations (same employer) and set participants from one location (n = 185, m = 96) to be the intervention group and participants from the other location (n=154) to be the control group. They took baseline assessments for risk evaluations, behavioral assessments, and health factors, then the intervention group went through the Risk Assessment and Modification Program, which included worksite-based programs, onsite classes, and (unspecified) group competitions between teams, for six months. Costs of health care was assessed the year before intervention and the twelve months after the intervention.

Participants in the intervention group exhibited significant improvement in behavioral and quality of life scores. Of the 48 participants in the intervention phase that had been considered high risk at baseline, 28 of them dropped to being low-risk after the intervention. Additionally, the researchers had access to a dataset from a health insurance company, which revealed a significant decrease in medical claim costs for the intervention group, leading the researchers to claim that “for every dollar invested in workplace interventions, $6 was realized in health care savings” (1391).

Psychosocial workplace intervention increases performance and attendance.

ANDERZÉN AND ARNETZ (2005) recruited 303 participants (m=67), who all together worked across 22 work units in the Swedish Internal Revenue Service, to participate in this study. Participants took a quality work competence (QWC) psychosocial questionnaire, gave blood samples (which were measured for stress-related hormones and testosterone levels), and sickness, absentee, and productivity data. After doing this, the participants were told their areas that could be enhanced and attended a presentation on the link between biological stress markers and psychosocial factors. The research team provided managers with training on how to interpret their employees’ results and work with them to improve them.

After a year, performance feedback, efficiency, leadership, and well-being increased from the baseline. For the 12 work units that had production data available, there was an increase in productivity. These results suggest that having work teams come up with specific goals and having managers encourage these efforts increases performance and efficiency in the long term.

30 minutes of brisk walking per day confers select health benefits.

TULLY ET AL. (2005) examine the effect of a 12-week, 30 min/day walking program on the cardiovascular health of participants, finding that there were significant effects on systolic and diastolic blood pressure and risk for coronary heart disease (CHD) and stroke, but no effects on BMI or lipid profile. 31 participants aged 50-65 with no history of heart or cardiovascular disease were recruited and randomized to a walking condition or a control condition. Those in the walking condition received a pedometer and were instructed to briskly walk for 30 minutes per day, either in one bout or in smaller bouts no shorter than 10 minutes each. All participants were instructed to keep their diets the same, and kept diaries of any physical activity (including the walking) that they completed. Weight, BMI, waist-to-hip ratio, systolic and diastolic blood pressure, total cholesterol and triglycerides, and 10-year risks for CHD and stroke were measured pre- and post-intervention.

Although they were prescribed 30 min/day of walking, participants in the walking intervention averaged 27.72 minutes of brisk walking per day of the study. Despite this, participants in the walking group showed significant decreases in systolic (-11.82 mm Hg) and diastolic (-4.00 mm Hg) blood pressure, compared to no change in the control group. These changes were associated with a 1.35 percentage point decrease in the 10-year risk for CHD, and a 0.44 percentage point decrease in the 10-year risk for stroke. However, there were no changes in the cholesterol or triglyceride levels (the lipid profiles) for either group, nor changes in BMI or hip-to-waist ratio. These results suggest that a 30 min/day walking program can have positive but limited effects on cardiovascular health.

Impact of a workplace stress reduction program on blood pressure and emotional health in hypertensive employees.

MCCRATY ET AL. (2004) studied the impact of a workplace-based stress management program on blood pressure and emotional health in hypertensive employees.

38 employees with hypertension were randomly assigned to either a treatment group (received the stress-reduction intervention) or a control group (no intervention). The treatment group participated in a 16-hour program, on positive emotion refocusing and emotional restructuring techniques which were to reduce sympathetic nervous system arousal, stress, and negative affect, increase positive affect, and improve performance. BP and emotional health were measured before and 3 months after the program. Three months post-intervention, the treatment group showed an average adjusted reduction of 10.6 mm Hg in systolic BP and of 6.3 mm Hg in diastolic BP. The reduction in systolic BP was significant relative to the control group. The treatment group also showed improvements in emotional health, including significant reductions in stress symptoms, depression, and global psychological distress and significant increases in calmness and positive outlook.

Reduced systolic BP was correlated with reduced stress symptoms. Results show that a brief workplace stress management intervention can produce clinically significant reductions in BP and improve emotional health in hypertensive employees.

WALKING MORE

Taking the stairs.

SLAUNWHITE ET AL. (2009) find that posters using normative messages to encourage people to take the stairs are more effective than generic information-based posters. For more detailed summaries of exercise interventions, see the hidden gyms doc.

General physical activity interventions.

CHAN ET AL. (2004) looked at a "pedometer based" physical activity intervention in 106 sedentary workers. The program consisted of two phases. The first phase, "adoption", lasted for 4 weeks. The second phase, "adherence", lasted for 8 weeks. During the adoption phase, participants met with a coordinator/trainer for 30 minutes to an hour every week. During the sessions, participants were taught under a curriculum of the benefits of walking more and ways in which they could keep up with their goals. They were also asked to set a goal each week for steps per day and were asked to self monitor their progress. During the adherence phase, participants continued to self monitor their progress and tweak their goals as needed. Before the treatment, participants' baseline steps per day activity was monitored by wearing the pedometers for two business days and one weekend day. Their baseline weight, height, waist girth, resting heart rate, and blood pressure were also taken. Steps per day increased from ~7000 steps to ~10500 steps. On average, participants experienced significant decreases in BMI (-0.01), waist girth (-0.093), and resting heart rate (-0.56). Waist girth and heart rate were also significantly related to increases in steps.

PROPER ET AL. (2006) reviewed several studies that aimed to promote physical activity in the Netherlands. One such study examined interventions for workers who were on sick leave due to lower back pain. 131 civil servants underwent a 9-month intervention based on PACE (Physician-based Assessment and Counselling for Exercise) strategies, where individuals had counseling sessions that focused on physical activity and healthy eating. At the end of the nine months, those in this intervention group had significantly higher total physical activity than those 168 participants in the control group. Also, when the researchers looked at sick-leave compensation costs during the intervention and the same 9-month period in the year after the intervention, the municipal service lost an average of half as much during the intervention as they did during the next year's period.

REDUCE SITTING TIME

Sit-stand desks.

SHRESTHA ET AL. (2018) reviewed 34 randomized controlled trials whose interventions aimed at reducing sitting time at work. The review showed that sit-stand desks, compared to sit-desks, reduce sitting time at work on average by 100 minutes per workday at short-term follow-up (up to three months), and on average by 57 minutes per workday at medium-term follow-up (3-12 months). To date there are no studies who look at the long-term effect. The short and medium-term effect holds whether sit-stand desks are introduced by themselves or in combination with information, feedback or counselling. There is no evidence that sit-desks or standing desks reduce sitting time at work. The authors find inconsistent findings regarding active workstations, such as treadmill desks or cycling desks. Workplace policy changes have not been found to reduce sitting time, while taking short breaks (one to two minutes every half hour) has shown to be more effective (reduce sitting on average by 40 minutes) than taking long breaks of two 15-minute breaks. There are inconsistent findings regarding the effect of computer prompts. One study found that computer prompts with instruction to stand reduced sitting at work in the short run on average by 14 minutes per day more than computer prompts with instruction to walk at least 100 steps.

Among the reviewed articles is a paper by **ELLEGAST ET AL. (2012)** who randomly assigned 13 office workers to the intervention group, and 12 office workers to the control group. Intervention group participants were exposed to sit-stand tables, pedometers, motivation sessions and an incentive system for bicycle commuting or sports activities. Before and after the 12 week intervention, the authors assessed physical activity, well-being and did a medical check-up. Emotional well-being was assessed using a multidimensional mood state questionnaire (MDBF), consisting of 24 items to assess the current mental state. The authors find that during the 12 weeks, participants in the intervention group spent significantly less time sitting down compared to control participants. They reduced their daily sitting time by an average of 58.3 minutes/day and increased their daily standing time by an average of 64.4 minutes/day compared to control participants. Lastly, intervention participants showed improvements in resting heart rate, BMI and muscle strength. They also showed improved mood, felt more awake, and calm.

VENEMA, KROESE AND RIDDER (2017) tested whether setting sit-stand desks (SSD) into the “stand” position as a default would reduce sedentary behavior at work. They found that the nudge intervention increased stand-up rates of office workers. The intervention involved setting all 110 SSDs into the stand-position at the beginning of the 2-week period. Additionally a sign was placed on top of desks asking employees to leave the desk at standing height when they left the desk or office. The authors did not have a control group. A baseline and post-intervention survey measured demographics, intention to engage in stand up work, (injunctive) social norms, attitude of standing behavior, and in the post-intervention survey, asked about the acceptability of the nudge. Researchers measured stand-up rates eight-times per day by counting the number of employees sitting or standing at the SSD. They found that the nudge intervention increased stand-up rates of office workers from 1.82% at baseline to 13.13% during the two-week intervention. They

found that the change in behavior persisted two weeks and two months after the intervention period (10.01% and 7.78%, respectively).

In addition to the change of behavior, the intervention changed psychological factors related to sedentary behavior and stand-up working. Intention for stand-up working increased from baseline (M=1.93 on 5 point scale) to post-intervention (M=2.09). Social norms also increased from baseline (M=1.45 on 5 point scale) to post-intervention (M=1.59). Attitude towards stand-up working and ratings for perceived behavioral change did not change from baseline. 56.5% of the employees indicated that the nudge intervention was acceptable. However, further analysis reveals that intention to work standing up significantly predicts whether the employee would find the nudge acceptable.

Standing meetings.

BLUEDORN ET AL. (1999) randomly assigned 555 participants to a five-member group. Groups were assigned to either a meeting room with furniture or without furniture, which required the meeting to be held standing up. Each group was tasked with the "Lost on the Moon" decision-making exercise. Results show that stand-up meetings reduced meeting times by 34%, but did not produce better decisions, more synergy or more commitment to the decision than sit-down meetings. However, participants in sit-down meetings focused more on instrumental information and scored higher on meeting satisfaction.

Future directions.

The Web of Things has the potential to automate some techniques tested in the above interventions. Rather than manually resetting desks to their default standing-position, and manually recording in which position a desk is, smart desks could automatically put desks in either standing or sitting positions according to precommitted schedules, and keep track of what position the desk is in. Similarly, smart chairs could measure sitting time.

"Structured workouts are essential for optimal health. But you should also try to stand and move around more during the day, especially if you have a desk job. Sitting for hours on end can increase your risk of serious ailments such as heart disease, type 2 diabetes, and certain cancers. By contrast, you can lower your risks of all of these conditions simply by standing and moving more— even if you already exercise. That's because routine movement during the day adds on to those benefits.

That was the conclusion of a large, long-term study of 123,000 middle-aged adults by researchers from the American Cancer Society, published in the *American Journal of Epidemiology*. Women who sat the most had a 34% greater risk of dying from any cause over the 14 years of the study compared with those who sat the least. For men, the increase was 17%. When exercise was factored in, the difference was even starker. The most sedentary women, who neither moved nor exercised a lot, were almost twice as likely to die during the study period as those who moved and exercised the most. The most sedentary men were 50% more likely to die than their more active counterparts. Similarly, other studies have concluded that routine, everyday movement has benefits, whether for heart disease, diabetes, cancer, or weight loss. It's gotten to the point now where some doctors actually advise their patients to use sitting "in moderation."

Why does prolonged sitting have such harmful health consequences? One explanation is that it relaxes your largest muscles. When muscles relax, they take up very little sugar (glucose) from the blood, raising your risk of type 2 diabetes. In addition, the enzymes that break down blood fats (triglycerides) plummet, causing levels of the "good" cholesterol, HDL, to fall, too. The result is a higher risk of heart disease.

By contrast, everyday movement not only reduces your risk of major ailments, but also helps you burn more calories. Dr. James Levine at the Mayo Clinic coined the term "non-exercise activity thermogenesis," or NEAT, to refer to the energy you burn through ordinary activity that you don't think of as exercise, such as fidgeting, carrying the laundry upstairs, dancing around the house to your favorite tune, or even standing while you talk on the phone. In one study, he measured NEAT in lean and obese people, all of whom had similar jobs and were forbidden to exercise during the course of the study. There was one key difference between the two groups. The obese people sat more than their lean counterparts, by an average of two-and-a-half hours more per day. Changing that behavior could result in burning up to 350 more calories a day."

HEALTHY EATING AND DRINKING

Distance, vegetables, and serving size at Google.

The Google Food Team and the Yale Center for Customer Insights ran a series of four field experiments to study employee health choices at Google. Looking at the distance between beverage stations (offering hot and cold drinks) and snack stations (offering nuts, crackers, candy, dried fruit, chips, and cookies) at Google, **CHANCE ET AL. (2016)** found that people who used the beverage station that was 6.5 feet away from the snack station were 50% more likely to get a snack with their drink compared to people who used the beverage station that was 17.5 feet away.

The researchers further studied the effect of promoting vegetables at a Google cafeteria through persuasion. Displaying colorful photos and trivia facts next to the dish containing the "Vegetable of the Day" as its main ingredient, **CHANCE ET AL. (2016**) increased the number of employees choosing the dish by 74% and increased the average amount each employee served themselves by 64%.

In a third field experiment, the researchers replaced bulk M&Ms bins that employees could use to fill up four-ounce cups with small, with individually wrapped packages. Compared to baseline consumption of M&Ms, the intervention reduced the average serving size by 58%, a reduction from 308 calories to 130.

In their last field experiment, the researchers ran a randomized controlled trial on goal setting and habit formation. Volunteers set personal diet and body goals and were randomly assigned to one of three conditions: (1) information group, which received information about blood glucose and weight gain; (2) information and tools group, which received the same information and in addition to that received blood glucose monitoring devices, data sheets, and advice on measuring glucose,

weight, BMI, and body composition: (3) control group. Volunteers completed weekly surveys over a period of three months. At the end of the study period, the researchers didn't find a difference between the information group and the control group in achieving goals, but volunteers from the information and tools groups, 10% more people said they made progress towards their body goals and 27% more people said they made progress towards their diet goals.

Workplace cafeteria designs.

VELEMA, VYTH, HOEKSTRA AND STEENHUIS (2018) show that changes to workplace cafeterias in The Netherlands promote healthier food choices. The authors evaluated the effect of changes to workplace cafeteria on Dutch employees' purchasing behavior at 30 worksites over a 12-week period. Companies had a minimum of 80 lunch customers and had a catering contract with Veneca, the Trade Association for Dutch Catering Companies. Worksite cafeterias were randomly assigned to either treatment or control group. Control group cafeterias didn't see any changes, whereas treatment group cafeterias were subject to 14 simultaneous interventions, affecting product, place, price and promotion. In addition to nudges and social marketing-based strategies, prices of snacks were increased, and prices of healthy sandwiches/salads were decreased by 25%. All workplace cafeterias were measured in terms of sales data, 4 cafeteria scans (only intervention cafeterias) and 2 online questionnaires, completed by employees of the company before the intervention and after the 12-week period. Results show that mean sales were significantly higher per 100 customers in treatment cafeterias compared to control cafeterias during the 12-week period, for healthier sandwiches (3.3 vs. 0.9), low-fat cheese (M: 4.8 vs. 3.3) and fruit (9.4 vs. 8.7).

TABLE 2
Intervention strategies[1]

Strategy	Description
Product	
1	In every product category, ≥1 product of "better choice" is visibly offered.
2	A warm lunch meal is also offered in a smaller portion.
3	Fruit and vegetables are offered.
4	Water is offered for free.
5	The visible share of healthy ("better choice") products is ≥60%.
6	Warm snacks[2] are offered ≤3 d/wk.
Place	
7	Healthy products are at the beginning of the route. These products are salads, fruit and vegetables, bread, bread topping, and healthier sandwiches.[3]
8	Of every product group, the "better choice" product or presentation of this product is most visible (at the front at eye level).
9	If there is a shelf at the cash register, it is partly filled with fruit and vegetables; fruit and vegetables are on top or at the front.
Price	
10	A relatively cheap combo deal is offered with milk,[4] coffee, tea, or vegetable juice, a healthier sandwich,[3] and fruit with a price comparable to the average price of a sandwich in the same cafeteria.
11	Prices of warm snacks[2] (e.g., chicken nuggets) are increased by 25% and prices of healthier sandwiches[3] are decreased by 25%.
Promotion	
12	There is only promotion of food products in the "better choice" category (or the Choice criteria for combined meals).
13	When a healthy product is promoted, it has a recognizable, permanent spot in the cafeteria.
14	On the menu (e.g., on displays or Intranet), the healthy products are named first.

Vending machines.

APPELHANS ET AL. (2017) discuss the effects of "delay discounting", the tendency by which people may prefer smaller rewards they can receive now as opposed to larger rewards some amount of time into the future. This concept of immediate gratification is applied to the use of vending machines to promote healthy eating. This is primarily done by applying a 25 second delay on receiving "regular snacks" versus instant receipt of "healthy snacks". This treatment is then used in combination with two different price interventions, one where the health snack

includes a 25 cent discount and one where the regular snack includes a 25 cent tax. This study was conducted over 32,019 vending machine sales from three different locations at the Rush University Medical Center in Chicago, IL. The percent of people choosing healthy snacks in the 25 delay treatment increased from 40.1% to 42.5%. This is comparable to the effects of the discount treatment. Combining discount and delay treatments saw 46.0% healthy purchases. However, the most effective treatments were tax only (53.7%) and tax and delay combination (50.2%). The authors note that this contrasts with recent publications that state that price discounts (discount treatment) should have a greater effect than price increase (tax treatment) but note that this could be due to the fact that the tax treatment increases the price to $1.25 and requires customers to get out another quarter which may discourage them from making that choice. They also note that the combination of tax and delay did not increase the effect from the tax only treatment. They attribute these results to the ceiling effect. Finally, the analysis was broken down into both white collar and blue collar locations. They found that the tax treatment had a greater impact on blue collar locations compared to white collar locations, while delay only and discount only did not have this effect.

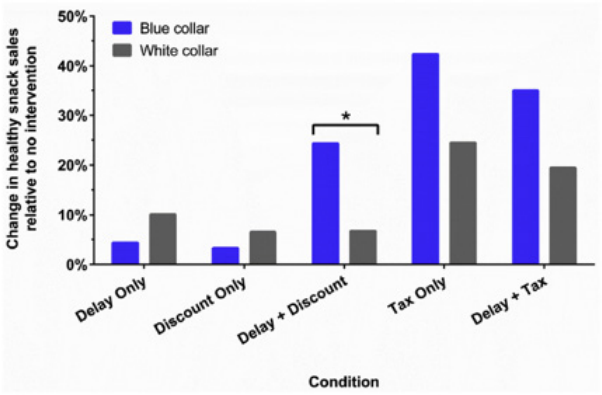


Fig. 4. Changes in the proportion of sales from healthy snacks in the "blue collar" and "white collar" locations, expressed as a relative percentage of baseline sales (not an absolute percentage) under *No Intervention* in the respective location. Asterisk indicates a significant difference between locations at $p < .05$. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

KUSHIDA AND MURIYAMA (2014) examined the effects of an informational intervention on self-reported vegetable consumption in 16 different workplaces in Niigata, Japan. 8 workplaces were assigned to the intervention group, 8 to the control group. Participants included a total of 349 male workers aged 20 to 59 who visited the cafeteria at least 3 times a week. To measure a baseline, participants responded to a questionnaire where they responded to how many servings of vegetables they ate a day and how long they've been eating that amount/if they planned to increase their consumption. They were then classified into various stages of "healthy eating": maintenance, action, preparation, contemplation, and pre-contemplations (in decreasing order of healthy eating behavior). Intervention was executed in the form of a total of 12 informational table tents which were placed every 2 weeks on all tables in the cafeteria. The different tents represented different stages of intervention towards healthy eating and were set up with an order of progression so as to introduce new "stages" of healthy eating to the workers every few weeks. For example, the following chart shows the progression of tents:
Results were measured by issuing the same questionnaire and seeing if any of the participants had reached the next "stage" of healthy eating. The results indicated

that the proportion of workers in the action/maintenance groups (healthiest groups) increased 2.1 times, but it is unclear whether this intervention had long-term effects.

Intervention Phase	Table Tents, n	Processes of Change	Definitions of Change
1–4 (1–24 wk)	1–12	Social liberation[a]	Increasing alternatives for nonproblem behaviors available in society
1 (1–6 wk)	1–3	Consciousness raising[a]	Increasing information about self and problem
		Dramatic relief[a]	Experiencing and expressing feelings about one's problems and solutions
		Environmental reevaluation[a]	Assessing how one's problem affects physical environment
2 (7–12 wk)	4–6	Self-reevaluation[a]	Assessing how one feels and thinks about oneself with respect to a problem
3 (13–18 wk)	7–9	Self-liberation[b]	Choosing and commitment to act or belief in ability to change
4 (19–24 wk)	10–12	Reinforcement management[b]	Rewarding one's self or being rewarded by others for marketing changes
		Helping relationships[b]	Being open and trusting about problems with someone who cares
		Counterconditioning[b]	Substituting alternatives for problem behaviors
		Stimulus control[b]	Avoiding or countering stimuli that elicit problem behaviors

Nudges increase consumption of healthy items.

In order to nudge customers to increase their healthy eating and gauge customer attitudes towards the nudge, **KROESE, MARCHIORI, AND DE RIDDER (2016)** modified the choice architecture at three train station snack shops in the Netherlands. These three shops all looked the same and sold the same goods, but were modified into the following conditions: control, nudge (healthy food choices were placed at the cash register), and nudge + disclosure (a sign explained the change in choice architecture). The shops were controlled for a baseline week, and the researched measured the change in healthy goods purchased for the second week. On average, the nudge shop sold 18 more healthy items each day than the control shop, and the nudge + disclosure shop sold 12 more healthy items each day.

Additionally, Kroese, Marchiori, and de Ridder surveyed a subsample of customers after they exited the shop (about 30 per shop, 52% male, with a mean age of 39). Most customers had not noticed the repositioning of items, and the majority either liked or did not care about the nudge when its purpose was explained to them. An important note is that while the sale of healthy items increased, the sale of non-healthy items remained the same. A possible future direction could be to run a similar study for longer than a week to see if purchasing habits change further.

Simple labelling schema.

For six months, **THORNDIKE, SONNENBERG, RIIS, BARRACLOUGH, & LEVY (2012)** conducted a 2-phase choice architecture intervention in the main cafeteria at Mass General in Boston. They began by collecting baseline data for three months. Then, for the next three months, all food was labeled red, green, or yellow on a menu board above the food. For the three months after that, the researchers rearranged food so that green-labeled food was located at eye level and red/yellow foods were below eye level.

They found that the sale of red items decreased across both phases. Red beverages (like sodas) in particular decreased the most. This research suggests that a simple labelling policy can nudge consumers towards purchasing healthier foods and not purchasing unhealthy foods.

Displaying healthy items on left leads to healthier consumption.

ROMERO & BISWAS (2016) found through 7 different studies that laterally displaying healthy food and beverage options to the left of unhealthy options significantly increases preference for and consumption of the healthy options. The authors note that all studies were performed with US participants, and that there may be cultural limitations.

In the first study, participants were presented with a menu, consisting of 4 previously-verified healthy-perceived items (salads) and 4 verified-perceived unhealthy items (burgers), randomized to either a "healthy-left, unhealthy-right" or "unhealthy-left, healthy-right" display, and instructed to select the item they would prefer. Participants were told that costs and portions were equal across all menu items. Results indicated a larger preference for healthy items when they were placed on the left vs. the right (58.33% vs. 29.16%). Authors hypothesized that generally participants may tend to naturally organize healthy items on the left and unhealthy items on the right, which they confirmed in their second study. In that study, participants were given word pairs ("eating healthy-indulging", "grilled chicken-fried chicken", etc.) and asked to organize each component of the pair to either a left or right column. Participants consistently associated the healthy concepts with the left lateral column (for example, 64.10% placed "healthy-eating" on the left and "indulging" on the right, 64.10% placed "grilled chicken" on the left and "fried chicken" on the right.)

In their final study, the authors observed that lateral display also had effects on consumption volume. Participants were presented with 3.5oz of orange juice and orange soda, organized either with juice on the left or juice on the right, and told to consume as much or as little of either as they so pleased. The cups were weighed before and after to determine consumption volume. Results indicated that "healthy" consumption increased when the orange juice was placed on the left vs. the right (1.79 vs. 1.14 oz), while consumption of the "unhealthy" option did not differ significantly based on lateral position (1.27 vs. 1.07 oz). In total, the results of these studies suggest that simple lateral display of healthy and unhealthy options, on a menu or in a vending machine for example, may have significant effects on consumption choices.

Simple nudges have significant effects on consumption in buffet setting.

FRIIS ET AL. (2017) compare the effects of different nudges on vegetable consumption in a self-service buffet setting, finding that priming and perceived variety nudges decreased total energy intake (largely through decreased meat consumption), while a default nudge increased vegetable-based energy intake. 88 Danish adults were randomized into either a default, priming, or perceived variety condition. The default condition consisted of including pre-portioned salad "take-away" bowls in the buffet, the priming condition consisted of creating a green and "natural" ambience through potted plants and herbal fragrances, and the perceived variety condition consisted of separating the salads into their individual ingredients. All participants served as their own controls, as they participated on 2 separate days, and the ordering of the treatment-control days was randomized. Energy intake was measured through the Intelligent Buffet system, which allows for exact measurement and recording of selected food items and their weight.

Results indicated several significant effects of the behavioral nudges. Those in the priming condition significantly reduced their energy intake in comparison to the control (469.42 vs. 638.29 g), with the majority of this decrease in meat consumption (162.79 vs. 278.38 g). Similarly, those in the variety condition also reduced their total intake (633.00 vs. 732.36 g), largely due to reduced meat consumption (213.94 vs. 296.61 g). Those in the default condition did not reduce their total intake (653.64 vs. 621.39 g), but did significantly increase their vegetable intake (238.88 vs. 193.67 g). These results indicate that simple nudges in a buffet or cafeteria setting can contribute to healthier consumption choices, either through increased vegetable intake or reduced overall intake and specifically reduced meat intake.

Mindfulness and eating disorders.

BUSH ET AL. (2014) found that a joint mindfulness-intuitive eating (i.e. rejecting external cues to eat) program was effective in boosting participant's levels of body appreciation, intuitive eating, and mindfulness measures, and significantly reduced the probability that they would show symptoms of an eating disorder, compared to a waitlist control group. Through non-random assignment, 53 women joined the intervention group and received a 10-week mindfulness and intuitive eating program called *Eat for Life*, which focused on increasing awareness of the body's internal cues and eating accordingly. The program consisted of weekly 1-1.5 hour meetings including lectures on healthy eating behaviors, mindfulness practice, readings from the *Eat for Life* manual, and group discussion, as well as homework assignments (listening to mindfulness meditation CDs, eating meditations, additional readings). All participants completed pre- and post-intervention questionnaires composed of the Intuitive Eating Scale (IES) and Body Appreciation Scale (BAS), whose scores range 1-5, and the Five Facets of Mindfulness Questionnaire (FFMQ), whose scores range from 39-195. Participants also completed the Questionnaire for Eating Disorders Diagnosis (Q-EDD), which sorts participants into 3 groups: full-syndrome eating disorders, symptomatic behavior, and asymptomatic behavior.

After the 10-week intervention, the scores for the intervention group were significantly better than for those in the control group. Intervention group participants had higher body appreciation (3.53 vs. 3.01), higher intuitive eating

scores (3.39 vs. 2.72), and higher mindfulness scores (136.31 vs. 123.41). Additionally, at post-intervention only 50.7% of control participants were deemed totally asymptomatic, compared to 73.5% for the intervention group. These results suggest that an educational program focused on mindfulness and intuitive eating can be effective in boosting several measures of body satisfaction and decrease the risk for problematic eating behaviors.

STRESS REDUCTION AND MENTAL WELLBEING

MANOCHA ET AL. (2011) discusses a study conducted in Australia that tested the effects of meditation on worker's stress, anxiety, and mood. 178 participants were assessed in an 8 week trial that looked at a control group, and two different types of meditation: one that focused on clearing the mind and one that focused on relaxation. During the 8 weeks, participants in the meditation groups followed 1 hour sessions twice weekly. They were also instructed to "practice" at home twice daily for 10-20 minutes. The "mental silence" group used Sahaja yoga which used many techniques but focused on directing the mind towards exclusively thinking about the present moment and not about the past or the future. The "relaxation" group used more traditional meditation techniques such as breathing exercises and reflection on the day. The participants were measured before and after using a combination of the Psychological Strain Questionnaire (PSQ), a subscale of the larger Occupational Stress Inventory (OSI), the State component of the State/Trait Anxiety Inventory for Adults (STAI), and the depression-dejection (DD) subscale of the Profile of Mood States (POMS). The results showed that the "mental silence" group showed significant improvements in the PSQ and DD categories over both the "relaxation" and control groups with 42.4% people improving over 30% in the PSQ category and 59.3% people improving over 30% or more in the DD category.

Park walks and relaxation exercises' impacts on job stress and wellbeing.

DE BLOOM ET AL. (2017) conducted two RCTs to study the effects of park walks and relaxation exercises during lunch breaks on job stress. They found that compared to the control group, the treatment group had lower feelings of tension. The trials consisted of 153 Finnish knowledge workers who engaged for 15 minutes daily in prescribed lunch break activities for ten consecutive working days. Participants were randomly assigned to a: 1) park walking group (N = 51), 2) relaxation exercises group (N = 46) or 3) control group (N = 56). The study was divided into two parts scheduled in spring (N = 83) and fall (N = 70). Recovery experiences (detachment, relaxation, enjoyment) and recovery outcomes (restoration, fatigue, job satisfaction) were assessed with SMS and paper-and-pencil questionnaires several times per day before, during and after the intervention period. Overall, the researchers concluded that walking was the most effective intervention, but the effects seemed weak and short-lived. In addition, this study identified that effects seemed to be dependent on the season: the spring interventions had much weaker effects than the fall interventions. It is possible that seasonal mood changes were partially responsible for this, given that many people report feeling more negative emotions in the fall and winter months compared to spring and summer.

BURNOUT AND STRESS PREVENTION

In a report published by **PUBLIC HEALTH ENGLAND (2016),** the authors reviewed existing literature on workplace interventions aimed at preventing and reducing the impact of burnout and work-related stress. Most of those interventions are executed at the individual or small-group level.

Staff training and workshops with the focus on stress awareness and coping have been shown to prevent the risk of burnout. Cognitive-behavioral therapy can reduce burnout[1], and has been shown to work better than relaxation or meditation techniques. Mindfulness-based interventions are not more effective than relaxation or yoga in reducing negative psychological effects. The review done by **SHRESTHA ET AL. (2018)** found that mindfulness training did not significantly reduce workplace sitting time.

Looking at the organizational level, changes to workload and working practices reduce stress and burnout.

Online cognitive behavioral therapy.

A workplace intervention in the UK, found that online cognitive behavioral therapy significantly improved employees anxiety and depression as compared to conventional therapy alone. Participants (n=48) were employees of a National Health Service (NHS) department and had been absent from work for 10 or more cumulative days during the previous 6 months due to stress, anxiety or depression. The intervention consisted of an 8-week treatment period during which half of the participants received conventional care (e.g., medication, counseling) and the other half received conventional care plus access to online cognitive behavioral therapy (CBT). The online program, "Beating the Blues", prompts users to recognize thinking errors and automatic thoughts that result in unhelpful and pessimistic thinking. Beating the Blues was loaded onto computers at the workplace and participants were provided with passwords that maintained their confidentiality.

Scores on two questionnaires served as the outcome measures. The Hospital Anxiety and Depression Scale (HADS) was used to measure anxiety and depression (scale 0-21 where 0-7=normal; 8-10=borderline abnormal; 11-21=abnormal). The Attributional Style Questionnaire (ASQ) was used to measure attributional style. ASQ respondents must associate causes to a series of positive and negative hypothetical situations. ASQ yields two sets of scores: a positive attributional style score and a negative attributional style score. A higher positive attributional score indicates that the respondent attributed positive events to more internal, stable, and global factors. A higher negative attributional style indicates the respondent attributed negative events to more internal, stable, and global factors.

At the end of the 8-week treatment period, results showed that participants exposed to online CBT had significantly lower mean depression scores (5.38

1 https://www.ehstoday.com/health/workplace-interventions-can-reduce-stress-and-burnout

compared to 8.61 in the control) as well as significantly lower mean negative attributional style scores (12.09 compared to 14.71 in the control). At the 1-month follow-up, the treatment group continued to have significantly lower mean depression (5.00 compared to 8.53 in the control) and negative attributional style scores (12.75 compared to 14.87 in the control) as well as significantly lower mean anxiety scores (8.2 compared to 12.00 in the control). No significant differences were found at the 3- and 6-month follow-ups.

Flexible work spaces/places.

As part of their global program, **HAWORTH INC. (2017)** study the connection between office design and happiness and a meaningful work experience. Over 2000 office workers at worksites in the USA, Mexico, Colombia and China. Using pre-and post-move survey measures, the company assessed ambient environment (noise, acoustics, lighting, air quality, etc.), planning features, workspace types, furnishings, and technology that impact the outcome measures of meaningful work, frustration, happiness, well-being, and contentment. Measures of happiness include frustration levels, contentment, feeling relaxed, happiness at work, and the sense that work is meaningful. Regression analysis showed that (1) design features conveying employee value, and (2) the ability to focus at work directly impact happiness.

Next, they found that the following five office design features contribute to the feeling of being valued: legibility of the office space (understanding the layout and furnishings), control over the workspace (adjustability of features), having the right technology, access to daylight, and adequate storage space. Legibility and access to daylight have the largest impact on feeling valued. Two of the features (legible space and user control) were also identified to affect worker's ability to focus at work.

In a recent video, Haworth Inc. explains that offering people choice and control over how and where they work in a given setting, leads to increased happiness and sense of wellbeing. This means that workplace designs that unlock a healthier and happier workforce, include flexible work areas, such as lounges. The Dutch consulting company '*Workwire*' recommends this type of space for people to meet, collaborate and share ideas. Haworth Inc.[2] further adds that such a shared space improves collaboration and knowledge sharing, while designated quiet areas, which minimize visual or noise distraction, not only allow for more focused work, but lower stress and increase well-being.

Work from home.

Taking the topic of flexible work a step further: Research with employees at the Chinese travel website Ctrip showed that letting employees work from home not only raised productivity by 13.5%[3], but increased happiness at the same time.

2 https://www.encompas.com/extra/2018/9/5/the-healthy-workspace-nudge

3 https://hbr.org/2014/01/to-raise-productivity-let-more-employees-work-from-home

STRATEGIES TO SLEEP MORE

Health effects of sleep deprivation.

NAITOH ET AL. (1990) study the effects of sleep deprivation on health in this overview of studies conducted on the topic. The factors discussed include: adrenomedullary activity, adrenocortical activity, metabolism, hematological and immunological changes, autonomic nervous system activity, epilepsy, physical working capacity, antidepressant effects, and mental health. The authors identify three types of sleep deprivation: total (no sleep in a 24 hour period), selective (manipulation of sleep in a lab), and partial sleep loss (less than usual amount of sleep). Partial sleep loss is likely the most common, they note, but also the least studied because it is expensive to do studies over long periods of time.

Overall, the authors find that the literature suggests that direct detrimental health consequences of sleep loss are probably minimal. For example, no serious immunological changes follow sleep deprivation. However, sleep loss is often linked to other problems, and can have impacts on mental health. For instance, lack of sleep can cause chronic excessive fatigue and sleepiness, sagging motivation for work, and poor job performance leading to frustrations and conflicts with other workers.

BAXTER AND KROLL-SMITH (2005) discuss how to normalize workplace napping. They identify the apparent irony in promoting napping at work: what has been an unacceptable, perhaps deviant behavior may now be encouraged in certain workplaces. The authors observe that several companies are trying to encourage napping because they believe it has restorative qualities and may improve productivity. The article examines the trend toward this practice and the necessary change in workplace culture, which include making employees feel comfortable napping, and combatting any stigma around napping. It also discusses how the introduction of napping into the workplace blurs the lines between the public and private lives of employees. It distinguishes between breaktime napping and worktime napping, with the latter giving the employee more autonomy. Finally, the article concludes with a section on the decline in “siestas” in Spain and China.

Sleep inertia.

In their literature review, **HILDITCH, DORRIAN, AND BANKS (2016)** discuss how to counteract sleep inertia, which is especially important for employees napping at work who need to be alert and highly functional on the job. They define sleep inertia as “a period of impaired performance and grogginess experienced after waking”. Although many studies have investigated the right timing and duration of naps to minimize sleep inertia, few others have looked into countermeasures to sleep inertia when it does happen **(KAIDA ET. AL. 2003, KRAUCHI ET. AL. 2004, TASSI ET. AL. 1992).** The authors find that the current literature does not have a strong evidence-base for a reactive countermeasure to sleep inertia, so more research is needed on the topic. Countermeasures that have been tested are caffeine, light, and temperature.

MEDNICK ET AL. (2008) found that participants taking up to a 2-hour nap performed better on verbal memory as well as procedural motor tasks compared to participants taking 200 mg of caffeine, though there were no significant differences on a perceptual learning task. 61 adult participants who self-identified as low- to moderate-caffeine drinkers (<2 cups of coffee/day) were randomized into napping, caffeine, and placebo conditions. All participants' sleep was monitored for 7 days prior to the testing day, and participants were instructed to spend at least 8 hours in bed each night. On the day of the intervention, all participants completed baseline measurements for the three tasks at 9:30 AM. At 1:00 PM, participants in the napping condition were instructed to take naps lasting a maximum of 90 minutes, while those in the caffeine and placebo conditions listened to audiobooks for the same time period. At 3:00 PM those in the non-napping groups were given either a 200 mg caffeine pill or a placebo pill, according to their condition. At 4:00 PM, subjects were re-tested on all 3 tasks.

There were no baseline differences for any task measure across groups. For the verbal task, which involved recalling a set of words previously delivered and discriminating these words from "lure" words, those in the napping condition performed significantly better for recall (16 words vs. 11.8) and recognition 7 hours post initial word delivery than both the caffeine and placebo conditions, between which there were no significant differences. For the motor skills task, which involved repeated typing of a specific numeric sequence, the caffeinated group showed significant "impaired learning" between baseline and post-intervention testing compared to the placebo and napping groups (increase of 4.4 vs. 0.9); that is to say the non-caffeine groups significantly improved their scores between the two testing sessions while the caffeinated group did not. For the perceptual task, in which participants discriminated different letters and line orientations on a computer screen, the napping group performed significantly better than the placebo group, but there were no significant differences between the caffeine group and either of the other two groups.

DINGES AND ORNE (1985) study alertness upon waking up from a nap. This study seeks to examine whether people perform better immediately upon awakening from a nap as sometimes, when awakening from naps, people feel more tired than they felt prior to napping. The authors show that short power naps (15–20 minutes) are more effective than longer naps because the subject rarely enters slow-wave sleep during power naps. Thus, they are likely to experience only minimal sleep inertia when they wake up. Sleep inertia can limit performance because of disorientation and grogginess (though these are only present for brief periods after awakening). Thus, the authors recommend short power naps, and in particular warn against 2-hour naps.

Stages & length of naps.

HAYASHI, MOTOYOSHI, AND HORI (2005) studied short naps (<10 minutes) in the context of sleep stages to determine whether amount of time in sleep stages 1 and 2 influence alertness. Stages 1 and 2 are typically the only of the four sleep stages reached when napping. Stage 1 sleep is characterized by the presence of slow eye movements and the slowing of brain wave activity, and stage 2 is characterized by the discontinuation of slow moving eye rolls plus the continued slowing of brain waves disrupted by burst of rapid activity called sleep spindles. For reference, stage 3 is the most restorative stage of sleep, known as deep sleep - it is very difficult to

awaken someone from stage 3 sleep. Stage 4 sleep, which many recognize as the dreaming stage, consists of rapid eye movement (REM). Ten university students (M=3, W=7) participated in each of the three conditions (no nap, S1-nap where they were awakened 5 minutes after stage 1 sleep occurred, and S2-nap where they were awakened 3 minutes after stage 2 sleep occurred), randomized for order and with at least one day between conditions. The night before each condition, they went to bed two hours later than usual. Before each condition, they rated their own subjective sleepiness and fatigue then conducted two cognitive tasks -- a visual detection task and a symbol-digit substitution task -- where their mean reaction times and number of misses were recorded. The researchers also measured sleep and eye movements using an electroencephalogram (EEG), as slow eye movement is associated with increased sleepiness. After the nap condition, participants answered questionnaires about their estimated nap time, quality of nap, and satisfaction with the nap, and then did the same tasks for the next 30 minutes.

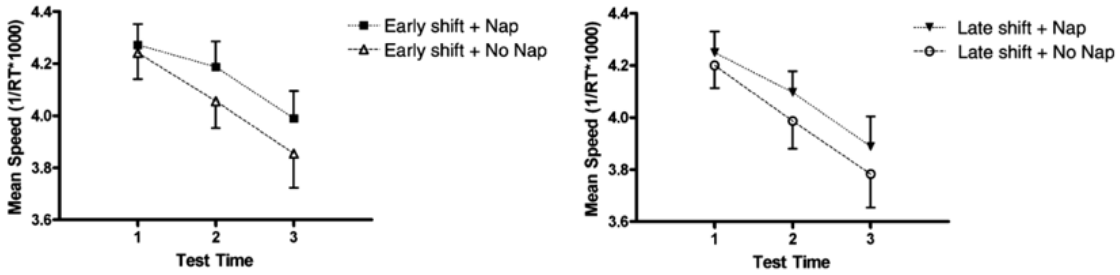
On average, those in the S1 condition slept for 4.5 minutes while those in the S2 condition slept for 9.1 minutes. Sleepiness immediately decreased in both nap conditions. However, as time increased, number of misses and slow eye movement increased in both the no-nap and S1-nap conditions, leading to a significant difference between those conditions and the S2-nap condition at the 30-minute mark. These results suggest that stage 2 sleep is needed to increase alertness in the long run. On average, it took participants in the S2 condition 6 minutes of stage 1 sleep before they reached stage 2 sleep. Although the researchers suggest to further study whether sleep time length or stage 2 sleep time more heavily influenced these results, we can from a practical standpoint assume that power naps must be at least 9 minutes to be effective.

In a study with 24 aircraft maintenance workers following their 12 hour overnight shifts, **PURNELL ET AL. (2002)** assessed the impact of 20 minute naps at work between 01:00AM and 03:00AM. In the control week there was no given opportunity to nap. A computerized neurobehavioural test was employed to understand the difference in performance and subjective levels of fatigue at the beginning and end of each night shift, and pre- and post-nap. Subjects were also asked to self-report and rate how close they were to falling asleep while commuting to and from work. The results revealed that taking a single 20-min nap during the first night shift at 03:00 significantly improved speed of response on a vigilance task (Mackworth Clock Task) measured at the end of the shift compared with the control condition week. For example, the response latency (ms) at the end of the night was 815.7 ms for the nap condition and 928.1 ms for the control condition. Also, in terms of subjective ratings of sleepiness while driving, the nap condition self reported 38.88 and the control 41.44 (on a scale of 0-100, with 100 being most fatigued), showing a decreased self-report of fatigue for those who had napped during their shift.

Alertness & attention.

SIGNAL ET AL. (2009) looked at the effects of a 40-min planned nap during the night shift of 28 air-traffic controllers. Each participant completed 8 night shifts evenly spread out over the course of 8 months; 4 night shifts with the planned nap (two with early start which lasted from 10:30PM to 6AM and two with late start which lasted from 11:30PM to 6:30AM) and 4 nights without the planned nap. Polysomnographic data was used to measure the effects of the naps in each case. The participants completed the PVT (Psychomotor Vigilance Task) three times

across each night shift: immediately prior to the shift, after the nap opportunity and just before returning to work, and at the end of the shift. The PVT is a sustained-attention, reaction-timed task that measures the speed with which subjects respond to a visual stimulus. To measure neurophysiological alertness, electro-oculographic (EOG) recordings across the second half of the night shift were viewed for the presence of slow rolling eye movements (SEMs) and electroencephalo-graphic (EEG) recordings across the last hour of the night shift were evaluated using spectral analysis. Sleep latency was relatively long (19 min on average) and actual sleep time was relatively short (18 min on average). However, even though the sleep was relatively short and of poorer quality, results showed that performance on the PVT was higher in case where naps were taken. Additionally, EEG showed higher alertness and decreased likelihood of SEMs.



TAKEYAMA ET AL. (2002) looked at the effect of napping during the night shift on "morning types" and "evening types". The study was conducted with male students in a Japanese university, 5 of whom were classified as morning types using a questionnaire and 8 as night types. Each participant completed 9 days of shifts consisting of 3 days shifts (8AM to 4PM), 3 night shifts (10PM to 8AM), and 3 more day shifts. In one treatment, the participants took a nap from 2-4AM and in the other they did not. During the shifts, participants typed random figures given to them for 20 minutes, took a 5 minute break, then did arithmetic for 15 minutes. Task performance decreased and fatigue increased in proportion to work time in both E-types and M-types. However, naps increased performance and decreased fatigue for M-types more than E-types although both types saw positive results in comparison to no nap.

TAKAHASHI ET AL. (1998) randomly separated thirty adults (M=11,W=19) into three groups—a control group (no nap), a 15-minute nap group, and a 45-minute nap group—and then measured their alertness, performance, and autonomic balance. To measure autonomic balance they used the P300, a neurophysiological correlate of cognitive function; to measure sleepiness, they used a 100-mm visual analogue scale; and to measure performance, they had the participants complete a transcription task and measured the number of words they transcribed correctly and erroneously. The researchers found no significant results with the P300, and that both nap conditions reduced subjective sleepiness in comparison to those in the no nap condition. Also, those in the 15-minute nap condition had lower error rates on the last part of the transcription task than those in the other conditions, due to sleep inertia following the 45-minute nap. They concluded that a 15-minute nap after lunch was effective in improving alertness and performance. This result is

particularly significant as the researchers found that participants in the 15-minute nap condition actually slept for 7.3 minutes on average, which was enough to increase alertness despite previous research suggesting at least 10 minutes of sleep were needed for that.

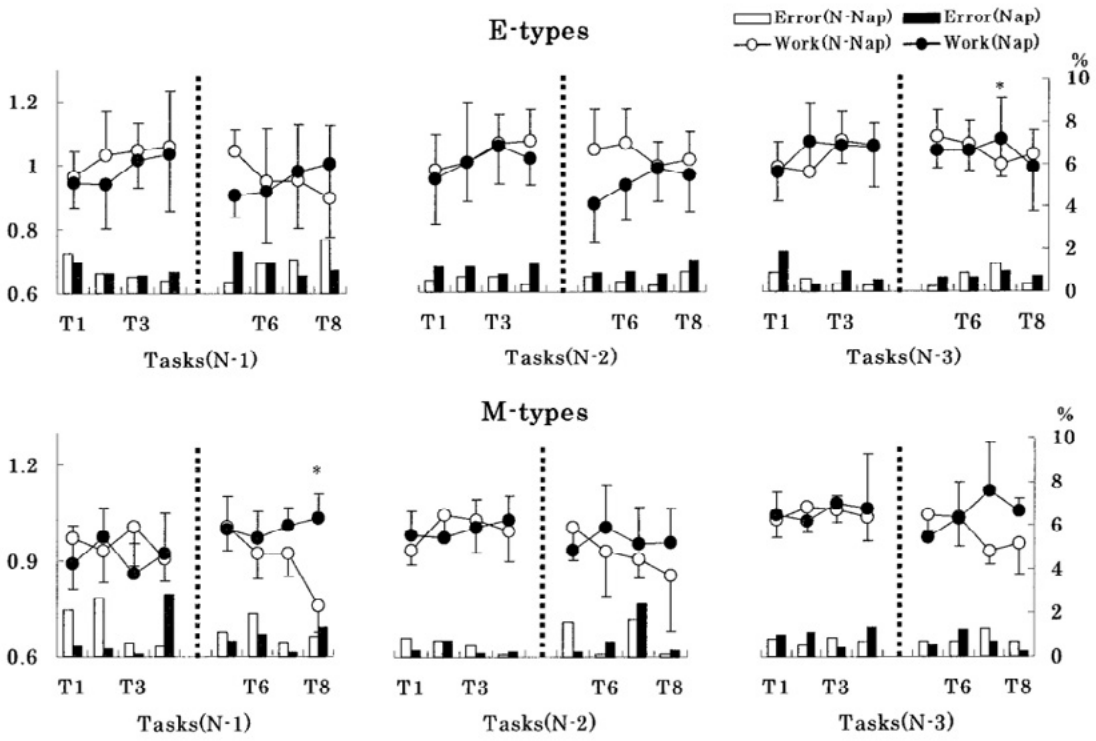


Fig. 3. Fluctuations in task performance (amount of typed figures and errors) during the three shifts in E-types and M-types under nap and no nap conditions. Each circle is the mean, and vertical lines are SD. The dotted line is the boundary line before and after a nap and no nap. *P<0.05.

In a 16-person study, **TIETZEL AND LACK (2002)** tested the effects of power naps on alertness and cognitive performance after the subjects had restricted nocturnal sleep. They found that the 10-minute power nap correlated with improvements in performance, while the 30-second and 90-second naps had no measurable impact compared to the no-nap control. The study tracked measures of subjective and objective alertness, fatigue, vigour, and cognitive performance. They recorded these measures before the nap and then for up to sixty-five minutes after the nap. The significantly improved alertness for the 10-minute nap as compared to the lack of improvement in alertness for the shorter naps suggests that stage 1 sleep does not underlie the benefits of napping. They conclude that further research is needed to identify the minimum nap duration needed to improve daytime alertness.

Timing of naps.

SMITH-COGGINS ET AL. (2006) found that physicians and nurses provided with a 40 minute napping period mid-shift during a 12-hour shift performed better in a number of measures as compared to those who continued to work during this period. 49 physicians and nurses were randomized into a NAP or NO-NAP condition. All participants completed baseline questionnaires (Sleep Disorders, Shift-work Experiences, Owl and Lark), and were given wrist-activity monitors 4 days prior to initial testing to record nightly sleep durations. There were no significant differences across these measures between the two groups.

All participants completed the battery of measurements on two successive nights, at three times: pre-shift (at 6:30 PM), mid-shift (at 4:00 AM), and post-shift (at 7:30 AM). On the second night (treatment night), those in the NAP condition were given a 40 minute napping period at 3:00 AM. The test battery consisted of a Psychomotor Vigilance Task (testing visual reaction time), a Probed Recall Memory Task (testing memory recall and scored 0-6), a CathSim virtual catheter insertion simulation (measured in terms of duration time, number of attempts, and hematomas), a StiSim Drive simulation (assessed for dangerous driving by a blinded 3rd party), a Profile of Mood States (assessing scores on anger, confusion, depression, fatigue, tension, and vigor), and the Karolinska Sleepiness Scale (9-point scale of self-perceived sleepiness).

For the treatment night, a number of significant differences were found between the groups, predominantly at the post-shift measurement period. The NAP group had fewer lapses on the Psychomotor Vigilance Task post-shift (3.13 vs. 4.12 lapses), completed the CathSim simulation more quickly post-shift (66.40 vs. 86.48 sec), demonstrated less fatigue (7.4 vs 10.43) and more vigor (4.44 vs. 2.39) on the Profile of Mood States, and self-reported less sleepiness (5.36 vs. 6.48). Notably, the NAP group performed worse on the Memory Recall Task during the mid-shift measurement period (2.76 vs. 3.7), perhaps indicating sleep inertia, the feeling of grogginess after awakening. No significant differences were found for other measures at other measurement periods.

Overall, this study demonstrates that a mid-shift nap may be beneficial in improving work performance and alertness for workers. However, this study is limited in that it only examined an intervention for one night, and was limited to physicians and nurses working 12 hour night-shifts, perhaps amplifying the effects of the napping period due to the significantly tiring aspects of this shift and profession.

Unplanned napping.

There is relatively little research examining the differences of planned versus unplanned napping. 4.3 million older adults in the U.S. regularly nap unplanned, and 1.4 million individuals routinely took extended planned naps. **FOLEY ET AL. (2007)** used the National Sleep Foundation's "2003 Sleep in America Poll," of 1506 older adults. The average age for the sample was 55–84 years. The researchers found that nearly 36% of the sample, n = 515, self-reported napping anywhere from 1 to 7 times per week, with more than half of the sample size (50.7%) reporting planned versus unplanned napping. The researchers concluded that the demographics of being older and unmarried, alongside excessive daytime sleepiness (EDS) anhedonia and consuming more than 4 coffees per day were all strong predictors of unplanned napping.

A similar study was completed by **LELAND ET AL. (2017)** where the data set was obtained via medicare beneficiaries less than 65 years of age enrolled in year four of National Health and Aging Trends Study. The participants self reported regular napping (n=1,016) and the regressions sought to examine the sociodemographic and clinical characteristics and napping outcomes, specifically unplanned or extended (60 minutes+) naps. 58.7% reported unplanned naps and 18.5% regularly take extended naps. On average, unplanned napping correlated to older age, non-white races, unmarried status, poorer self-reported health, and shorter nighttime sleep.

Individuals 75–84 years of age had 2.1 higher odds of unplanned naps compared to those aged 65–74. Male sex, poorer self-reported health (2.8x more likely to take longer naps), and a greater number of chronic conditions were associated with higher odds of extended naps. Moreover, more research and investigation is required to look at different risk factors associated with unplanned and extended napping.

Measuring napping.

DINGES AND POWELL (1985) discuss the psychomotor vigilance task, a standard for measuring wakefulness across literature. A form of an visual reaction time test was originally published by Wilkinson and Houghton in 1972 but was popularized in the form of the PVT by Dinges and Powell (1985). The task requires a device referred to as PVT-192 whereby participants look at a screen with stimulus and are to respond with a push button response. The task runs for 10 minutes. Stimulus is presented at variable rates between 2000-10000 ms and when the participant sees it, he is to push the button with his dominant hand. "The visual stimulus was the four-digit LED counter turning on and incrementing from 0 to 60 sec at 1-msec intervals. In response to the subject's button press, the LED counter display stopped incrementing, allowing the subject 1 sec to read his or her RT before the counter restarted. If a response had not been made in 60 sec, the clock reset and the counter restarted. If a response was made prior to presentation of the stimulus, a "false start" (FS) message was displayed. If the button was not released after 3 sec, a reminder message (RELEASE BUTTON) was displayed."

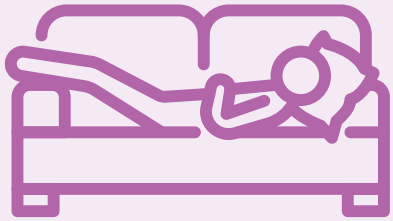
In their review paper, **MILNER AND COTE (2009)** investigate factors that affect the benefits of napping such as duration and temporal placement of the nap, and summarize the type of performance improvements that result from napping. The paper reviews several different kinds of measures: One was "differences in sleep electroencephalogram (EEG) [which] may be investigated using quantitative EEG measures" (274). The paper also reviews studies that have used "quantitative electrophysiological measures following a nap as measures of alertness." Others examined "waking event-related potentials (ERPs) following a nap," which "allows investigation of information processing and attention changes resulting from the nap."

Other measures included "Visual Analog Scales for sleepiness and fatigue, performance tests (logical reasoning, alphanumeric detection, addition, and auditory vigilance), and self-rating of performance."

Here's an interesting table with definitions of types of "nappers":

Definition of habitual and non-habitual nappers

Study



LAWRENCE AND SHURLEY (1970)

- Collected information on frequency of napping, typical nap duration, and typical nap time from 505 male and female undergraduates, aged 16-45:
- 78.6% of students napped when not working
- 4.5% of students napped 4 or more days per week; 6.5% napped 3 days per week; 15.6% napped 2 days per week; 24.9% napped 1 day per week; All other had variable napping frequencies
- Approximately one-third of students napped for 1 h, one-third for 2-3 h, one-third had no consistent nap duration
- Over half the students napped in the afternoon

TAUB ET AL. (1976)

- Habitual nappers were those who napped in the afternoon one or more times per week, for 0.5-2 h, for at least 2 years

EVANS ET AL. (1977)

- Nappers were those who sometimes, usually, or always took naps during the day, and they also found napping to have restorative effects (less sleepy, more satisified, and more subjective benefit after a 60 min nap than non-nappers)
- Non-nappers were those who rarely or never napped.

SPIEGEL (1981)

- 61 to 70 year olds
- Habitual nappers defined as those who took a daily daytime nap (about half the sample)
- Only habitual nappers awoke refreshed from a nap

BLIWISE AND SWAN (2005)

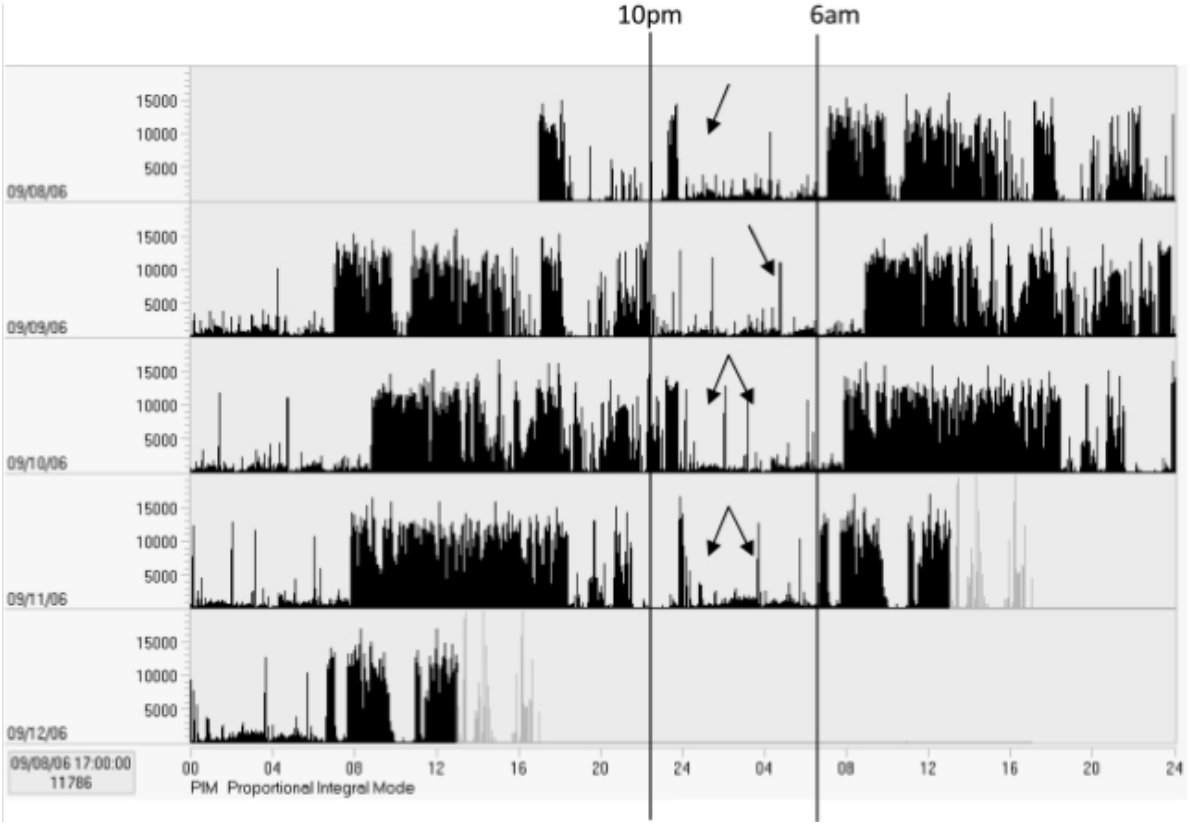
- Habitual nappers were characterized by older age, higher depression scores, and poorer performance on the trail making test

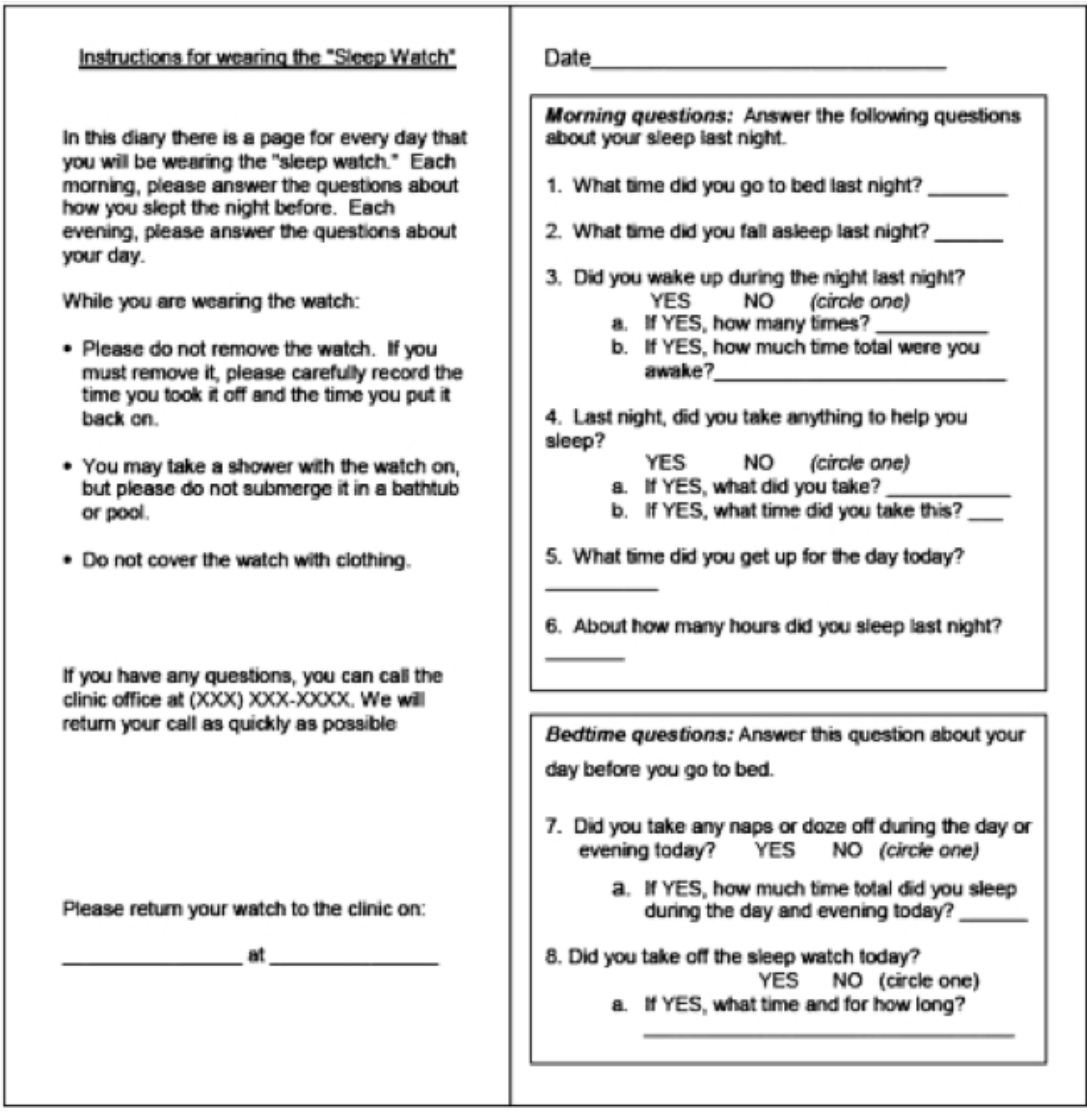
MILNER ET AL. (2006)

- 70.8% of 137 first-year undergraduates were habitual nappers (napped every day or once or twice a week)
- 29.2% of respondents were non-habitual nappers (napped at most once or twice a month)

Actigraphs, a wearable (wrist device), represents a useful diagnostic tool, allowing for assessment of sleep over extended periods of time (a couple hours-week) in the natural sleep environment. The data can be later exported to an offline source or even transmitted in real time. They can vary widely in size and features; including extensions such as temperature, ambient light and sound levels. It has the advantage of providing objective information on sleep habits in the patient's natural sleep environment. Actigraphy appears to provide a valid estimate of Total Sleep Time, sleep percentage, Wake After Sleep Onset, and useful information in the evaluation of insomnia and circadian rhythm sleep disorders. Key limitations remain the absence of validation studies with many of the commercially available devices and the use of actigraphy in the assessment of daytime sleeping.

Actigraphs have multiple ways of accumulating the values from the accelerometer in memory. ZCM (zero crossing mode) counts the number of times the accelerometer waveform crosses 0 for each time period. PIM (proportional integral mode) measures the area under the curve, and adds that size for each time period. TAT (time above threshold) uses a certain threshold, and measures the length of time that the wave is above a certain threshold. Literature shows that PIM provides most accurate measurements for both sleep and activity.





Instructions for wearing the "Sleep Watch"

In this diary there is a page for every day that you will be wearing the "sleep watch." Each morning, please answer the questions about how you slept the night before. Each evening, please answer the questions about your day.

While you are wearing the watch:

- Please do not remove the watch. If you must remove it, please carefully record the time you took it off and the time you put it back on.
- You may take a shower with the watch on, but please do not submerge it in a bathtub or pool.
- Do not cover the watch with clothing.

If you have any questions, you can call the clinic office at (XXX) XXX-XXXX. We will return your call as quickly as possible

Please return your watch to the clinic on:

_____ at _____

Date_____

Morning questions: Answer the following questions about your sleep last night.

1. What time did you go to bed last night? _____
2. What time did you fall asleep last night? _____
3. Did you wake up during the night last night?
   YES NO *(circle one)*
   a. If YES, how many times? _____
   b. If YES, how much time total were you awake?_____
4. Last night, did you take anything to help you sleep?
   YES NO *(circle one)*
   a. If YES, what did you take? _____
   b. If YES, what time did you take this? ___
5. What time did you get up for the day today? _____
6. About how many hours did you sleep last night? _____

Bedtime questions: Answer this question about your day before you go to bed.

7. Did you take any naps or doze off during the day or evening today? YES NO *(circle one)*
   a. If YES, how much time total did you sleep during the day and evening today? _____
8. Did you take off the sleep watch today?
   YES NO (circle one)
   a. If YES, what time and for how long?
   _____

Actigraphs, a wearable (wrist device), represents a useful diagnostic tool, allowing for assessment of sleep over extended periods of time (a couple hours-week) in the natural sleep environment. The data can be later exported to an offline source or even transmitted in real time. They can vary widely in size and features; including extensions such as temperature, ambient light and sound levels. It has the advantage of providing objective information on sleep habits in the patient's natural sleep environment. Actigraphy appears to provide a valid estimate of Total Sleep Time, sleep percentage, Wake After Sleep Onset, and useful information in the evaluation of insomnia and circadian rhythm sleep disorders. Key limitations remain the absence of validation studies with many of the commercially available devices and the use of actigraphy in the assessment of daytime sleeping.

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Relaxation & mindfulness programs.

KENNEDY & BALL (2007) examined whether a hypnorelaxation program, Power Break, done twice a day for 10-minutes each session could improve physical health, mood, and job satisfaction. Power Break is a program that participants could listen to at their work stations which followed a 10-minute relaxation script.They used 75 opt-in participants from a telephone call center in Australia, of which 43 volunteered to be in the Power Break group (M=18, W=25) while the other 32 (M=14, W = 18) were in the control group. Both groups had two 15-minute breaks a day, but the Power Break group used 10 minutes both time to do the Power Break routine. The researchers measured baselines for both groups the first week, after which the Power Break group did the hypnorelaxation program for the next four weeks. At the end of the four weeks, the participants took the surveys again.

In the first week of the study, while there were no significant differences between the Power Break and control groups, the Power Break groups had lower job satisfaction and higher depression ratings than those in the control group. By the fifth week, there were still no significant differences between the Power Break and control groups; however, there was a significant increase in physical health symptoms and satisfaction with job scores and significant decrease in many of the mood measures (depression, anger, and confusion) between the Power Break group's baseline and end results. This could be due to the non-random assignment to groups -- those who self-selected into the Power Break group initially had lower scores than the control group, but ended up with similar scores to the control group. Therefore, although this self-selection is a limitation of the study, it could also be useful to see how naps and/or meditation routines can increase the health, mood, and satisfaction of underperforming workers.

AIKENS ET AL. (2014) found that a predominantly online workplace mindfulness program was largely effective in increasing subjective measures of facets of mindfulness, resilience, and vigor, and decreasing perceived stress, compared to a control group. 89 Dow Chemical Company employees volunteered to participate and were randomized into the treatment (n=44) and waitlist (control) condition (n=45). The intervention consisted of a 7-week mindfulness program consisting of weekly hour-long virtual class meetings, online trainings, and a physical workbook component. Covered topics included focus exercises on breath and physical sensation, movement exercise with focus on stretching and sensation awareness, and focus on relaxed thought. At baseline and post-intervention participants completed assessments including the 5 Facets of Mindfulness Questionnaire (FFMQ) (measured across aspects of Acting with Awareness, Non-judging of inner experience, Non-reactivity to inner experience, describing, and observing on a 0-39 score), the Perceived Stress Scale, the Connor-Davidson Resilience Scale, and the Shirom Vigor Scale.

Post-intervention, the treatment group scored significantly better on every measure, except the non-judgemental facet of the FFMQ. The researchers did not perform a difference-in-differences analysis, but at the post-intervention period the treatment group had higher scores on Observe (28.81 vs. 23.91), Describe (28.72 vs. 25.48), Act Aware (27.67 vs. 24.29), and Nonreact (24.17 vs 21.31) of the FFMQ. Perceived stress was lower (18 vs 24.76), and perceived resilience was higher (76.11 vs. 71.02). Vigor was also higher across all 3 of its sub-measures: physical strength (4.77 vs. 4.17), emotional energy (5.47 vs. 5.12), and cognitive liveliness (5.11 vs. 4.75).

Napping - applied

Opinion piece on napping rooms.

Inadequate sleep is a major factor in human error, yet less than one percent of companies allow for naps on the job. **AUTUMN ET AL. (2016)** advocate for the "perfect nap", a 10-20 minute nap following lunch, based off of previous literature. After reviewing general literature on napping and sleep inadequacy in America, they review case studies on companies which promote napping. For example, Google has napping pods in the workplace, which signals to workers that napping is both allowed and encouraged to increase productivity. Similarly, Huffington Post has nap rooms, and Arianna Huffington, president and editor chief, publicly endorses these rooms and naps in her own office at work. Other companies now have nap rooms which employees can make use of, with their executives claiming they have increased productivity. Overall, the creation of napping rooms paired with executives highly endorsing (and using) them has changed company cultures and increased productivity.

EnergyPods.

A short article on Sleep.org (Sleep.org, n.d.) reviews five companies (Google, Huffington Post, White & Case, Mercedes-Benz Financial Services, and NASA) that use "EnergyPods." The company MetroNaps designed this innovation: the world's first chair designed for sleeping at work. "According to MetroNaps, hundreds of companies on four continents have installed these high-tech napping stations," the article states, "which feature ergonomic positioning, a privacy visor, and built-in lighting and music to gently wake you from your slumber." This article also recommends 20-minute power naps, but does not go into detail about why.

The Guardian **(CASSIDY, 2017)** published an article which looks at a few different companies that have already implemented sleeping at work procedures. Some techniques include EnergyPods, special sleep/meditation rooms, flexible work hours to suit people with different sleeping habits (Nike), and lighting systems in the office that help regulate melatonin (P&G). The article describes a top down approach to implementation. I.e. Ariana Huffington (Huffington Post) implemented napping at work after collapsing from exhaustion.

Google.

Napping, or more specifically 20 minute power naps, have become an increasingly common trend in the workplace culture. Due to the overwhelming support of technology companies such as Google, a number of innovative solutions have surfaced. MetroNaps, most famous for their product EnergyPod, created the world's first chair designed for sleeping at work. Thousands of companies have adopted this high tech napping station with privacy visors and built-in lighting/music/vibrations to wake you up gradually. Its ergonomic design allows people to shift into "zero-gravity position"; head downwards and feet raised which ensures maximum blood flow. As noted by the article, it is on Fortune's 100 Best companies to work for list; Google states that no workplace is complete without a pod. The company prefers its employees to take these 20 minute naps to boost productivity during the second half of the workday, when lulls are common. There are specially designated office

nap rooms with airtight door locks to keep them light and soundproof. There is a history of employees abusing the privilege with extended naps. Google also offers wellness centers, which have gyms, saunas and massage rooms. The staff within Google can give each other massage credits which are redeemable for a free one-hour pampering session when a peer has done an exceptional job. Average time to go to sleep in the pods is 3pm. All this is in efforts to boost productivity, which with these napping pods can increase alertness by 54% (NASA study). At HubSpot for example, there are no rules about how often employees can use the napping room, as it is an integrated part of the company culture and therefore fosters the honor code.

JET LAG

CHO ET AL. (2000) investigated the effects of transmeridian flying and chronic jet lag on the salivary cortisol levels, memory function, and reaction times of 62 women working in the airline industry. The study measured cortisol levels of the women throughout the working day for both women working in the cabin crew (weekly transmeridian flights) and in the ground crew (no transmeridian flights). A baseline reaction time and memory performance of the women were also taken. Then the women were subdivided according to the length of time they had been working in the industry, so as to differentiate between long term and short term effects. Finally, the cabin crew that did experience weekly transmeridian flights were compared with cabin crew that staffed short term flights (no timeline crossings) in order to isolate the effects of transmeridian flying as opposed to general in flight physical stresses. The results found that the flight crew had significantly higher salivary cortisol levels than the ground crew and that long distance crew had significantly higher cortisol levels as compared to short distance crew. There were no significant differences in memory function for those with below the 3 years of work experience but cabin crew with over 4 years experienced significant decreases in memory function compared with ground crew. The reaction time of cabin crew with over 4 years of experience was also significantly slower than comparable ground crew.

WATERHOUSE ET AL. (2007) outline trends and coping strategies related to jet lag by reviewing the literature on jet lag since 1997. They describe jet lag as caused by unsuitable timing of the body's clock primarily, but also dehydration when flying and stress related to airport travel. Jet lag usually occurs when a person has crossed three or more time zones. Flights to the East create more jet lag than flights to the West. It is not really possible to fully prevent jet lag, but the authors review pharmacological and behavioral methods for mitigating it. Field studies of short-acting hypnotics in a military context have shown to improve sleep. Caffeine has been shown to alleviate fatigue in the short term. Exposure to the light during the day also aids in alertness. Helping people get to sleep is another area of concern, as sometimes people are sleepy during the day and alert at night. A dose of melatonin, generally 3–5 mg taken 2–3 hours before bedtime has been demonstrated effectively. There are some unexplained problems still, including the fact that older people seem to suffer more from jet lag, and a lack of understanding about molecular changes associated with time-zone transitions.

Effects of jet-lag and their alleviation by melatonin.

ARENDT ET AL. (2007) conducted a study on 17 volunteers (10 women and 7 men, 29-68 years). The participants were flown from London to San Francisco and stayed there for 14 days prior to flight home. Subjects took melatonin (N = 8, 5 women, 3 men) or placebo in a double-blind design, at 18.00h local time for three days before the return flight and at bedtime (22.00-24.00h) in London for four days. For three days before departure and on days 1-7,14,15, 21 and 22 after their return subjects collected 6-hourly urine samples and were asked to keep a daily sleep log, mood and body temperature 2 hourly and performed logical reasoning and letter cancellation tests 4 hourly from 08.00h (or wake up time) to 24.00h (or bedtime) whichever was the earlier. Urine was also collected for 48 h prior to departure from the U.S.A On day 7 after their return subjects rated 'jet lag' (10 cm visual analogue scale—VAS) from 0 (insignificant) to 100 (very bad). Melatonin significantly improved 'jet lag' ($p= 0.009$). Comparisons by ANOVA between jet-lagged placebo subjects (N = 7) and melatonin (N = 8) showed decreased sleep latency with melatonin ($p= 0.0397$) which correlated positively with jet lag ratings, $p< 0.001$. Sleep quality was significantly improved in the melatonin group and correlated negatively with jet-lag ratings ($p<0.001$) but the researchers found no important differences in temperature, or performance data. Melatonin treated subjects tended to be more alert than placebo subjects, especially at bedtime. They were also less depressed. Endogenous melatonin and Cortisol rhythms resynchronized more rapidly in melatonin subjects ($p= 0.0216$ and $p= 0.0299$). These data suggest that MT can alleviate jet-lag after Eastward flight over eight time zones.

Effects of travel across time zones (jet-lag) on exercise capacity and performance.

WRIGHT ET AL. (1983) conducted a study on 81 healthy male soldiers, 18-34yo. They were studied for 5 days before and after an eastward deployment across six time zones to determine the effects of translocation on exercise capacity and performance. Fatigue, weakness, headache, sleepiness, and irritability occurred in most of subjects. Most of the symptoms were absent by the fifth day following the translocation. Cardiorespiratory function and perception of effort during both submaximal and maximal treadmill exercise were unaffected. Isometric strength of the upper torso, legs, and trunk extensor muscles also unchanged. Dynamic strength and endurance of elbow flexors declined significantly. Dynamic knee extensor strength and endurance scores exhibited a progressive decrement prior to translocation and were inconsistent suggesting that the stress of repetitive testing outweighed any jet-lag effects on performance capacity. Performance times for a 270 m sprint were increased for the first 4 days following translocation as were times for a 2.8 km run on the second and third days and for a 110 m lift and carry on the third day after deployment. Times for a 6.5 m rope climb did not change. These findings indicate that certain symptoms and physiological capacities are affected as a result of multiple time zone translocation. However, the specific mechanisms involved, the factors influencing the magnitude of any physiological alterations, and the ultimate impact of these capacity changes on actual physical performance remain to be clarified.

REYNOLDS AND MONTGOMERY. (2002) found that adoption of the Argonne diet, consisting of alternating moderate feasting and fasting, was an effective preventive treatment for jet-lag in deployed National Guard personnel. More specifically,

the diet entails “feasting” days of high protein breakfasts and lunches and high carbohydrate dinners, followed by “fasting” days of small, low-calorie meals. The diet is thought to prevent jet-lag by “preparing” the body, through varying energy and protein levels, for the effect of the sudden time shift on the internal clock. 186 soldiers participated in the study, and were given a description of the Argonne diet and the choice to use it either before a flight to Korea (nine time zones away) or before the return flight to the US. Questionnaires were circulated which asked the soldiers about their use of the diet, their activities, and their symptoms and history of jet lag. 95 soldiers used the diet before the departure flight to Korea, and 39 used the diet before the return flight.

Questionnaire results indicated that 26% of soldiers experienced jet-lag after the initial flight, and 71% experienced jet-lag following the return flight. Odds-ratio analysis determined that those soldiers not using the diet were 7.5 times more likely to experience jet-lag upon arrival in Korea, while those not using the diet were incredibly 16.2 times more likely to experience jet-lag following the return flight to the US. Results also indicated correlations between previous history of jet-lag and jet-lag experience (2.8 times more likely post-departure flight, 4.25 times more likely post-return flight). Those reporting a sedentary lifestyle at home were also 2.86 times more likely to experience jet-lag. It should be noted that this study has several limitations, notably selection bias and self-report bias.

SICKNESS IN THE WORKPLACE

KUMAR ET AL. (2013) found that the provision of paid sick days (PSDs) can help reduce influenza transmission in the workplace, according to an agent-based modelling simulation. The authors used a platform called FRED (Framework for Reconstructing Epidemic Diseases) to model the spread of a pandemic influenza strain in a simulated version of Allegheny County, Pennsylvania, essentially tracking 1,242,755 simulated individuals created on the basis of the American Community Survey, LandScan USA data, and census aggregated data. Using historical data, the authors set initial parameters such that 72% of sick individuals would stay home if they had access to PSDs vs. 52% who would stay home in the absence of PSDs, and that those staying home stayed for an average of 1.7 days. They then compared the outputs of this model to one in which there was universal access to PSDs, and another in which employees were granted 1 or 2 “flu days”, changing the model so that those who stayed home now stayed for 2.7 or 3.7 days. Each model was run 50 times, and then the cumulative number of infected employees was determined, as well as counts for the number of individuals infected in the workplace, those infected due to presenteeism (going to work when sick), and those infected by symptomatic vs. asymptomatic individuals. Odds ratios were calculated thereafter.

In the first model, 11.54% of employees were infected owing to transmission in the workplace. Employees were 1.17 times more likely to be infected by an employee without PSDs engaging in presenteeism as compared to an employee with PSDs engaging in presenteeism. Under the universal PSD provision scenario, only proportion of employee infections due to workplace transmission fell to 10.86%. In

the “flu day” scenario, this proportion further dropped to 8.62% when employees had access to 1 “flu day”, and to 7.01% when employees had access to 2 “flu days”. The authors do note that the study is limited by the simplifying assumptions of the model, but these results suggest that provision of PSDs or additional “flu days” could significantly decrease the spread of disease at the workplace.

SKOV ET AL. (1986) conducted a study in 14 town halls in Copenhagen, Denmark. 4369 town hall employees were surveyed and medically assessed to see if there was correlation between the building’s indoor climate factors and symptoms experienced by the workers due to “sick building syndrome”. The 14 buildings had a variation in age, mechanical vs. natural ventilation, urban vs. rural vs. residential environments, circulation and humidifier usage. The questionnaire included information on work type, previous and present diseases, presence of mucosal symptoms, frequency and timing of symptoms and other complaints (dry air, low temperature etc). Clinical study included measurement of blood pressure, evaluation of skin, collection of nasal secretion, and determination of lung function. Measurement of climate included temperature, humidity, carbon dioxide, static electricity, formaldehyde, airborne dust, floor dust, collection of microorganisms, lighting and more. Results showed that the most popular mucosal related symptom reported is nasal irritation and the most popular general symptom is fatigue. Popular workplace complaints included drought, changing temperatures, and stuffy air. Mayors, directors, and engineers reported the least amount of symptoms. Clerks and social workers reported the most. Symptoms were most prevalent in buildings where more than 30 people worked. Symptoms were more frequent in workers working with photo printing, carbonless paper, and women working more than 30 hours per week. There was no statistically significant difference between naturally and mechanically ventilated buildings. However, younger buildings actually produced more symptoms on average than older buildings.

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