Steele's Top 10 Dietary Principles and Strategies For Maximizing Cognitive Performance

Principle #1: **Eat food.** All details aside, any food is better than no food when it comes to sustaining function during a prolonged period of cognitive demand. Logistical factors, caffeine, and/or stress can cause us to either ignore normal hunger signals or to not have reasonable access to good food.
Strategy: **Arrange convenient access to meals and snacks.** Plan in advance for periods during which you may have minimal time for trips to the market and meal preparation or if you will be awake at odd hours when (most) food vendors are not open. Energy bars, liquid meals, jerky, mixed nuts, dried fruits, microwavable meals, and some comfort food should be in supply.

Principle #2: **Avoid major alterations in dietary habits during a performance period.** Deviations from standard diet can generate unpredictable gastrointestinal, metabolic, and cognitive disruptions. Additionally, self-restriction of preferred foods (with the intent of dieting, for example) can disrupt psychological equilibrium in a manner that can profoundly affect abilities across several metrics of cognitive performance.
Strategy: **Save experimentation with major adjustments in dietary composition for the 'off-season.'** In the meantime, you are safe to experiment with adjustments in meal size and timing – in accordance with the remaining principles below.

Principle #3: **Don't eat a huge meal before an exam.** Many of our cognitive systems evolved for the purposes of seeking out and processing potential food sources. Bulky and high caloric meals permit these systems to go 'off-line' for a while – after a job well done! This is mediated by the fact that brain systems involved in alertness, learning, and memory are transiently depressed in response to high levels of leptin, insulin, glucose, fatty acids, and stretching of the stomach – all of which are the result of a bulky and high caloric meal.
Strategy: **Time larger meals for 2-4 hours prior to an exam – then consume a light snack 10-15 minutes prior to the exam.** Allowing for a long period of digestion enables the digestive organs and neuro-endocrine monitors of energy status to restabilize while a light snack before entering the exam prevents hunger and boosts performance in accordance with principles #4 and #5.

Principle #4: **Avoid intense hunger during a cognitively demanding task.** Strong feelings of hunger negatively impact cognitive performance. This is likely mediated through psychological preoccupations with food, as well as via the fact that very high levels of the hunger hormone ghrelin can promote anxiety and irritability. Note that this effect is valid regardless of one's body composition, reinforcing the statement that 'dieting' is never a good idea during a critical period such as exam week.
Strategy: **Eat regular meals and equip yourself with highly satiating snack foods.** Highly satiating foods are energy-rich and high in protein, such as meats, eggs, dairy, and nuts/seeds.

Principle #5: **Mild increases in blood glucose boost performance during cognitively demanding tasks, *but* avoid wild fluxes in blood glucose and insulin levels.** Many studies indicate that baseline (normal) blood glucose levels may not be adequate to keep up with the demands of active regions of the brain *during a cognitively demanding task*. Increasing the

supply of glucose reverses this effect. The caveat, however, is that both hyperglycemia and the accompanying hyperinsulinemia impair cognition. The most reliable principle therefore is that better glucose control = better overall cognitive performance. Hyperglycemic-driven reductions in performance are not limited to diabetics, although they are more pronounced in individuals with a reduced ability to regulate glucose levels.

Strategies: **Eat a light snack prior to a demanding task.** Providing a mild boost to your blood glucose levels can support the activity of highly active regions of the brain during a demanding task and combat the deleterious effects of stress on performance and mood.

Eat meals registering low on the glycemic index. Slow and sustained release of glucose into the bloodstream, with an accompanying reduction in blood sugar and insulin spikes, promotes better performance – especially late in the post-meal period. Although it is a useful reference, published glycemic index values for a food cannot be taken literally. Increasing the level of protein, fiber, and/or fat in a meal reduces and stabilizes the rate at which glucose is released into the bloodstream from the intestinal tract.

Regular light/moderate exercise. Regular exercise is demonstrated to increase the sensitivity of certain tissues to the effects of insulin, so fuels such as glucose are cleared out of the blood more effectively. Although individual exceptions exist, the general view is that a sedentary lifestyle combined with a high fat and high calorie diet tend to reduce the responsiveness to insulin with consequent impairments in blood sugar regulation

Principle #6: **Any breakfast is better than no breakfast, with two qualifications.** Upon waking you have essentially been fasting for the previous 8-10 hours. Eating breakfast of any kind increases blood glucose levels and provides fuel to sustain performance throughout the morning. *However*, almost all studies on breakfast and cognition indicate that a lower glycemic index breakfast improves cognition the best – especially as you progress into the late morning. *Additionally*, if you regularly skip breakfast, you may experience a post-breakfast dip on the rare occasion that you do consume breakfast. In the long run, you are better off to establish a breakfast routine, however, you may not want to tinker with this during a performance period.

Strategy: **Eat breakfast.**

Principle #7: **Be wary of the "post-lunch dip in performance."** Although this phenomenon is driven primarily by circadian rhythms, the effect is exacerbated if sleep was poor the night before and/or if the lunch is of a high fat and caloric content.

Strategies: **Consume a low-caloric, low-fat lunch; graze during the afternoon.** A high fat lunch with less overall calories promotes stronger post-lunch drowsiness versus a lunch with a balanced macronutrient composition.

Surrender to the sleepiness. Afternoon naps are common in many cultures and can restore energy and mood, as well as promote better cognitive performance later in the afternoon and evening. A nap of 15-30 minutes is best.

Don't attempt cognitively demanding tasks. The afternoon 'blahs' can be a good time to tend to organizational tasks such as printing and consolidating notes, responding to emails, and updating your daytime planner. Making a poor attempt at a more difficult task during this state can generate erroneous feelings of helplessness or inadequacy that can contaminate your efforts once you inevitably return to a sharper level of cognitive functioning.

Drink a caffeinated beverage in the afternoon. If necessary, consumption of a caffeinated beverage reliably combats the post-lunch drowsiness, although the best result is when caffeine is consumed following a brief nap.

Nevertheless - don't skip lunch. Although it may initially stave off the early afternoon decline, skipping lunch will lead to poorer performance later in the afternoon, and will also make it difficult to meet your daily energy and nutritional requirements.

Principle #8: If *carefully executed*, a slight negative energy balance over a 2-3 day period is OK and may actually improve cognitive performance and perception of energy. As already mentioned, stress and caffeine may suppress appetite, and large meals can transiently depress performance. You can get away with and may even benefit from a slight decrease in energy consumption over a 2-3 day period, *as long as* you are sure to eat a lot of high quality protein *and as long as* afterwards you consume plentiful amounts of food over a 1-2 day period (the weekend for example). You should definitely not attempt or persist in this strategy if: eating less causes you to become excessively hungry (Principle #4); you are an athlete actively training or competing; you have less than 5-10% body fat; or you notice unfavorable changes in mood.
Strategy: Experiment with eating *slightly* smaller portions during a 2-3 day period – then feast and be merry for 1-2 days to restore normalcy.

Principle #9: Caffeine restores mood, vigilance, and performance during periods of prolonged stress and sleep-deprivation. Formulas such as Red Bull® and 5-Hour Energy® are superior to coffee due to additional ingredients, but several caveats exist. In brief, caffeine is reliably effective in combating fatigue and improving mood, alertness, problem-solving, speed, and accuracy – especially in regular users and during times of stress and/or sleep deprivation. Recently many caffeinated products have emerged with additional ingredients (detailed in the glossary of terms) that either serve to increase the levels of neurotransmitters involved in learning, cognition, and vigilance or that operate to sustain their effect. It is uncertain the manner in which regular consumption of these products might lead to addiction or long-term remodeling of the target neurotransmitter systems. Individuals who find these products particularly attractive might actually be self-medicating against certain neurochemical deficiencies, and should seek more sustainable avenues towards normalizing these systems.
Strategy: Use in moderation, if and when necessary.

Principle #10: Boost brain serotonin levels after a job well done. Among other functions, serotonin operates in the brain to counter any deleterious effects *following* a stressful period – such as depressed mood, lingering anxiousness, and decline in hippocampal function. As with dopamine and norepinephrine, the output of serotonin depends on the supply of its precursor: the amino acid tryptophan. Tryptophan has to compete with certain other amino acids for uptake into the brain, so increasing the ratio of tryptophan to other amino acids is the essence of increasing brain serotonin levels.
Strategy: Get some moderate exercise, and/or reward yourself with a pleasurable and high carbohydrate meal. These represent the two major avenues to naturally boost brain serotonin. During moderate exercise, skeletal muscle increases its utilization of branched-chain amino acids but not of tryptophan. Simultaneously, during exercise there is an increased release of fatty acids into the blood by adipose tissue, which displaces tryptophan from the plasma protein albumin, thus increasing the free tryptophan pool. When a high carbohydrate and low protein meal is consumed, the action of insulin also increases the ratio of tryptophan to other amino acids.

Terminology:

Circadian Rhythm: The daily and cyclical flux in cognition, behavior and physiological functions.

Citicoline / CDP-Choline: The energy formula ingredient that supplies a precursor to the neurotransmitter acetylcholine. In the brain, acetylcholinergic systems are involved in learning, attention, and memory. Studies demonstrate that supplementing with citicoline can restore function if these systems are overworked or otherwise impaired due to a disease state.

Diffuse Modulatory System: A collection of neurons within the brainstem producing either noradrenaline, dopamine, or acetylcholine for release to diffuse targets throughout the central nervous system, thus 'setting the tone' for consciousness and cognition.

Ghrelin: A hormone released by cells lining the stomach. As the stomach returns to its resting size following a meal, ghrelin output increases, improving cognition but ultimately promoting hunger and anxiety.

Glycemic Index: A value assigned to foodstuffs reflecting the rate at which they promote rises in blood glucose levels following consumption. Although it cannot be taken at face value due to factors such as food combinations, it is still a useful reference - especially for diabetics.

Hippocampus: "Librarian of the brain" - the brain structure responsible for memory storage, memory retrieval, and place awareness. Hippocampus functioning is uniquely susceptible to levels of glucose, insulin, ghrelin, leptin, and other biomarkers of energy and metabolic status.

Insulin Sensitivity: The strength of the response of certain tissues to insulin in order to remove absorbed macronutrients from the blood *following a meal*. Exercise and certain diets can improve insulin sensitivity.

Macronutrient: Carbohydrate, protein, and fat.

Negative Energy Balance: The condition in which energy intake is less than energy expenditure.

Phenylalanine: Energy formulas ingredient and essential amino acid. Ability to alleviate depression and promote certain aspects of cognition is via conversion to phenylethylamine, a neuromodulator that sustains the activity of dopamine and norepinephrine – thus promoting focus, alertness, and stable mood while under stress.

Post Lunch Dip in Performance: The well-documented phenomenon related to circadian rhythms whereby a decrease in vigilance and increase in drowsiness sets in during the early afternoon.

Precursor Control Hypothesis: The phenomenon whereby the amount of neurotransmitter synthesis is limited by the supply of the raw material (precursor), such that increasing the precursor supply increases the levels of the neurotransmitter and its related effects on the nervous system.

Satiety: The feeling of satisfaction and decrease in the feeling of hunger that typically follows meal consumption, as mediated via hormones, nerve signals, and break-down products of food.

Taurine: Energy formula ingredient and abundant free amino acid in electrically excitable tissues such as the brain and skeletal muscle. Physiological levels are dependent on dietary supply and individual ability to synthesize from sulfur containing amino acids. Demonstrated to protect against fatigue and 'excitotoxicity' in the brain - also plays an important protective role within the cardiovascular system.

Tyrosine: Energy formula ingredient that is a precursor to the neurotransmitters dopamine and norepinephrine. Based on the precursor control hypothesis, supplementing with free tyrosine can enhance the activity of these neurotransmitter systems, *especially* under stressed conditions.

Vagus Nerve: Cranial nerve originating from the brainstem responsible for monitoring and regulating the heart and digestive organs. Input to the brainstem and brain from the vagus nerve regarding food intake appears to play a major role in mediating the impact of meals on cognition.