

Do Teams Adapt to Fatigue in a Synthetic C2 Task?

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briefed:

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Report Documentation Page

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Points covered



- **POINTS COVERED**

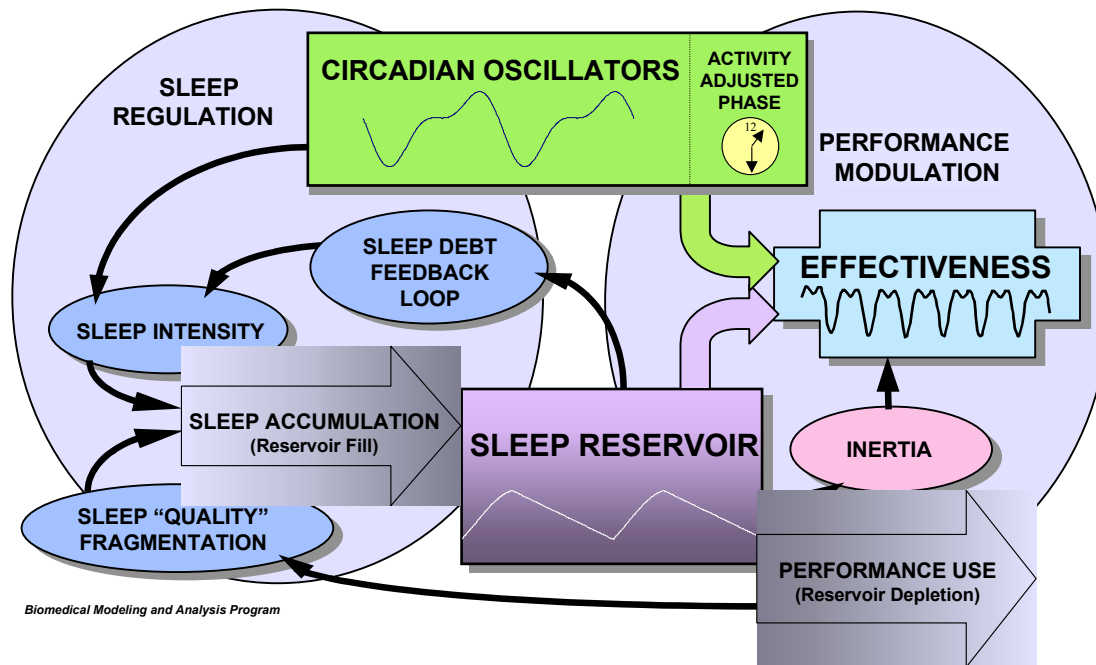
- **Background: Fatigue modeling for individual vs. teams**
 - **What we do well ...**
 - **and not so well (i.e. where we hope to go)**
- **Procedure: Naturalistic Experimental paradigm**
 - **Synthetic Task Environments**
- **Results of a modest fatigue protocol**
 - **Individual and Team level**
- **Conclusions**
- **Recommendations**



BACKGROUND: Fatigue Measurement (What fatigue modelers do well)



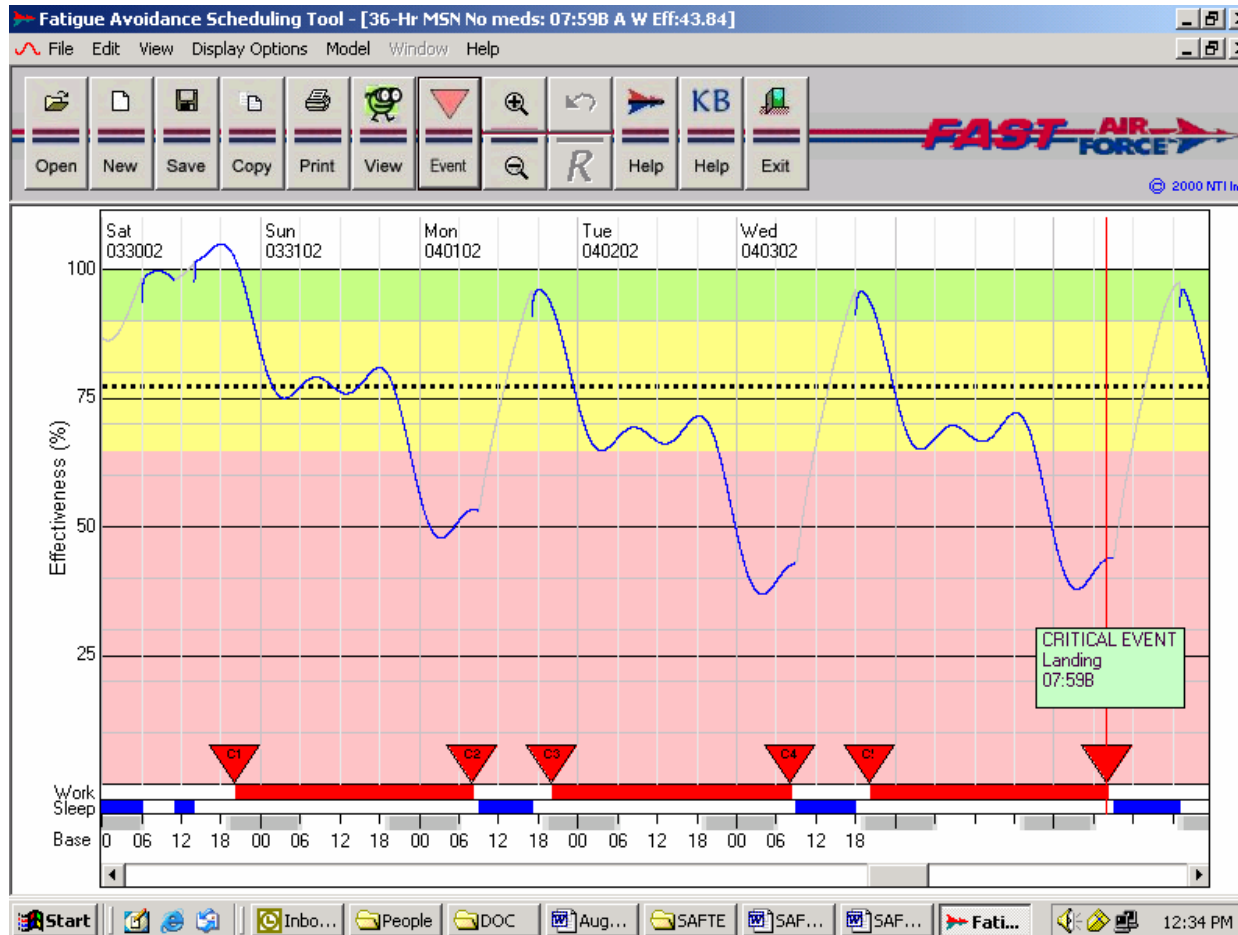
Schematic of SAFTE Model *Sleep, Activity, Fatigue and Task Effectiveness Model*



From Hursh, 2003 Sleep, Activity, Fatigue and Task Effectiveness (SAFTE) Model



BACKGROUND: Fatigue Measurement (Another perspective on what fatigue modelers do well)



From Hursh, 2003 — Fatigue Avoidance Scheduling Tool (*FAST*TM)

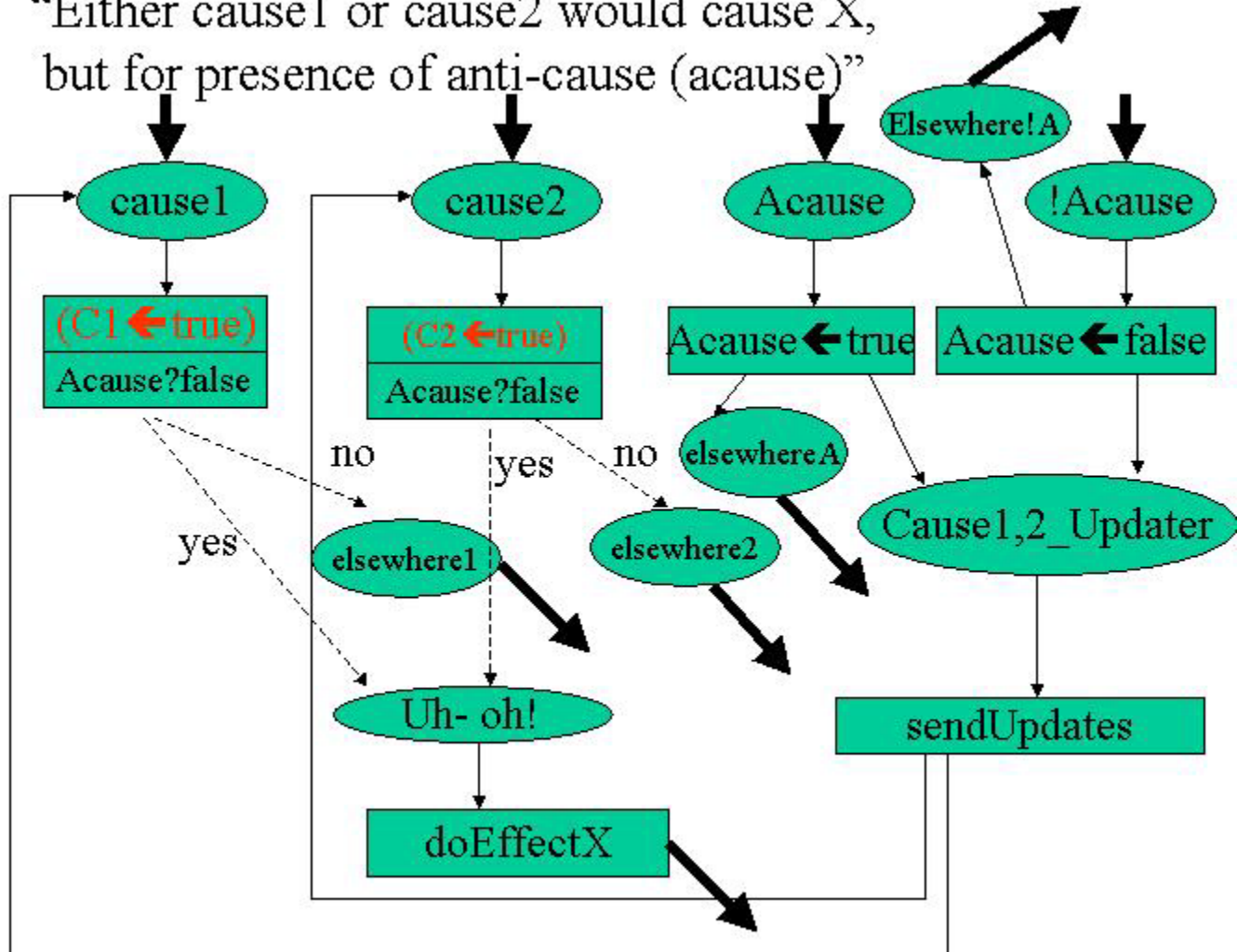


BACKGROUND: Team process measurement (fatigue modelers don't say what breaks down)



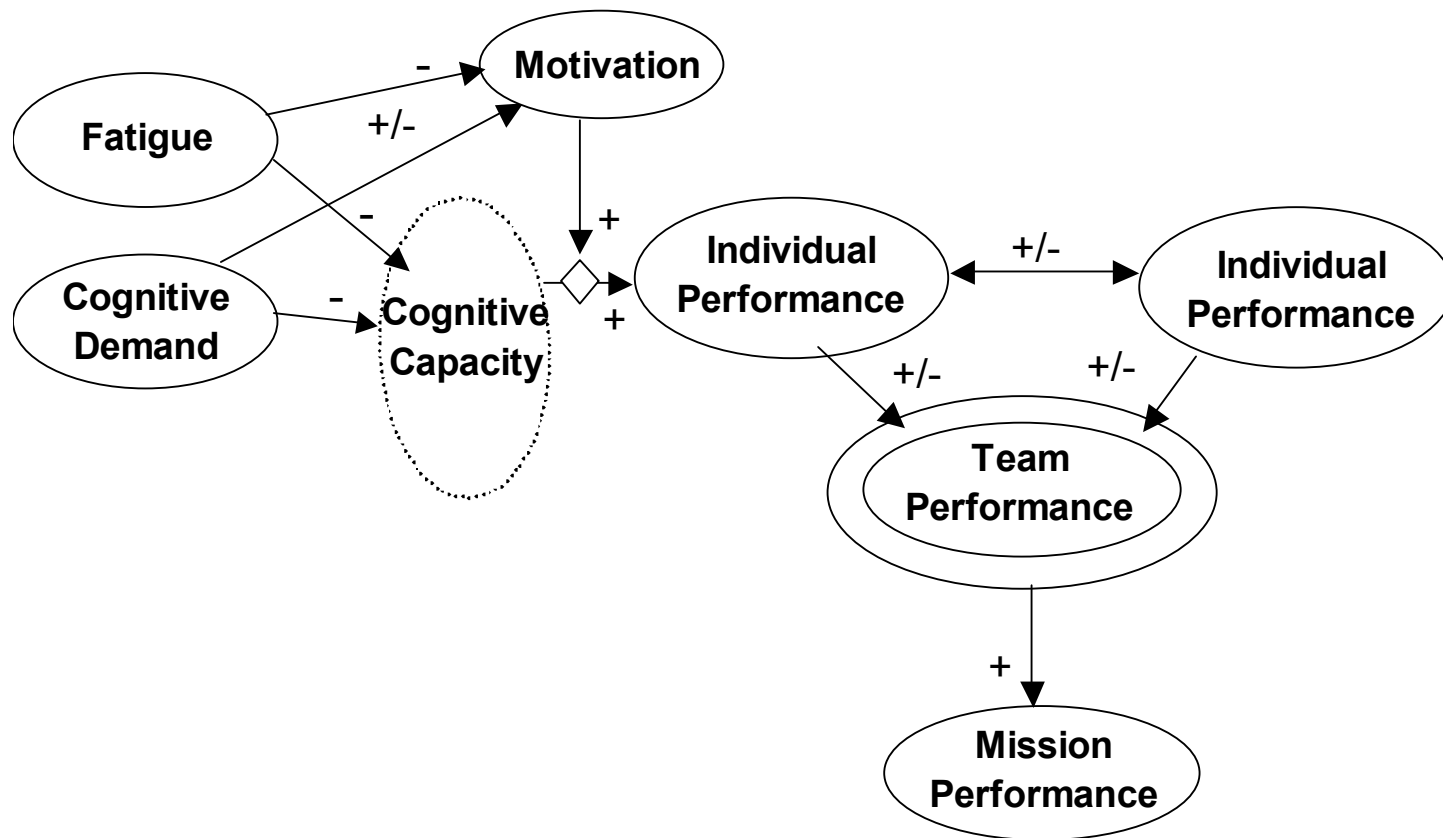
“Either cause1 or cause2 would cause X,
but for presence of anti-cause (acause)”

notional





BACKGROUND: Team process measurement (another perspective on what's not done well)





Why integrate team performance to fatigue models?



- **Gives us a reason to study team processes closely, which are important:**
 - Helps with CONOPS
- **Gives us the means to monitor real-time health of teams**
 - Allows specific team-fatigue interventions to be devised
- **Teams are a natural “unit of execution” in warfare**
 - Individual action is important, but maybe not as meaningful
- **Teammate interactions may be easier to “observe” and “model” fatigue-wise**
 - Relative to “neurons” in individuals, causes of errors are more explicit and can be tracked to behaviors



Naturalistic Study

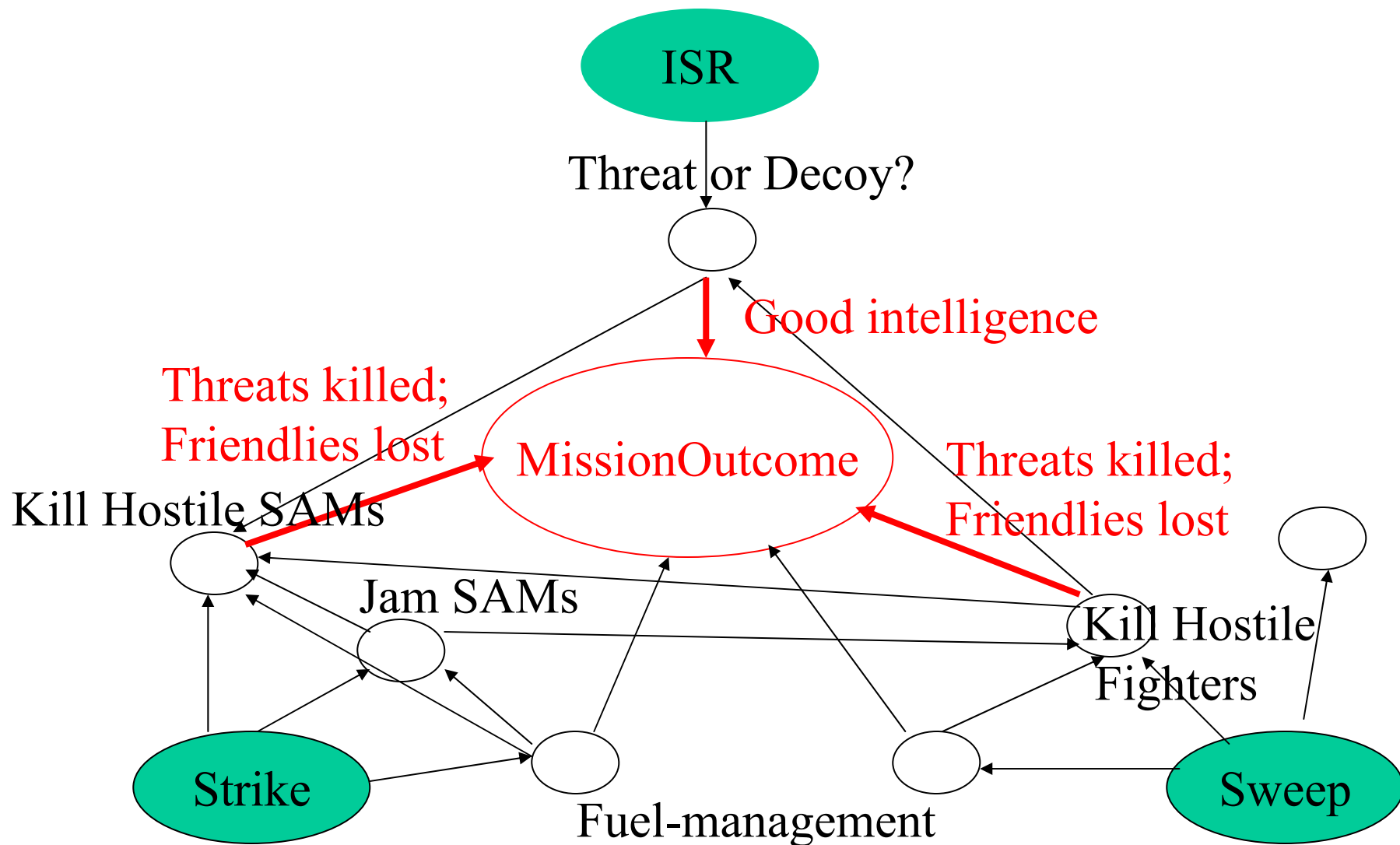


- Use AWACS-AEDGE™ (augmented to have some E10A MC2A functionality) from www.21csi.com
- observe 3-person C4ISR teams





AEDGE Mission Scenario Schema





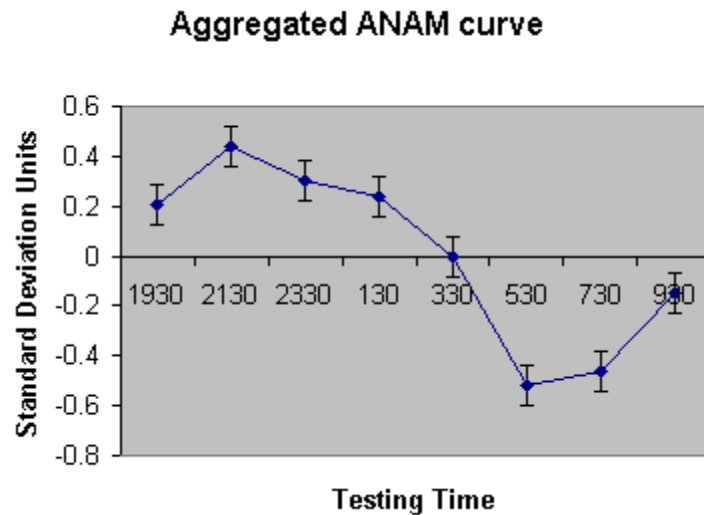
Study Events



- **TRAIN-UP** on everything Monday-Thursday:
 - 9 hours of ANAM practice.
 - Individual “Agent Enabled Decision GUIDE Environment” (AEDGE) Briefing/Training.
 - 3 Team plays with AEDGE, each player experiencing each role.
 - Just prior to testing: participants self-select roles played for the entire protocol; no explicit leader.
- **TESTING** 1830 Fri pm – 1030 Sat am: 8 AEDGE missions (given odd hours); 8 ANAM testing sessions (given even hours).



Results: Did we get fatigue effects on simple cognitive measures?



ANAM Test	Paired $t(29)$ -statistic	Correlation $r(28)$
CPT	5.41	0.62
MATH	2.89	0.77
SMRT	2.74	0.48
SPAT	3.76	0.88
SLEEPY?	15.4	0.70

Table 1. Individual ANAM tests compared early (less fatigued) to late (more fatigued).

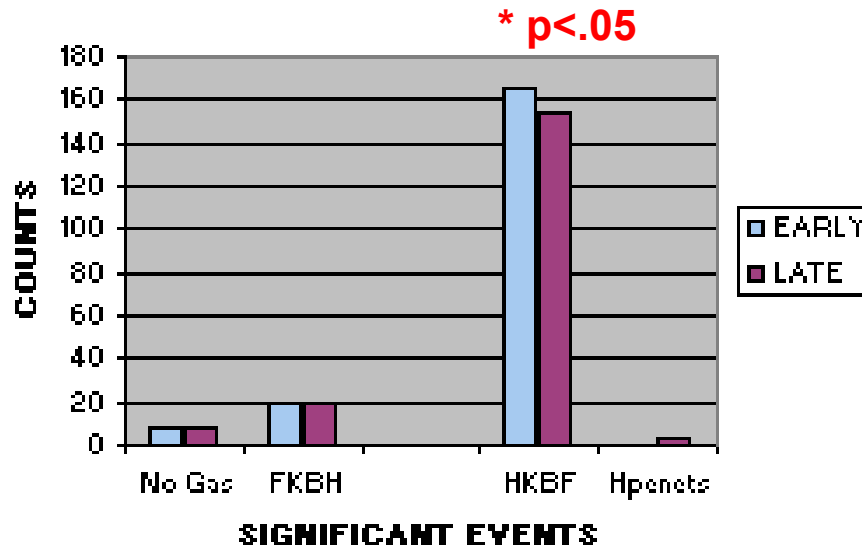
Answer: yes



Results: Did fatigue affect mission outcome?



Mission Outcome



Answer: yes, at least on one dimension

MEASURE	r(8)	p, 1-tailed
No Gas	.55	.05
FKBH	.68	.025
HKBF	.64	.025
Aggregated	.83	.01

Table 2. Early to Late correlations among team outcome measures. FKBH: Friendly killed by Hostile; HKBF: Hostile killed by Friendly

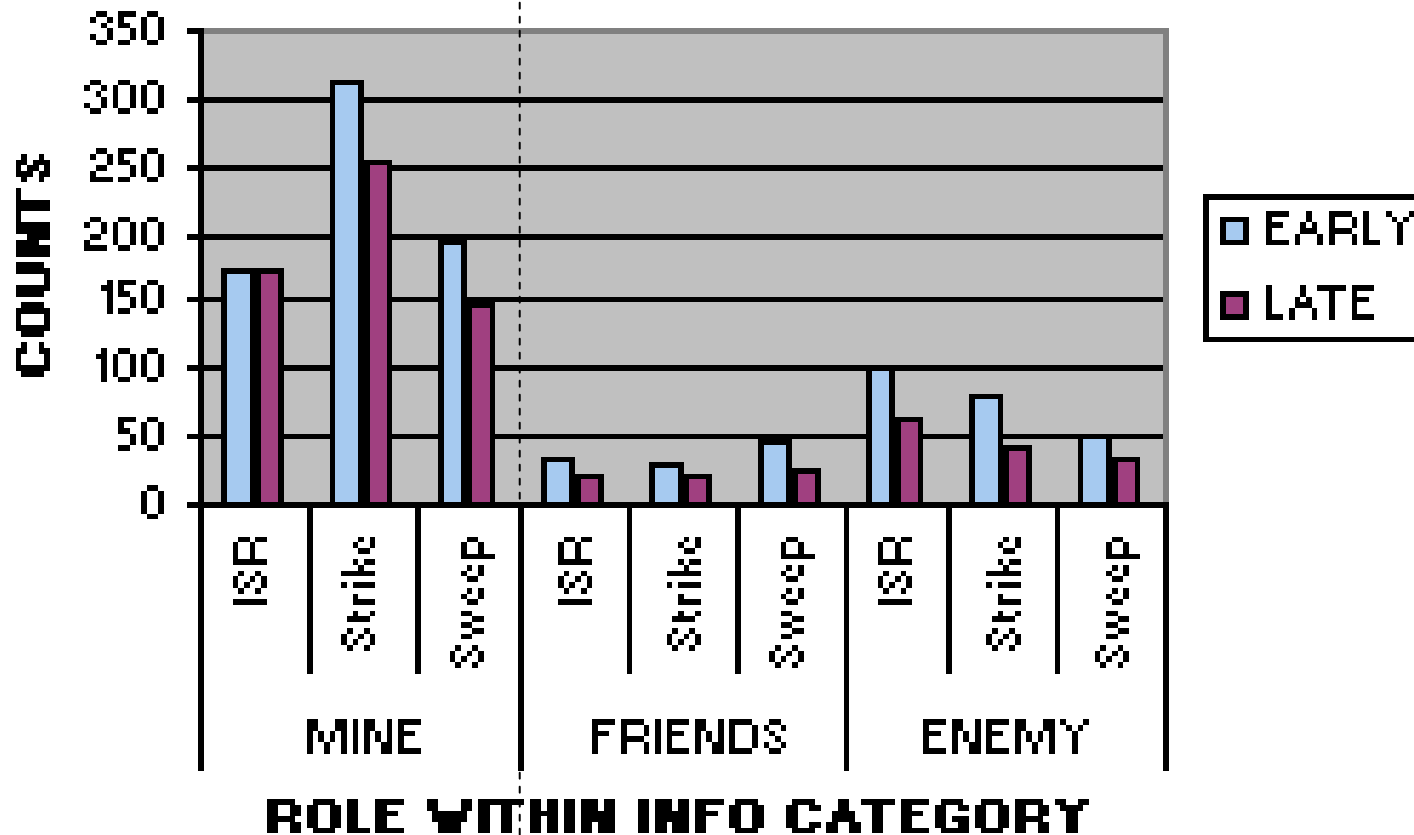


What about team process?: Fatigue depressed info seeking



Information Window Opens

* $p < .02$



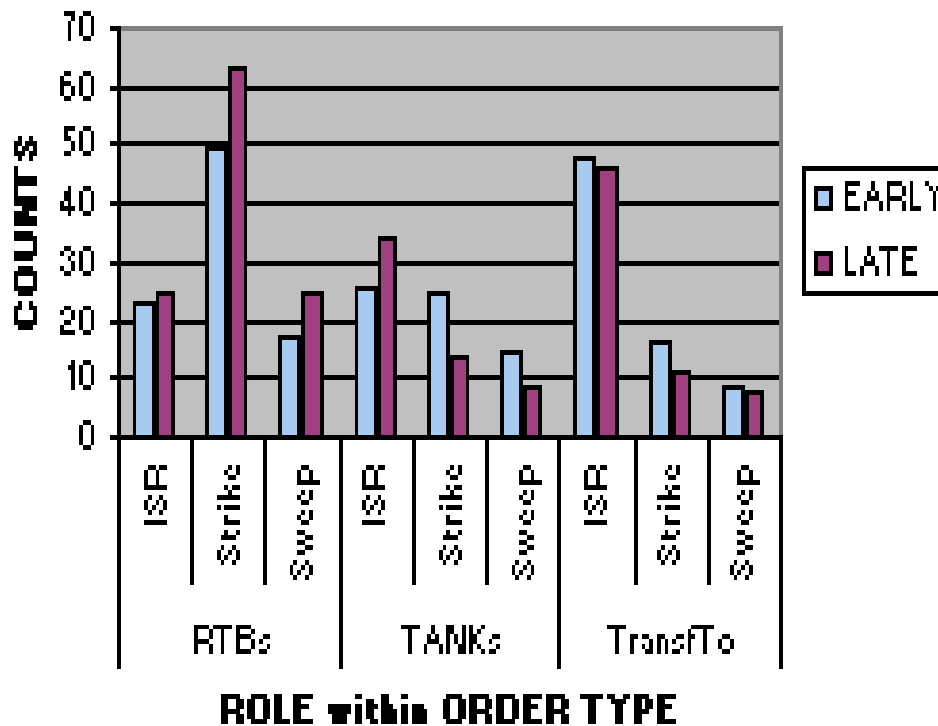


Fatigue affected role strategy (and depressed orders): **adaptation evidenced for specific tasks**

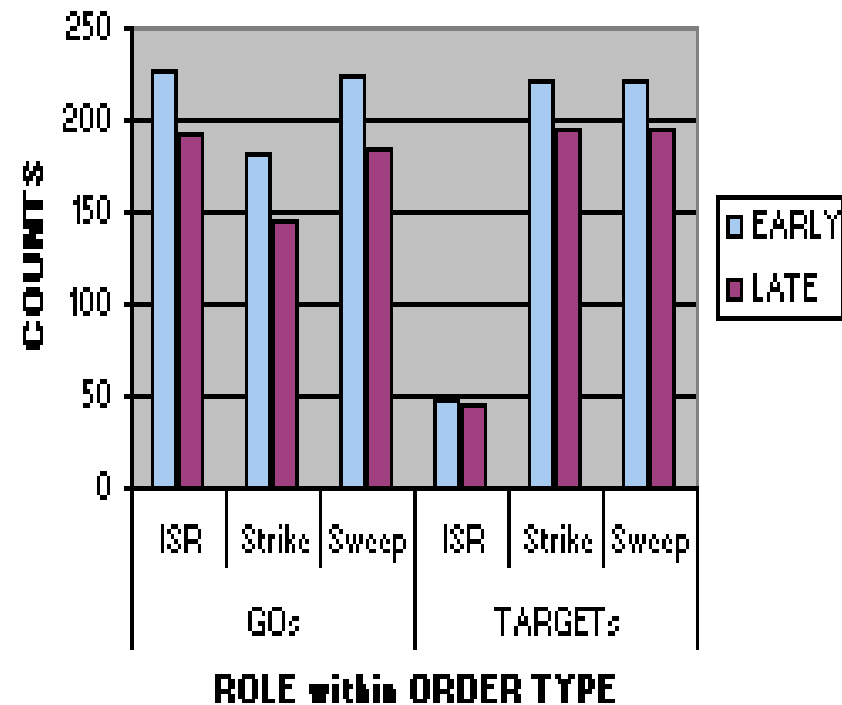


* $p < .001$: more orders for early missions

Maintenance Orders



Tactical Orders



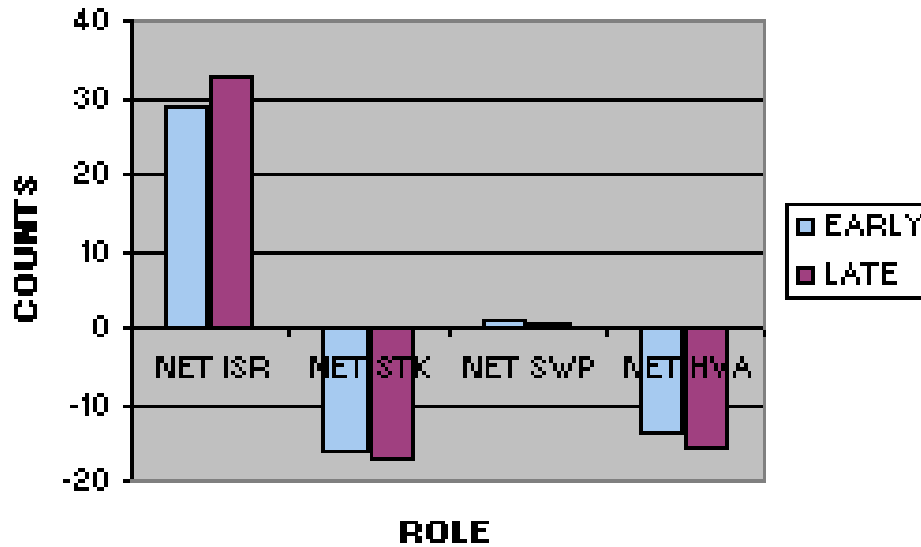


Fatigue adaptation at a team doctrine level: **role responsibilities didn't change much**



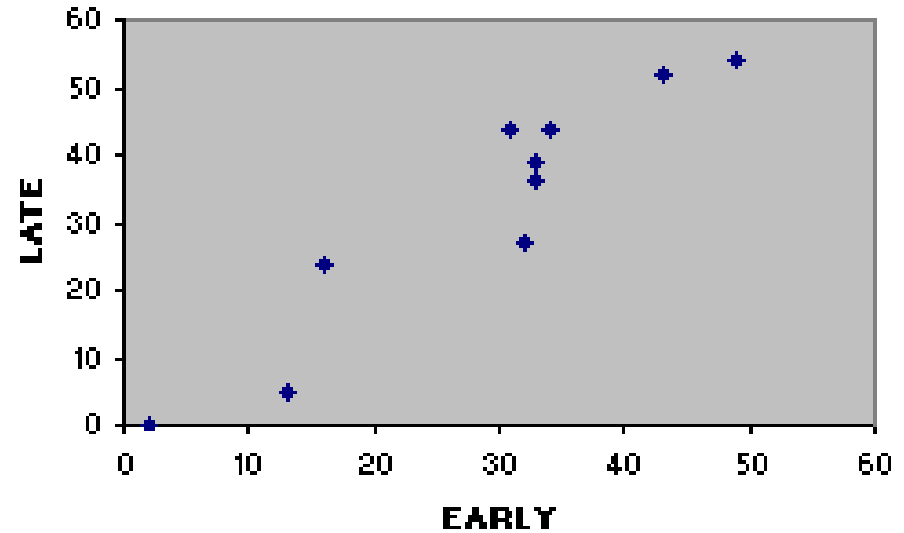
Not Significant: early vs. late

Net transfer (to - from) for each role



**“Team doctrine correlation”
early vs. late: VERY SIGNIFICANT**

Net ISR Transfer

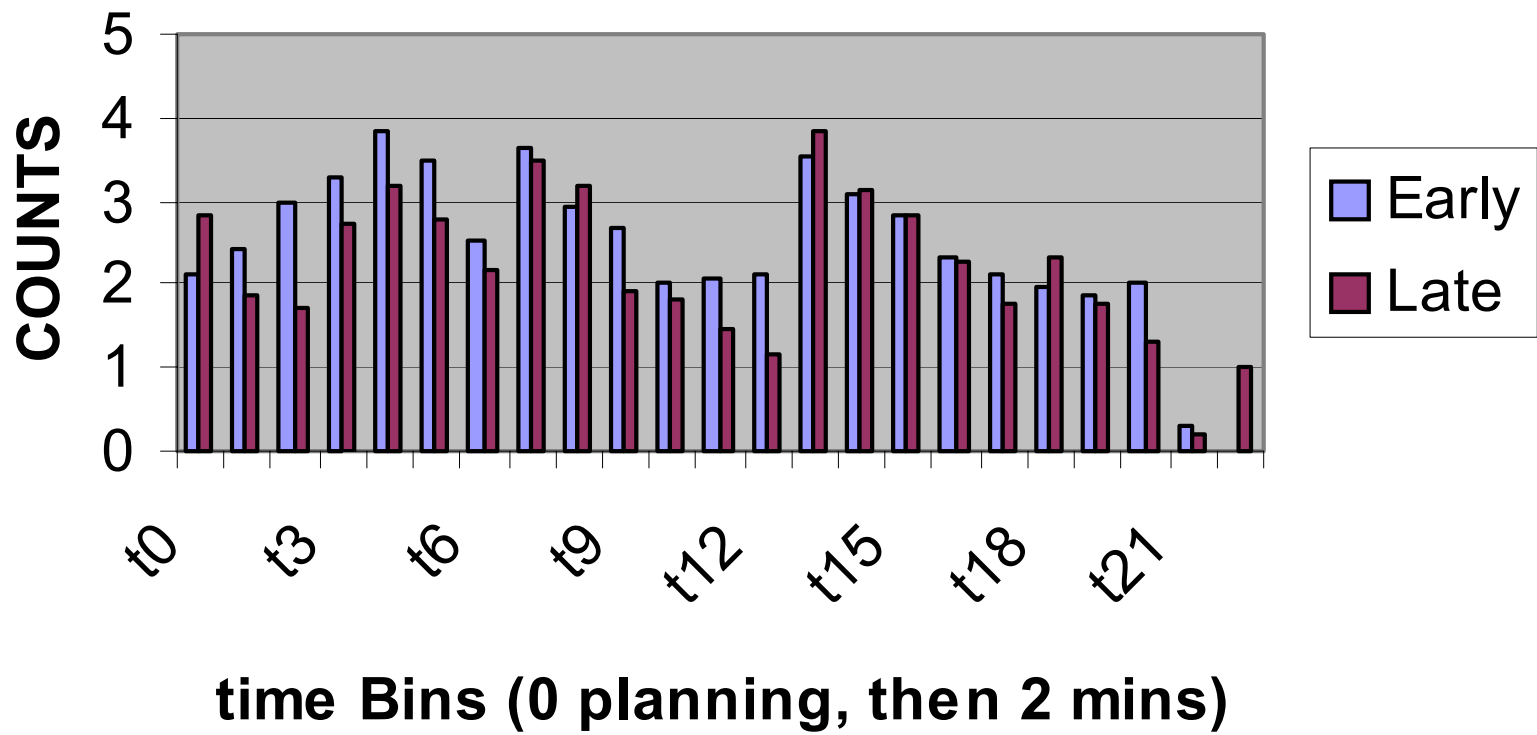




Other ways to measure team fatigue: role action latency



Strike Targets Dynamics

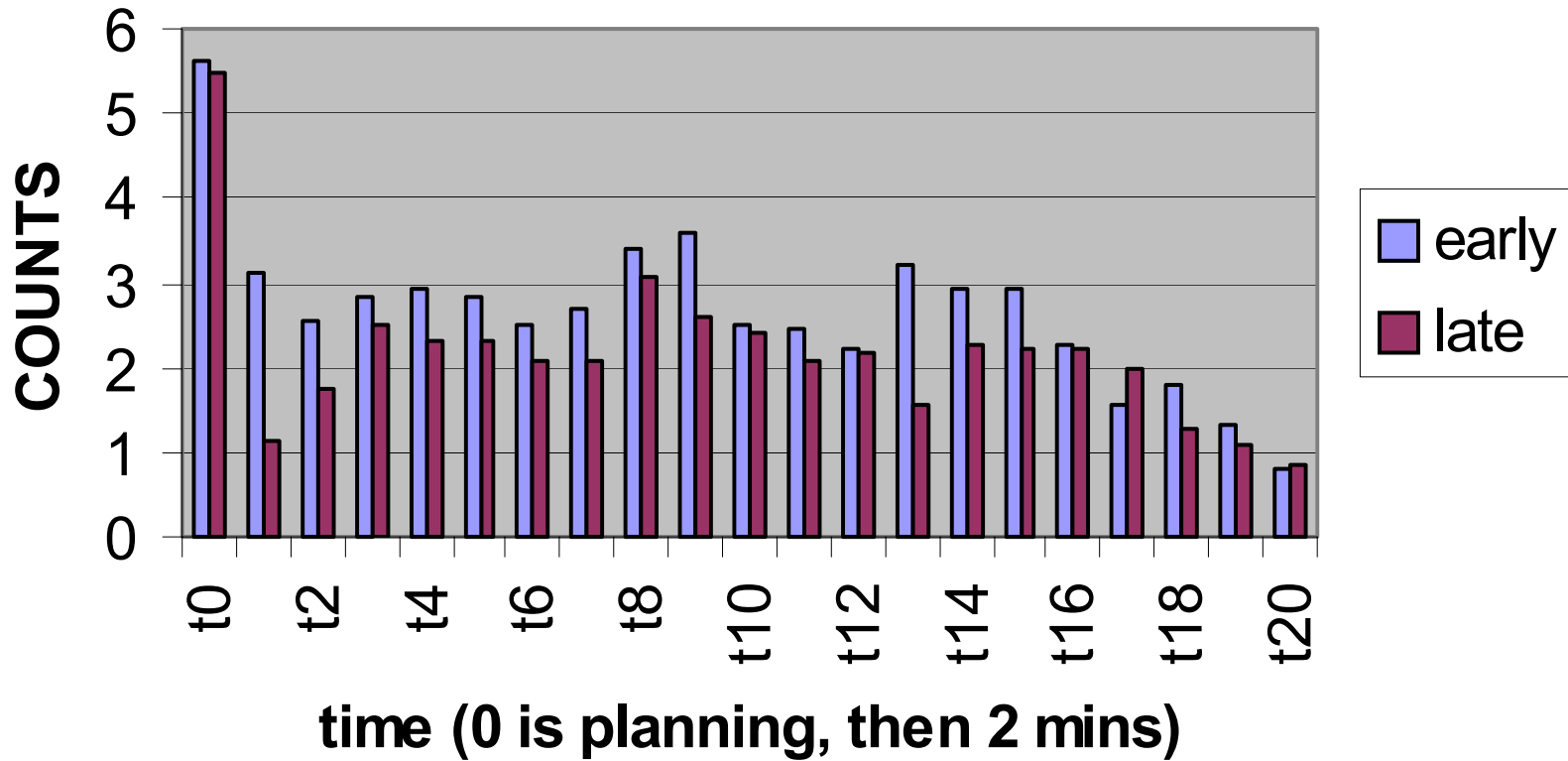




Other ways to measure team fatigue: role action latency



Sweep Gos Dynamics

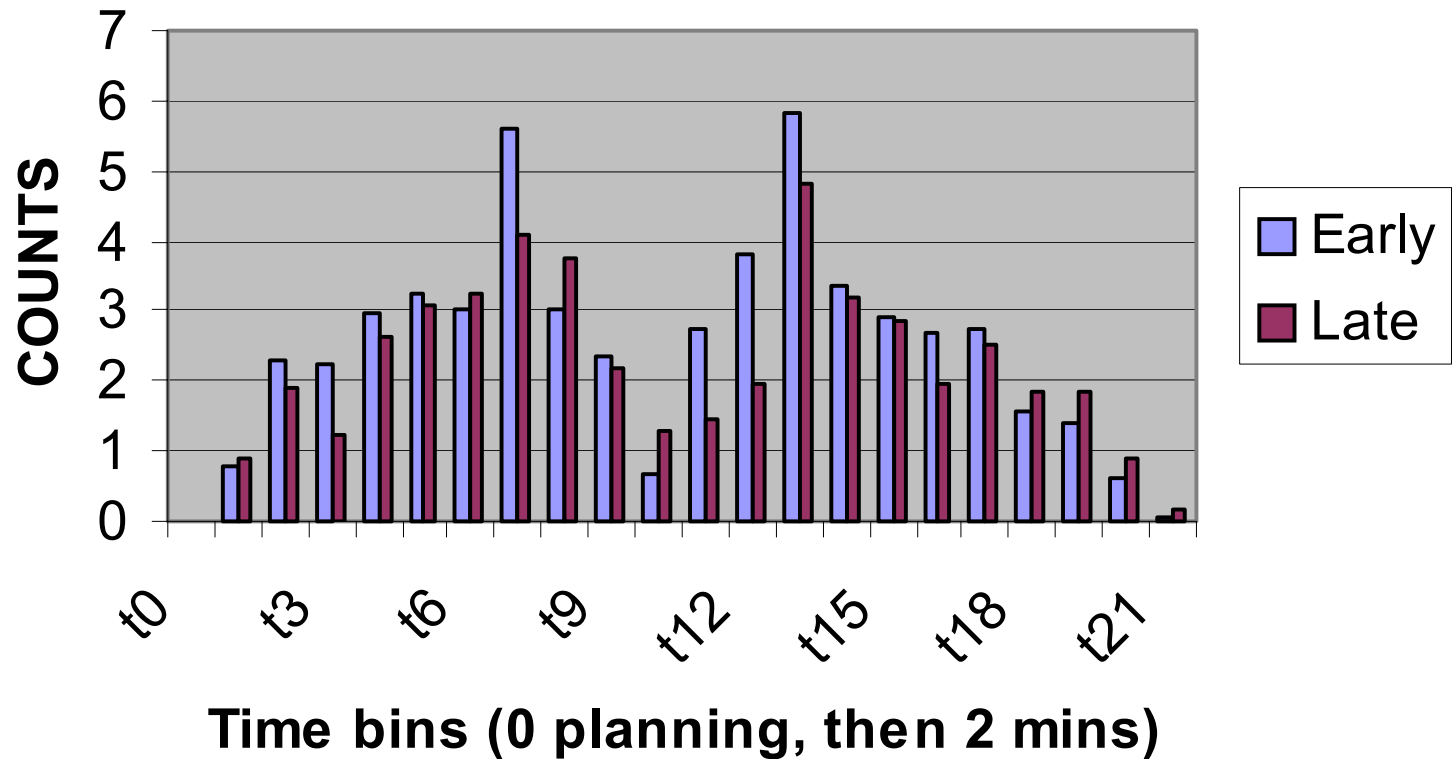




Other ways to measure team fatigue: role action latency



Sweep Targets Dynamics





Conclusions



- **Fatigue depressed general activity levels:**
 - Orders, info-window openings went down in frequency
 - Less activity can't be attributed to learning effects (in all cases)
- **Fatigue adversely affected Mission Outcome**
 - On one dimension: hostile kills went down (hostile penetrations up); can't be attributed to decreased risk-taking.
 - See paper for team “individual differences” both in ability and fatigue effects
- **Some fatigue strategy shifts and possible latency effects noted**
- **A “team doctrine” effect was observed (I.e. mutually agreed upon workload responsibilities)**
 - These are pretty rigid once developed (I.e. don't seem to vary with fatigue, at least not much).



Recommendations



- **Improve measurements (loggings of team activities)**
 - **For scientists and instructor/students**
- **Our teams didn't adapt much, but...**
 - **Would redistributing the workload more actually have helped?**
 - **encourage this by forcing role rotation (possible future study)**
 - **Other strategies**
 - **“Dolphin-ated” teams**
 - **Better interfaces**

