WHOOP

Case Study: Time Zone Maintenance

An Approach to Mitigate the Effects of Jet Lag

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Introduction

The unfavorable effects of travel are well known to athletes and non-athletes alike — inconvenient departure times, uncomfortable seating, unfamiliar food, and, not to mention, jet lag. This can be daunting for a team scheduled to travel large distances, especially when a championship is on the line. Symptoms of jet lag can include “sleep disorders, difficulties with concentrating, irritability, depression, disorientation, distorted estimation of time, space, and distance, lightheadedness, loss of appetite, and gastrointestinal disturbances” [1]— needless to say, these are unwelcome afflictions for competing athletes. Some studies suggest that individuals need one day per time zone crossed of acclimating in order for sleep-wake cycle to recover and as many as 8 to 10 days for other physiological cycles to resynchronize. [2,3]

When teams are faced with transmeridian flights heading into competition, what measures can players take to lessen these effects of travel and jet lag? Of course, there is the obvious — do enough good things (like sleep extension) in hopes of balancing out the bad. But for those looking to tip the scales even further in their favor, one effective, albeit admittedly unusual approach, is to minimize the desynchronization of circadian rhythms by refusing to acknowledge the change in time zone. Instead, the athletes maintain their daily schedules on their home time zone, a practice we at WHOOP call “time zone maintenance”.

When an individual travels across time zones, they typically expect to experience jet lag. But despite the name, jet lag actually has nothing to do with flying and everything to do with the internal/external clock desynchronization caused by changing one’s schedule from that of the home time zone to something more aligned with the new environment.[4] By adopting a time zone maintenance protocol while traveling, one can theoretically opt out of jet lag. This protocol entails selective light exposure and strict bed and meal times in accordance with the athlete’s home time zone, enabling athletes to preserve their circadian rhythms by maintaining synchrony in internal clock systems and lessening exposure to external clock systems.

This case study reviews the efficacy of adopting a performance enhancing behavioral protocol which included time zone maintenance in a collegiate team traveling from the East Coast to the West Coast of the United States for the NCAA championships.

[1] Manfredini, et al., 2011

[2] Reilly, 2009.

[3] Coste and Lagarde, 2009

[4] Vosko, et al., 2010

The Intervention

While traveling to the West Coast, the NCAA Division I East Coast-based team chose to follow a WHOOP travel protocol which, in addition to promoting sleep and other healthy behaviors, included maintaining their Eastern Standard Time routines. The time zone maintenance protocols are primarily concerned with light and food, as both are major influences on our biological clocks.[5,6] The following protocols were recommended during the weekend on the West Coast:

Time Zone Maintenance

- Light exposure upon waking (6:30 AM PST)
- Block light starting around dinner time (3:30 PM PST)
- Adhere to East Coast meal times

On-Plane and Travel

- One half-hour nap on plane, no sleep after 4:00 PM EST
- One cup of green tea, 30 minutes prior to nap
- Drink only water during flight except for one cup of caffeinated tea prior to nap
- Eat healthy foods such as fish, nuts, fruits, garlic, herbs, good oils, and dark chocolate

Sleep and Recovery

- Dim lights in room one hour prior to bed
- One hour “gadget-free” transition before bed
- Bedtime/wake-time guidelines to promote sleep
- Pool sessions and hot showers to promote recovery [7]
- Daily Melatonin, decaffeinated tea to promote sleep
- Avoiding NSAIDs which inhibit sleep [8,9]

The positive effects of increased sleep on performance have been extensively demonstrated elsewhere.[10,11] Therefore, we focus this case study on exploring the

[5] Duffy and Czeisler, 2009
[6] Ghorayshi, 2014
[7] Campbell and Broughton, 1994
[8] Gengo, 2006
[9] Murphy, et al., 1994
[10] Mah, et al., 2011
[11] Lansey, et al., 2016

implications of the more novel intervention of time zone maintenance. However, because the travel protocol was provided as advice to maximize performance rather than designed as a scientific study of the effect of a time zone maintenance protocol, WHOOP advised the team to simultaneously undergo several interventions. Since we cannot isolate the contribution of each intervention, we caution that this case study should be interpreted as potentially indicative of the value of such a protocol rather than as concrete findings supporting its efficacy. Nonetheless, the findings are intriguing and warrant a discussion of their potential merits.

The Effects of Travel

In order to determine the effects of the combined WHOOP travel protocol described above, we provide two analyses. First, we compare the distributions of various physiological measures during the weekend on the West Coast to another weekend during which the team played two away games on the East Coast (herein referred to as “West Coast Weekend” and “East Coast Weekend”, respectively). Here we aim to show that while we might expect to see the team statistics suffer from transmeridian travel, the team is, in fact, not significantly worse off compared to a home weekend. Second, we compare the players’ changes from baseline during the West Coast Weekend to the changes from baseline during travel for a sample of WHOOP users. In this case, we aim to show that fewer players felt the effects of transmeridian travel and attribute this difference to the WHOOP travel protocol.

All 10 field players that started in the games during the West Coast Weekend were considered. These 10 athletes were all between the ages of 18 and 23.

Analysis 1: Team Travel vs. Non-Travel

The East Coast Weekend spans a five-day period during which the NCAA team played two games. This weekend was chosen as all players from the West Coast Weekend competed in both games, and the weekend did not overlap with the baseline period for the West Coast Weekend. The West Coast Weekend spans a five-day period during which the team played two games. Of the 100 user-days eligible for analysis, WHOOP data was available and complete for 90 of them (45 user-days in each of the weekends). This data is summarized in Table 1.

Analysis 2: Team Travel vs. Control Group Travel

In addition to comparing the two weekends of data within the NCAA team, we also compare the changes from baseline during the West Coast Weekend to the changes from baseline of 46 WHOOP users (herein referred to as "control group") who traveled from the East Coast to West Coast in the past four months. This control group was brought in to answer the question, *"What is the expected hit to recovery and sleep metrics caused by travel from the East to West Coast?"*

The control group was comprised of 46 male and female WHOOP users between the ages of 18 and 30 who traveled to the West Coast from the East Coast and recorded WHOOP data for at least 15 of the 21 days prior to travel, stayed on the West Coast for at least 4 days, and only traveled to the West Coast once in the past four months. The first day on the West Coast and the three subsequent days were considered to be the travel period for both samples. WHOOP data was available and complete for 36 user-days in the team and for 175 user-days in the control group. We take a slightly different approach compared to the first analysis as the two samples in this case are quite varied and a direct comparison is less applicable. This data is summarized in Table 2.

Finding 1: No Worse Off

The NCAA team presented significant changes between East Coast and West Coast Weekend team metrics directly related to sleep, but presented no significant changes in other metrics. The team spent on average 49 more minutes in bed, 55 more minutes asleep, and saw an 11 point increase in median Sleep Performance, a proprietary algorithm WHOOP uses to measure the percentage of needed sleep that an athlete attains (for more information visit whoop.com/science).[12] And yet, there was no significant decrease in sleep efficiency (the ratio between time asleep and time in bed), indicating that there was no decrease in quality of sleep. An increase in sleep during travel is consistent with other WHOOP findings, and has been anecdotally attributed to the decrease in distractions when athletes are on the road.[13] In this case, the increase in sleep metrics may also be attributed to strict bedtimes in the travel protocol, daily Melatonin intake, and/or the increased significance of the games for the players.

[12] Breslow, 2016

[13] Breslow, 2016

Metric (units)	East Coast Weekend	West Coast Weekend
Sleep Performance (%)	78	89
Recovery (%)	53	53
Strain	14	14
HRV (% change from baseline*)	-7.89	-7.10
RHR (% change from baseline*)	+0.0	+3.39
Sleep (hours)	7.17	8.08
Time in Bed (hours)	7.75	8.85
Sleep Efficiency (%)	92.4	93.4

Table 1: Median values across all user-days for the players' East Coast and West Coast Weekends. Metrics that clinically** and statistically*** differ between the East Coast and West Coast Weekends are highlighted in green.

*Baseline is determined by the user's median value of the 21 days prior to the weekend.
**Clinical significance is considered to be a greater than 5% or 5 percentage-point change.
***Statistical significance is determined by a Welch's t-test or Mann-Whitney U test (in the case of non-normal data), each with a 0.05 significance level.

The team experienced no major change in average Strain, Recovery, HRV, or RHR between the East Coast and West Coast Weekends. Although similar average values and distributions in these metrics suggest that travel had a limited effect on the players, this may be attributable to the improvement in Sleep Performance during the West Coast Weekend offsetting travel-related decreases. Regardless, the physiological data suggests the West Coast Weekend was not significantly more taxing than the East Coast Weekend, and the players were "no worse off" in terms of physiological metrics on the West Coast Weekend than the East Coast Weekend.

Finding 2: Dampened Effect of Transmeridian Travel

We also see that the NCAA team had fewer players with clinically significant unfavorable changes from baseline during the West Coast Weekend compared to the control group. The team players also saw increases in sleep compared to the control group, with 60% of team players compared to 33% of the control group recording a greater than 5 percentage-point increase from baseline in Sleep Performance.

Unfavorable Change in Metric from User's Baseline*	Team West Coast Weekend	Control Group
> 5% increase in RHR	40%	48%
> 5% decrease in HRV	30%	50%
> 5 percentage point decrease in sleep efficiency	0%	17%
> 5 percentage point decrease in Recovery	20%	57%

Table 2: Percentage of the NCAA team and the control group with a clinically significant unfavorable change in the user's median value during travel period from the user's baseline.

*Baseline was determined by the user's median value of the 21 days prior to travel.

Therefore, the data does suggest that the travel protocol lessened the effects of jet lag for the players, but it remains undetermined which factor(s) of the protocol are primarily responsible for these findings. We note, however, that these are preliminary results and that a larger study with greater sample sizes and stricter control and experimental groups would be necessary to conclude with confidence that any findings are significant.

Discussion

While these preliminary results suggest that the performance enhancing protocol helped minimize the effects of jet lag, we acknowledge that this experiment was only feasible given the team's unique competition and travel schedule and it likely would be impractical for many other teams. For example, an East Coast team scheduled to play on the West Coast at 9:00pm PST would likely not be able to maintain an East Coast sleep schedule.

We also note that the team tapered their training leading into their West Coast Weekend, a practice known to increase various performance metrics.[14] As is the case with most retrospective analysis, the results may be confounded by these various treatments applied leading up to and during the championship weekend.

These results suggest that when competition scheduling allows, a time zone maintenance strategy may be an effective performance enhancing intervention for athletes traveling across time zones for short periods of time in order to compete. While beyond the scope of this case study, a larger study would be beneficial to quantify the effects of this strategy in isolation of the numerous other interventions undertaken by this team on this trip.

[14] Murach and Bagley, 2015

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