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Letter to the Editor

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Dangers of sleeping, and not sleeping enough, in war

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Few behaviors are as dangerous as sleep [1]. While awake, the senses send information to the brain for processing to elicit a behavioral response. While asleep, the links in the neurological chain of information processing break so sleep functions can play out uninterrupted by wakefulness [2]. It is this attenuated awareness of the local environment, and reduced responsiveness to changing circumstances, that characterizes sleep from humans to honey bees, and finches to flatworms [3]. And yet, the daily persistence of sleep, despite this vulnerability, indicates that the functions sleep serves are inescapable.

Indeed, sleep is essential [4]. People need 8 hours of sleep, on average, to perform their best while awake. When people forgo a single night of sleep, hand-eye coordination deteriorates to the level of someone with a blood alcohol content of 0.08% [5], the threshold for legal intoxication throughout much of the United States and the United Kingdom. In addition to total sleep deprivation, impairments manifest after sleep restriction. Human volunteers sleeping either 4 or 6 hours every night for 2 weeks had progressively diminished alertness and short-term memory, mimicking the poor outcomes showed by participants after two, or one, wholly sleepless night, respectively [6]. The dependency of effective waking performance on the amount of prior sleep has special relevance for those operating in environments that demand sustained concentration, sharp reaction times, deftness, and sound judgment.

For soldiers, these are mandatory characteristics. Yet, British Army recruits obtain fewer than 6 hours of sleep each night over months [7]. Perhaps unsurprisingly, disturbed sleep continues after deployment. More than half of American active-duty service members report sleeping fewer than 6 hours per day [8]. Sleeping so little during wartime is expected to degrade operational effectiveness. A mathematical model, informed by human performance data, on the number of artillery rounds accurately delivered to a target each day, depending on whether the military companies were restricted to 4, 5, 6, or 7 hours of sleep each night across 3 weeks, was developed [9]. On the first 2 days, sleep-restricted companies actually delivered *more* rounds per 24-hour day, owing to more time to work. However, after the third day, performance was lower than the best-rested group, despite the "extra" time to perform the task. In a separate study, a United States Army airborne division conducted an 86-hour simulated operation and was given targets at which to fire artillery shells [10]. Orders were given irregularly and could include managing simultaneous demands, questioning and prioritizing targets, calculating distances and directions, and mapping troop movements. After 36 hours, the teams showed lapses in communication, critical thinking, and positional awareness, resulting in delays in firing. Such situations, however realistic, remain simulated scenarios. There is scant information on the role sleep loss has played in real-world combat conditions. One military confrontation has been overlooked from the perspective of sleep biology, the Battle of Culloden (1746).

Historical Context

The House of Stuart ruled Scotland from 1371, and from 1603, England and Ireland as well, until 1714 (excluding the 11-year Interregnum). During the reign of King James II (in England and Ireland) and VII (in Scotland) (b. 1633–d. 1701), seeds of discord germinated between Protestants and Catholics. James had converted to Catholicism during the reign of his brother, Charles II, much to the displeasure of both his monarch brother and powerful Protestant nobles. Fewer than 4 years after his own ascension to the throne, James was deposed by those noblemen in 1688, who feared the establishment of a Catholic dynasty in England. James was exiled and replaced by his eldest daughter Mary II and her husband King William III and II, both firm Protestants. The rule of the House of Stuart ended in 1714 with the death of Queen Anne (James' second daughter). The Act of Settlement (1701) had excluded Anne's Catholic younger brother, James Francis Edward Stuart, from inheriting the crown, such that Anne was succeeded by her second cousin, George I of the House of Hanover. However, the deposed and exiled branch of the family continued to receive support in Britain, known as 'Jacobites' (*Jacobus* being Latin for James). Between 1689 and 1746, storied armed rebellions disrupted the rule of William and Mary, and their Hanoverian successors, aimed at returning the House of Stuart to power.

The final rising took place from August 19, 1745, to April 16, 1746, under the command of the grandson of King James II and VII, Charles Edward Stuart [11]. The Jacobite army found success in September 1745, taking Edinburgh and finding victory at the Battle of Prestonpans. They invaded England in November

entering Carlisle, Preston, and Manchester in rapid succession. The Jacobites made it as far south as Derby by December, but lack of recruitment and support, and an amassing government force caused Prince Charles and his army to retreat to Scotland that same month. And so, 3 months of southward advance was followed by 4 months of northward retreat. During the retreat, they were pursued by the British Army under the command of the son of King George II: Prince William, the Duke of Cumberland, Captain-General of the British Army. On April 14, this army, consisting of upwards of 6000 men, 750 cavalry, and crews for 10 cannons and 6 mortars, made camp in and around the town of Nairn [11]. Some 20 km to the west in Culloden, the Jacobites did likewise, albeit with one-quarter the number of horses and fewer artillery.

Dangers of Sleeping

On April 15, Prince Charles held a war council where a decision was reached to mount a surprise night attack on the government forces as they slept in their tents. Jacobite sympathizer, Sir George Lockhart, recounts the orders:

> "In the evening it was resolved in a council of war that we should march under cloud of night and attack the enemy in their camp at Nairn, judgeing that this being the Duke of Cumberlands birth-day his army would make merry and be less prepared for a surprize. Accordingly we sett out about eight o'clock that night, with express orders to observe the profoundest silence in our march. Our word was King James the Eighth. We were likewise forbid in the attack to make any use of our firearms, but only of sword, dirk and bayonet, to cutt the tent strings and pull down the poles, and where we observed a swelling or bulge in the falen tent there to strick and push vigorously" [12].

While morally debatable, the order was at least physiologically pragmatic. It is sensible to attack when the taut vigilance of your opponent slackens. Even still, the war plans were born out of desperation (against a superior and better-fed adversary) and naïveté (British picquets, either foot or mounted, would warn of an approaching threat). The plan nonetheless sought to slay soldiers disarmed by the vulnerability of sleep.

Dangers of Not Sleeping Enough

Little more than an hour before dawn, and miles yet to march, the attack was called off. The rebels were hungry and tired from 7 hours spent marching over the cold moor. Traveling without torchlight, many became confused. Some deserted in search of sustenance or sleep. The countryside was peppered with exhausted stragglers. "For some, a thousand or more, even the rant of their clan […] was not enough to waken them. They slept where they had fallen, in the ditches and by the walls, in the open fields, and they were to sleep through the battle that followed and were to sleep until well past noon when Cumberland's dragoons came down upon them" [13]. In the first hour of the morning, the first of the Jacobite soldiers returned to Culloden. Unbeknownst to them, the Duke of Cumberland and the government army had begun their own march towards Culloden. At 11 AM, rebel scouts sighted the approaching army; the Jacobites formed in order of battle. At midday, rebel artillery fire signaled the start of the Battle of Culloden. Sleepless and exhausted, the Jacobites fell prey to fatigue and to the British Army. They would be routed in a clash that lasted less than one hour. Of the 1800 casualties, greater than four in five were Jacobites [11].

Much has been written about this rapid and convincing defeat, with explanations that focus on the superior tactical leadership and execution by the well-trained British Army, or to the field of battle itself which may have favored the movements of the government force [11–13]. Undoubtedly decisive. The purpose here is to single out an underappreciated factor: a sleepless (or at best near sleepless) night preceded by ostensibly months of sleep restriction over a long campaign and subsequent retreat could have impaired concentration, dulled reaction times, hindered coordination, and eroded judgment. Few (if any) other battles had sleep shaped military tactics, and the lack thereof, military defeat. These are important lessons on the dangers of sleeping, and not sleeping enough, in war.

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