Assessment of a Novel Watchstanding Schedule on an Operational US Navy Vessel

Shattuck, Nita Lewis; Matsangas, Panagiotis; Waggoner, Lauren
Monterey, California. Naval Postgraduate School

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Assessment of a Novel Watchstanding Schedule on an Operational US Navy Vessel

Nita Lewis Shattuck, Ph.D.
Panagiotis Matsangas, Ph.D.
Lauren Waggoner, Ph.D.
The Military Climate: Doing More with Less

REALLY? WE'RE CHANGING TO A NINE-TO-FIVE ROTATION?

YEP, DEPLOY IN SEPTEMBER, BACK IN MAY.

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Fatigue and Sleep Studies at NPS 2001-2014

Sleep - Naval Operations

Training (USS NIMITZ - CVN 68) - Reactor department
Rough Water Trials (LCS 1) - Higher SS
Rough Water Trials (LCS 1) - Lower SS
Training exercise USS BENFOLD (DDG 65) - modified 6/18 watch
Independent steaming in Arabian Golf (DDG 109) - 6/6 watch
Independent steaming in Arabian Golf (DDG 109) - 3/9 watch
Rough Water Trials (LCS 1) - Higher SS
Rough Water Trials (LCS 1) - Lower SS
Predeployment training (USS RENTZ - FFG 46)
Predeployment training (USS CHUNG HOON - DDG 93)
Sea trials (HSV 2 SWIFT)
Sea trials (USS HENRY M. JACKSON - SSBN 730)
RIMPAC 2008 (USS LAKE ERIE - CG 70 / USS PORT ROYAL - CG 73)
GOMEX 05-1 (HSV 2 SWIFT)
Various operations (SSN / SSBN)
Operation Enduring Freedom (USS JOHN C. STENNIS - CVN 74)

Note 1: Blue bars indicate actigraphic sleep, gold bars are self-reported sleep
Note 2: Number centered on each bar refers to study sample size
Note 3: Horizontal lines indicate one standard deviation

Last update: 18 FEB 2014
Fatigue and Sleep Studies at NPS 2001-2014

Operational Sleep – Combat Operations

- Infantry officers from Iraq/Afghanistan (Fort n=46)
- Mine hunting operations (Naval Aviation n=25)
- Flight operations in Iraq (USMC AH-64 n=20)
- Operation Iraqi Freedom Phase VI n=273

Sleep during Military Training and Education

- Amphibious Vehicles Habitability n=61
- FLW Basic combat training n=94
- Marine Aviation, Weapons and Tactics n=20
- Marine Aviation, Weapons and Tactics n=13
- USMA study (West Point) n=80
- USN enlisted training at RTC Great Lakes n=31

Note 1: Blue bars indicate actigraphic sleep, orange bars are self-reported sleep
Note 2: Number centered on each bar refers to study sample size
Note 3: Horizontal lines indicate one standard deviation

Last update: 01 AUG 2013
• Members of the military get inadequate sleep

• US Navy Sailors
  – Habitual shiftworkers
  – Shifts result in circadian misalignment equating to an 18 or 20-hour day
  – No weekends or time for recovery
Types of Watchbills

Workday includes duties other than watchstanding. Other watchbills may be implemented by commanding officer!
**Modified 6 on/18 off:** Above is a visual depicting a modified 6 on/18 off watch rotation with a daily backward rotation. In this figure, each row represents one day on the schedule and each column represents a 30-minute period within that day. This is a four section watch, which is represented in the figure as both differing colors and numbers (section 1 = green, section 2 = purple, section 3 = orange, and section 4 = blue). Each day (24-hour period), each watch section rotates backward meaning that sailors report for watch earlier each day than the previous day. The figure only includes scheduled watchstanding times for each of the four sections. Time during each 24-hour period that is not scheduled as a watchstanding period is discretionary time in which the sailors eat, sleep, conducted all duties for their job, do laundry, mandatory cleaning periods, trainings, and studying for qualification exams.
Study Procedures

**Day 1**
- Recruit participants, explain study
  - Issue actiwatches
- Complete Pre-study Surveys, Informed Consent

**Day 2**
- PVTs Logs

**Day 3**
- PVTs Logs

**Day 4**
- PVTs Logs

**Day 5**
- PVTs Logs

**Day 6**
- PVTs Logs

**Day 7**
- Complete Post-study Surveys

**Day 8**
- Collect actiwatches
  - NPS Team analyzes data and briefs results to DDG 65 CO/XO and Crew

WWW.NPS.EDU
Results - Demographics

- **N = 34 participants on Modified 6/18**
  - 36 males, 11 officers
  - 26.9±6.7 years old, 6.31±6 years of military service
- **Morningness – eveningness preference score = 54±6.5**
  - Moderately morning type = 2, Moderately evening type = 2, Neither morning nor evening type = 27
- **PSQI Global score = 9.14±2.73**
  - None of the participants on the modified 6/18 watchstanding schedule was a “good sleeper” (PSQI score < 5)
- **Epworth Sleepiness Scale = 10.4 ± 4.01**
  - 16 participants (47.1%) with elevated daytime sleepiness (ESS score > 10)
Did sailors think they and their shipmates received enough sleep?

- **Frequency of Response**
- Much less than needed: 6 (Rest they received), 8 (Rest others received)
- Less than needed: 33 (Rest they received), 26 (Rest others received)
- About right: 15 (Rest they received), 18 (Rest others received)
- More than needed: 2 (Rest they received)

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How much sleep did the crew get overall?

Mean Daily Sleep Time (minutes)

Mean = 312 minutes
SD = 86 minutes
N = 55
• All but one of the crewmembers averaged less than 8 hrs of sleep daily
• 59% of crewmembers received less than 6 hrs/night
• On average, participants accrued a sleep debt of approximately 2.35 hours each day

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>MD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>6.62</td>
<td>1.66</td>
<td>6.67</td>
<td>2.58</td>
<td>10.5</td>
</tr>
<tr>
<td>Sleep</td>
<td>5.65</td>
<td>1.63</td>
<td>5.73</td>
<td>1.83</td>
<td>9.52</td>
</tr>
<tr>
<td>PVT metric</td>
<td>M ± SD</td>
<td>Min</td>
<td>Max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------</td>
<td>------</td>
<td>------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean RT, [ms]</td>
<td>349±140</td>
<td>203</td>
<td>730</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median RT, [ms]</td>
<td>269±76</td>
<td>172</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean 1/RT</td>
<td>3.91±0.86</td>
<td>1.93</td>
<td>5.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fastest 10% RT, [ms]</td>
<td>193±48.9</td>
<td>133</td>
<td>356</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slowest 10% 1/RT</td>
<td>2.37±0.81</td>
<td>0.552</td>
<td>4.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>False Starts (FS), [%]</td>
<td>2.25±3.23</td>
<td>0%</td>
<td>18.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lapses 500ms, [%]</td>
<td>10.4±12.4</td>
<td>1.02%</td>
<td>49.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lapses 355ms, [%]</td>
<td>21.2±20.6</td>
<td>1.53%</td>
<td>90.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lapses 500ms+FS, [%]</td>
<td>12.6±13.1</td>
<td>2.04%</td>
<td>50.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lapses 355ms+FS, [%]</td>
<td>23.5±20.8</td>
<td>2.55%</td>
<td>90.4%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DDG 109 – USS Jason Dunham

Navy Times
25 June 2012

Fired ERB sailors Lawmaker: Let them retire 24
Academy admissions Navy stats are misleading 25
Consolidate your debt The right way to do it OFFduty 10

3 HOURS ON 9 HOURS OFF
The new, better watchbill that sailors love.
So why isn’t every ship using it? 20
Both schedules lead to sleep deprivation, 1.5 hrs/night for “3/9” and 2.4 hrs/night for “modified 6/18”.

Sailors working the “3/9” received an average of 54 minutes more sleep compared to their counterparts working the “modified 6/18” (p=0.024).
Comparison of rest, sleep, and PVT performance metrics between Sailors on the modified 6/18 and on the 3/9 watchstanding schedules:

<table>
<thead>
<tr>
<th>PVT metric</th>
<th>3/9 M ± SD</th>
<th>6/18mod M ± SD</th>
<th>Level Δ A p-value</th>
<th>Variability Δ B p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily rest, hrs</td>
<td>7.25±0.8</td>
<td>6.62±1.7</td>
<td>0.054</td>
<td>0.013</td>
</tr>
<tr>
<td>Daily sleep, hrs</td>
<td>6.54±0.8</td>
<td>5.65±1.6</td>
<td>0.024</td>
<td>0.010</td>
</tr>
<tr>
<td>Mean RT, [ms]</td>
<td>365±105</td>
<td>349±140</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Median RT, [ms]</td>
<td>253±35</td>
<td>269±76</td>
<td>-</td>
<td>0.033</td>
</tr>
<tr>
<td>Lapses 500ms+FS, [%]</td>
<td>9.23±4.7</td>
<td>12.6±13.1</td>
<td>-</td>
<td>0.010</td>
</tr>
<tr>
<td>Lapses 355ms+FS, [%]</td>
<td>18.7±9.5</td>
<td>23.5±20.8</td>
<td>-</td>
<td>0.022</td>
</tr>
</tbody>
</table>

Inclusion criterion: p<0.10; \(^A\) Comparisons using Wilcoxon Rank Sum test; \(^B\) Variability differences using Levene’s test
PVT reaction times of different USN crews

- Mean RT, [ms]
- Fastest 10% RT, [ms]

<table>
<thead>
<tr>
<th>Crew Type</th>
<th>Sample Size (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-on/9-off</td>
<td>24</td>
</tr>
<tr>
<td>Modified 6-on/18-off</td>
<td>34</td>
</tr>
<tr>
<td>OPS with 6-on/6-off</td>
<td>9</td>
</tr>
<tr>
<td>RX with 5-on/10-off</td>
<td>39</td>
</tr>
</tbody>
</table>
"The only thing harder than getting a new idea into the military mind is to get the old one out."

- Sir Basil H. Liddell Hart

Thoughts On War
Give crew members opportunity to sleep at same time each day.

If 4 section watch can be supported, consider either 3-9 or fixed 6-18 schedules.

If 3 section watch, consider 4-8 watchstanding schedule.

Provide protected sleep periods for night watchstanders/day sleepers.

Naps are helpful, especially if not too close to major sleep period.

Rotations should be forward, lengthening the work day rather than shortening it.