Do Teams Adapt to Fatigue in a Synthetic C2 Task?

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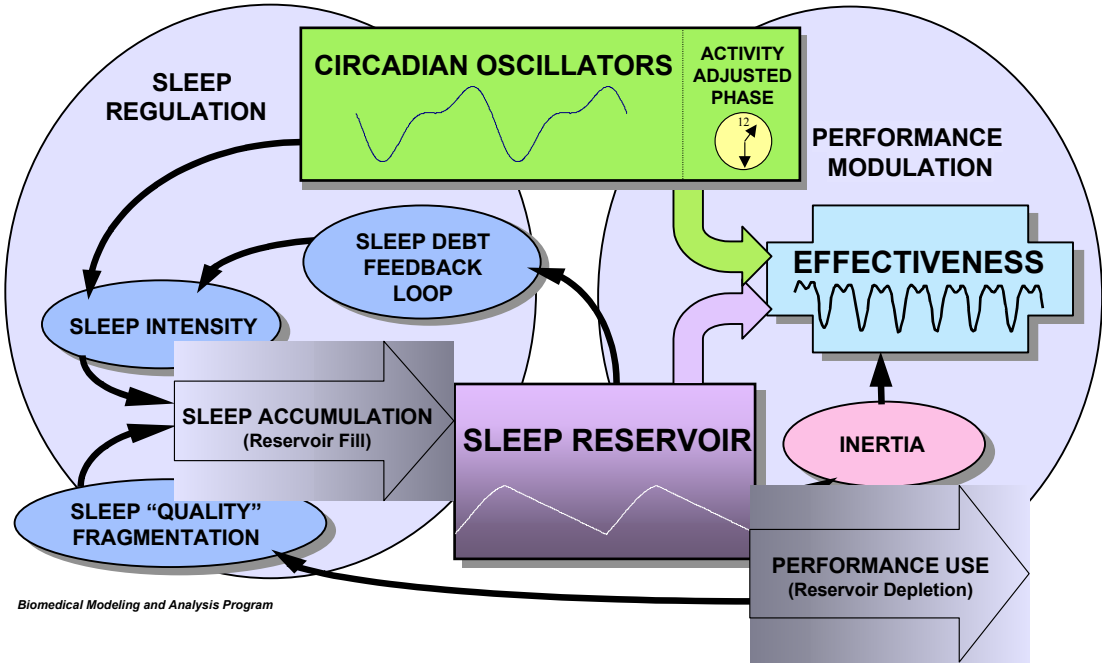
Points covered

- 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)

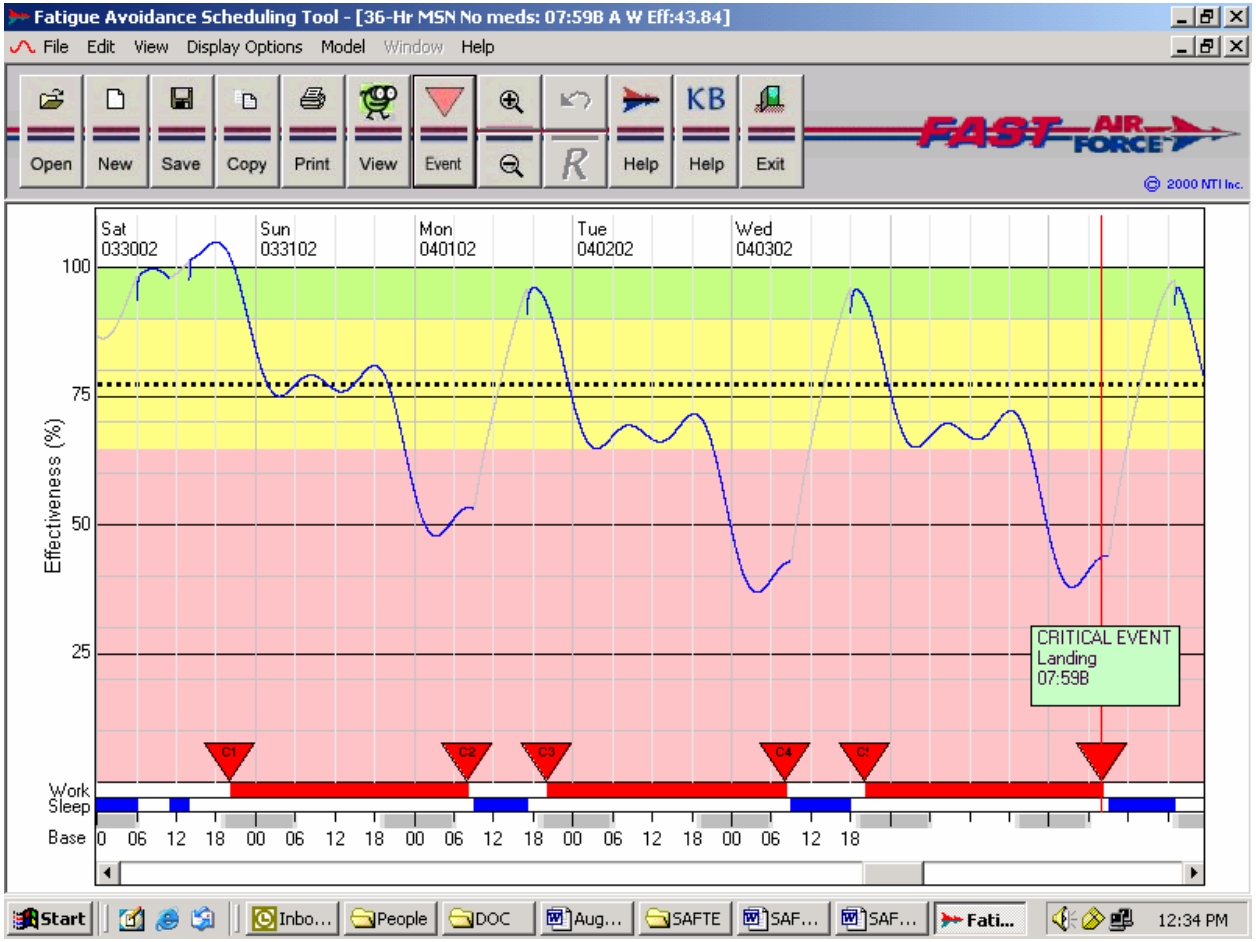
Schematic of SAFTE Model

Sleep, Activity, Fatigue and Task Effectiveness Model



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

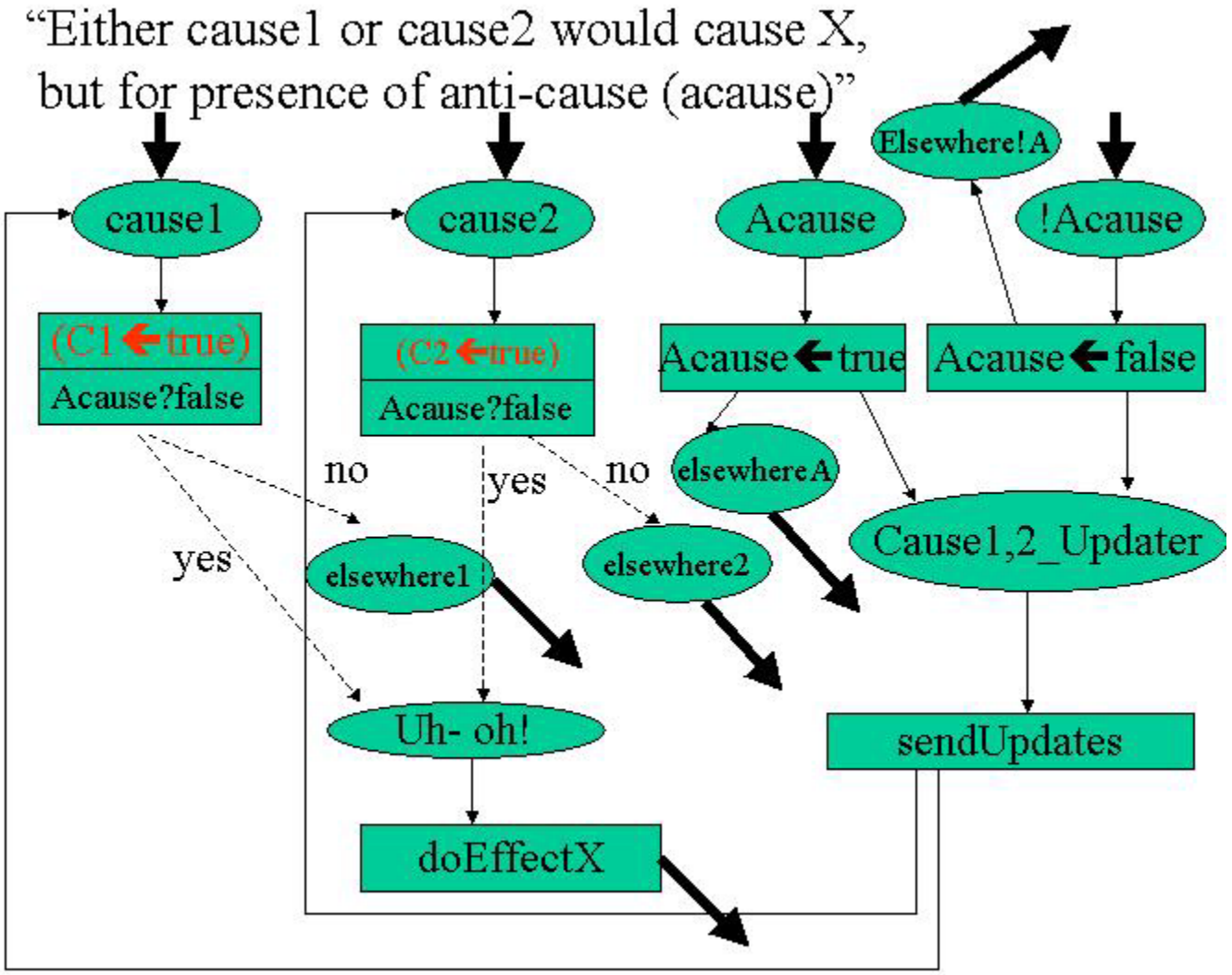
BACKGROUND: Fatigue Measurement (Another perspective on what fatigue modelers do well)



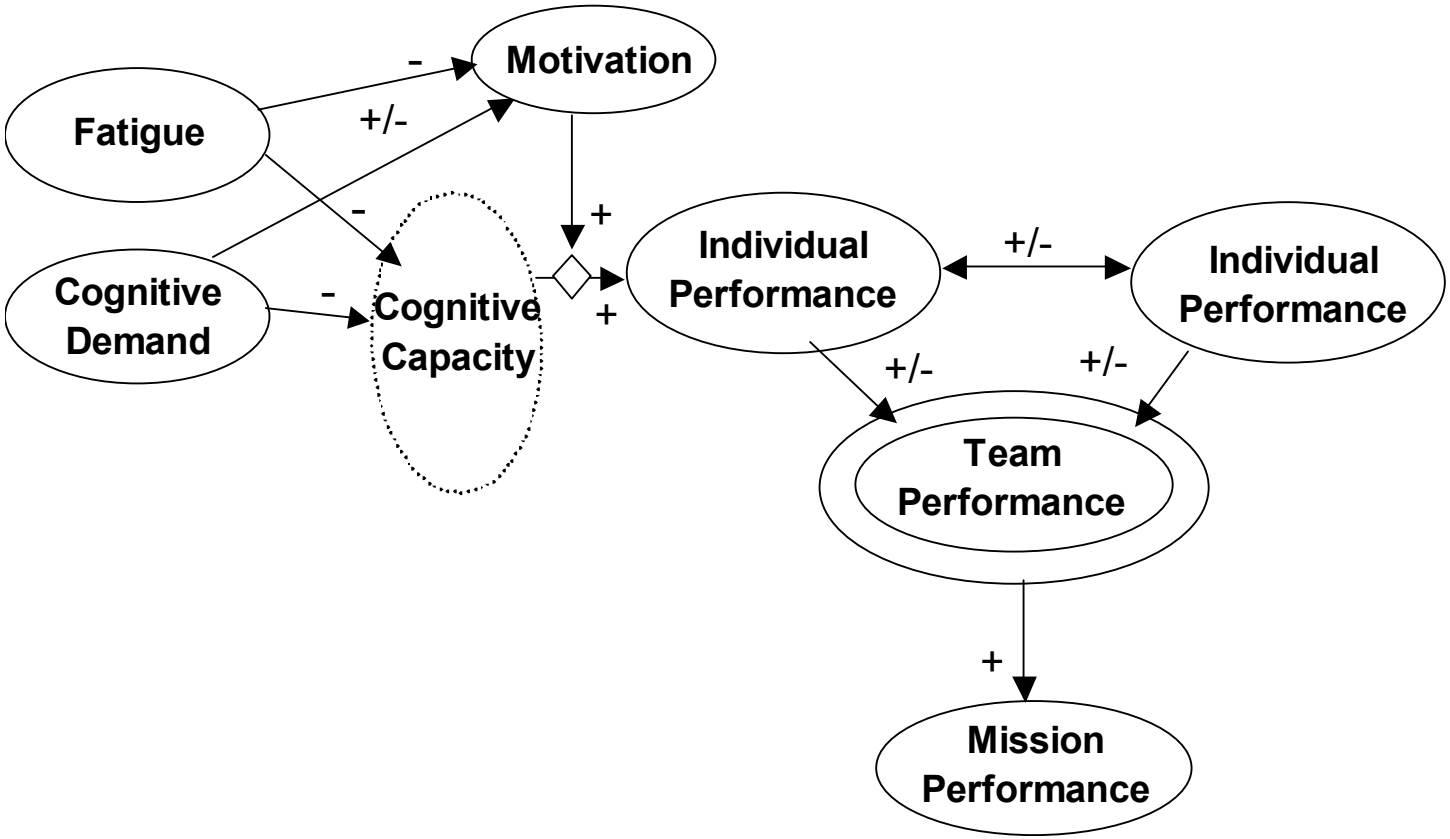
From Hursh, 2003 — Fatigue Avoidance Scheduling Tool (*FAST*™)

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

notional



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



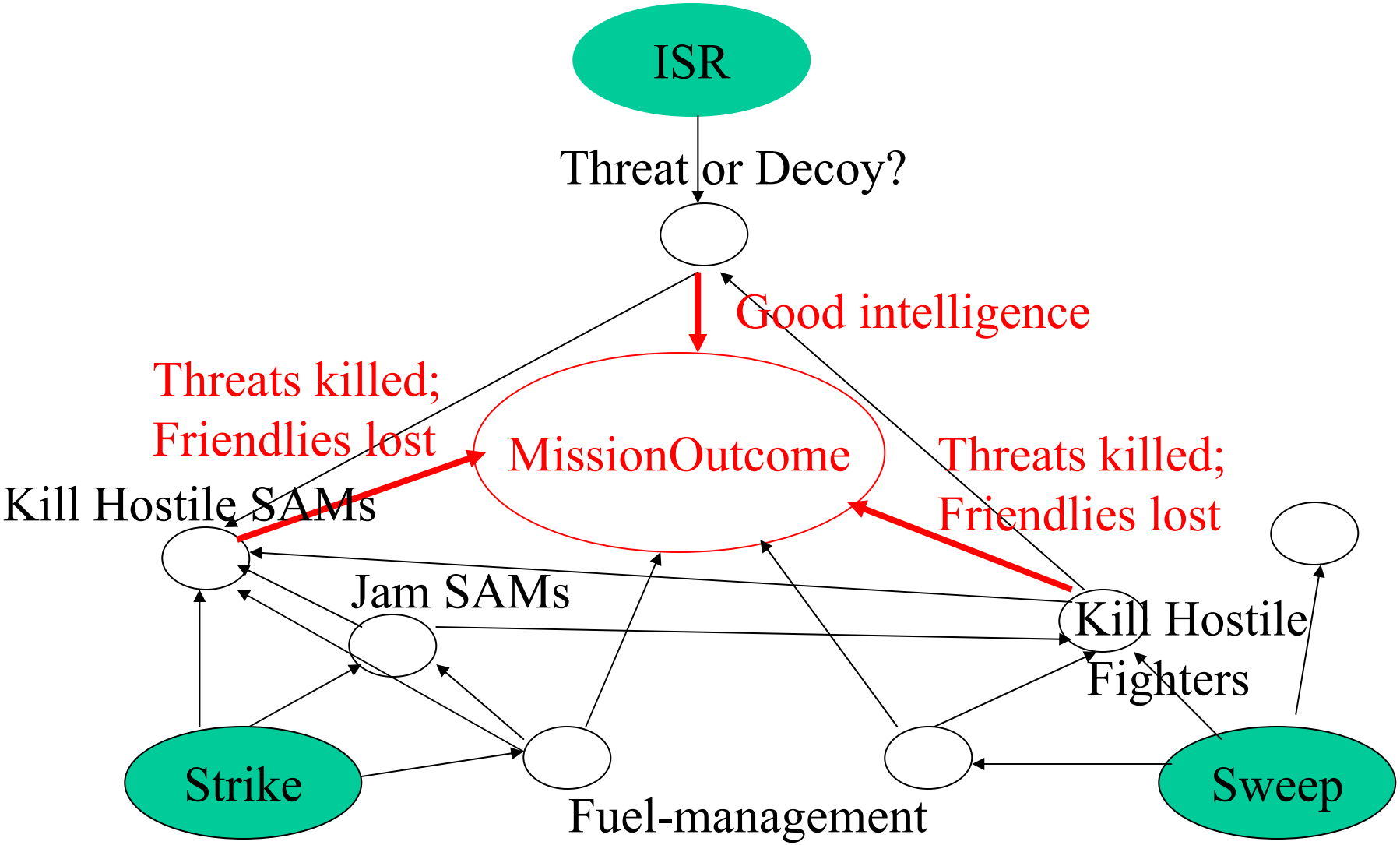
Why integrate team performance to fatigue models?

- 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

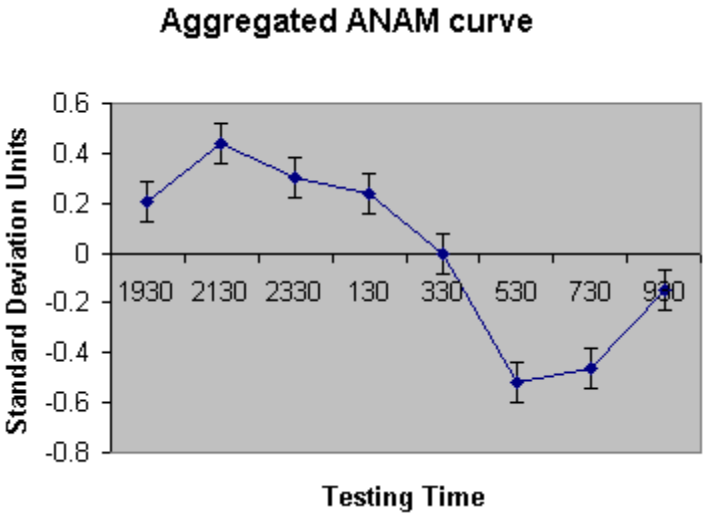
AEDGE Mission Scenario Schema



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?

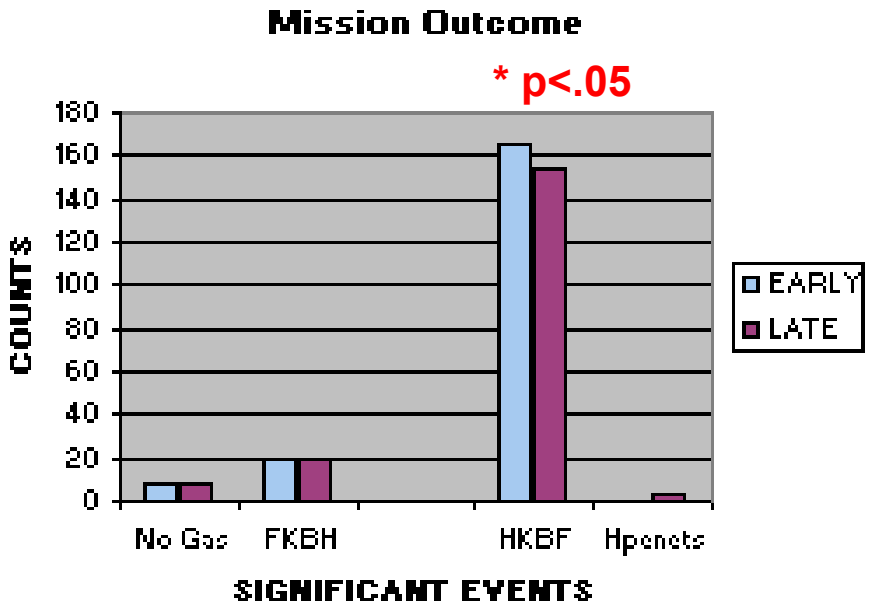


ANAM Test	Paired *t(29)*-statistic	Correlation *r*(28)
CPT	5.41	0.62
MATH	2.89	0.77
SMRT	2.74	0.48
SPAT	3.76	0.88
SLEEPY?	15.4	0.70

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

Answer: yes

Results: Did fatigue affect mission outcome?

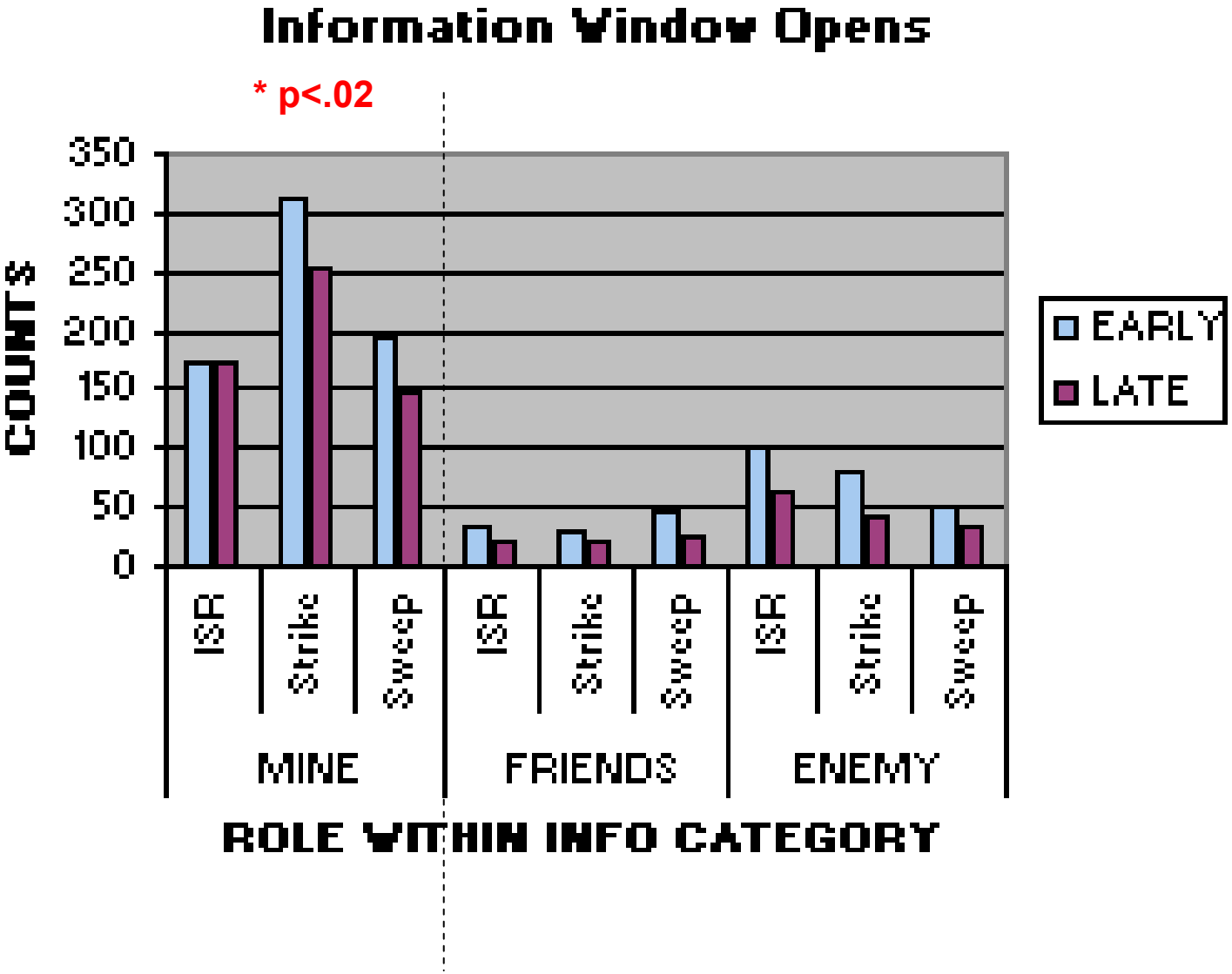


Answer: yes, at least on one dimension

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

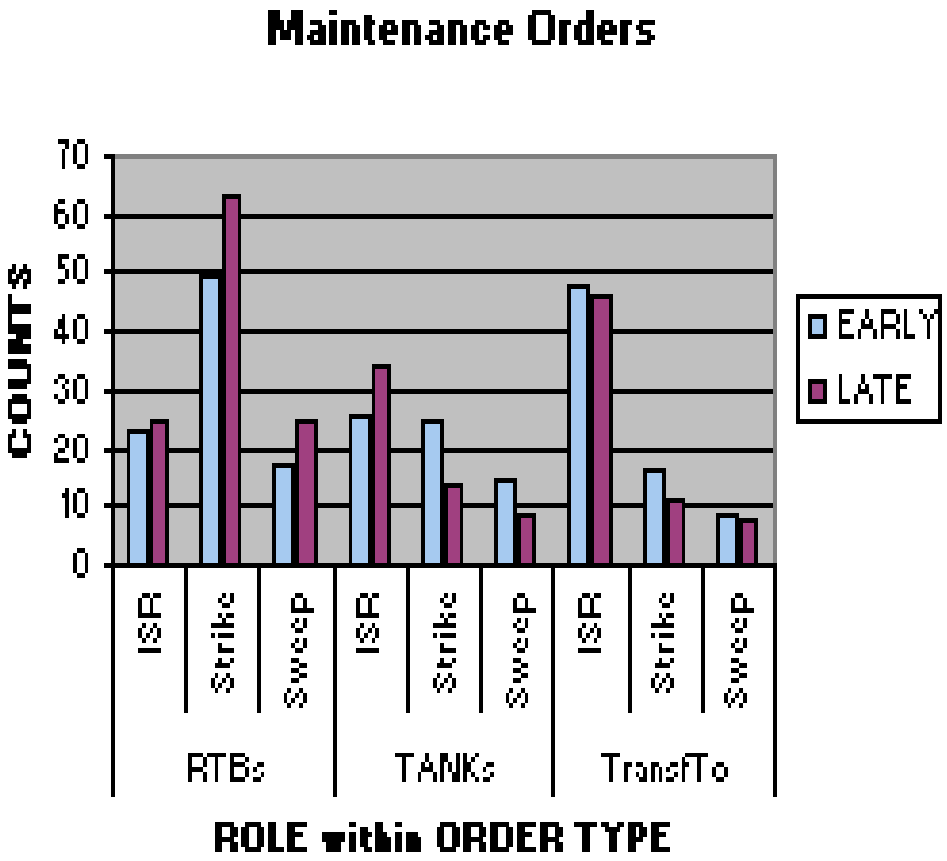
***Table 2.** Early to Late correlations among team outcome measures. FKBH: Friendly killed by Hostile; HKBF: Hostile killed by Friendly*

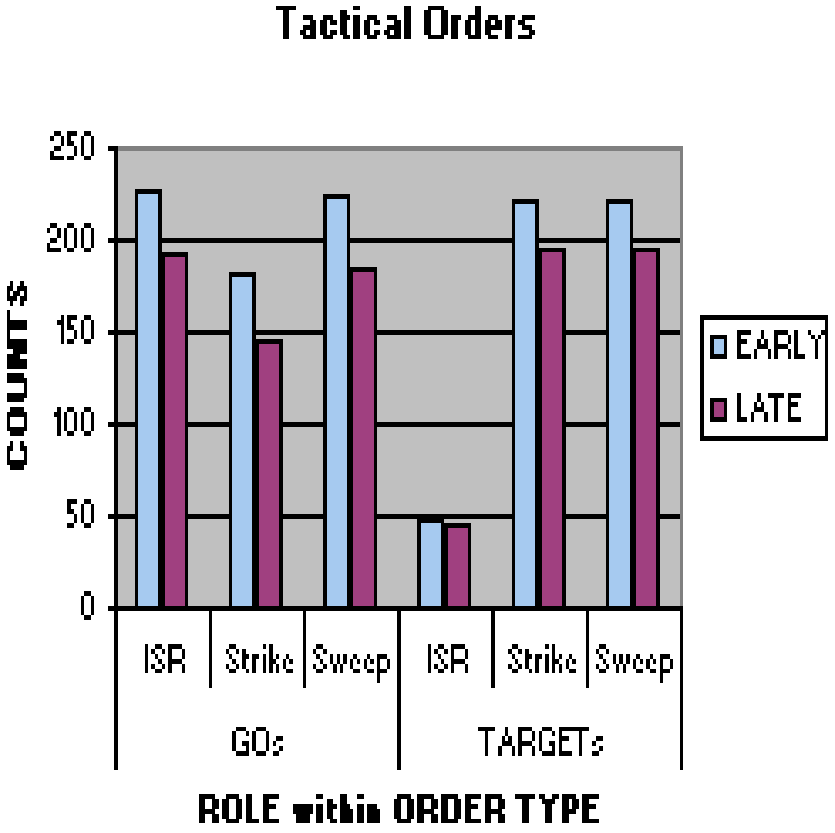
What about team process?: Fatigue depressed info seeking



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

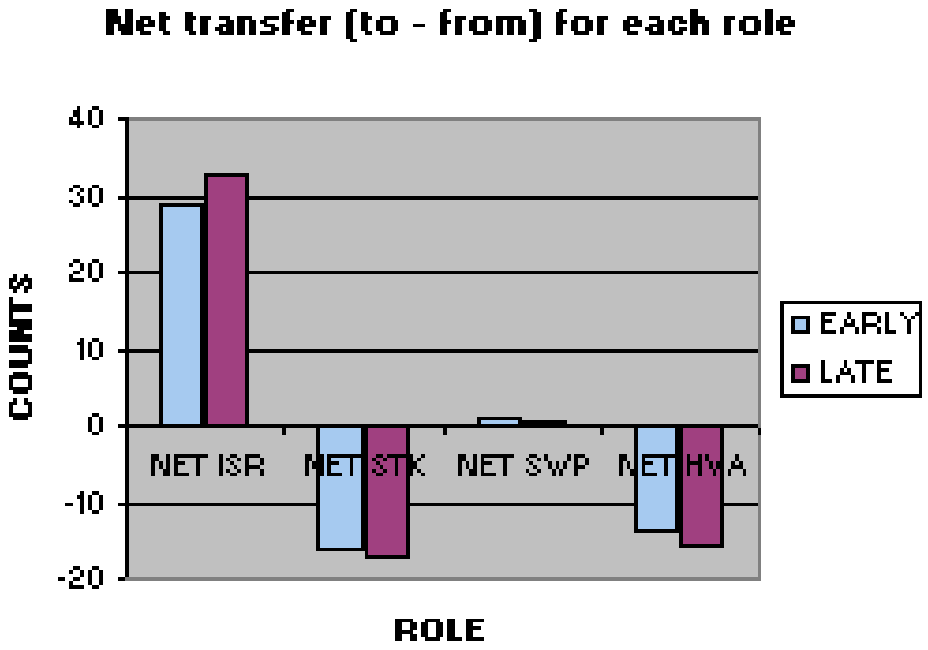
* p<.001: more orders for early missions



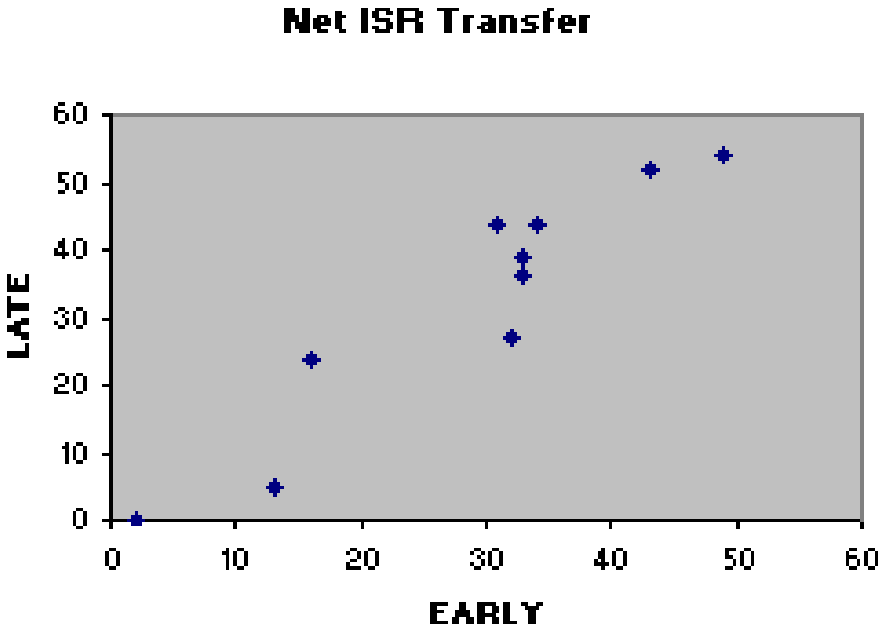


Fatigue adaptation at a team doctrine level: role responsibilities didn't change much

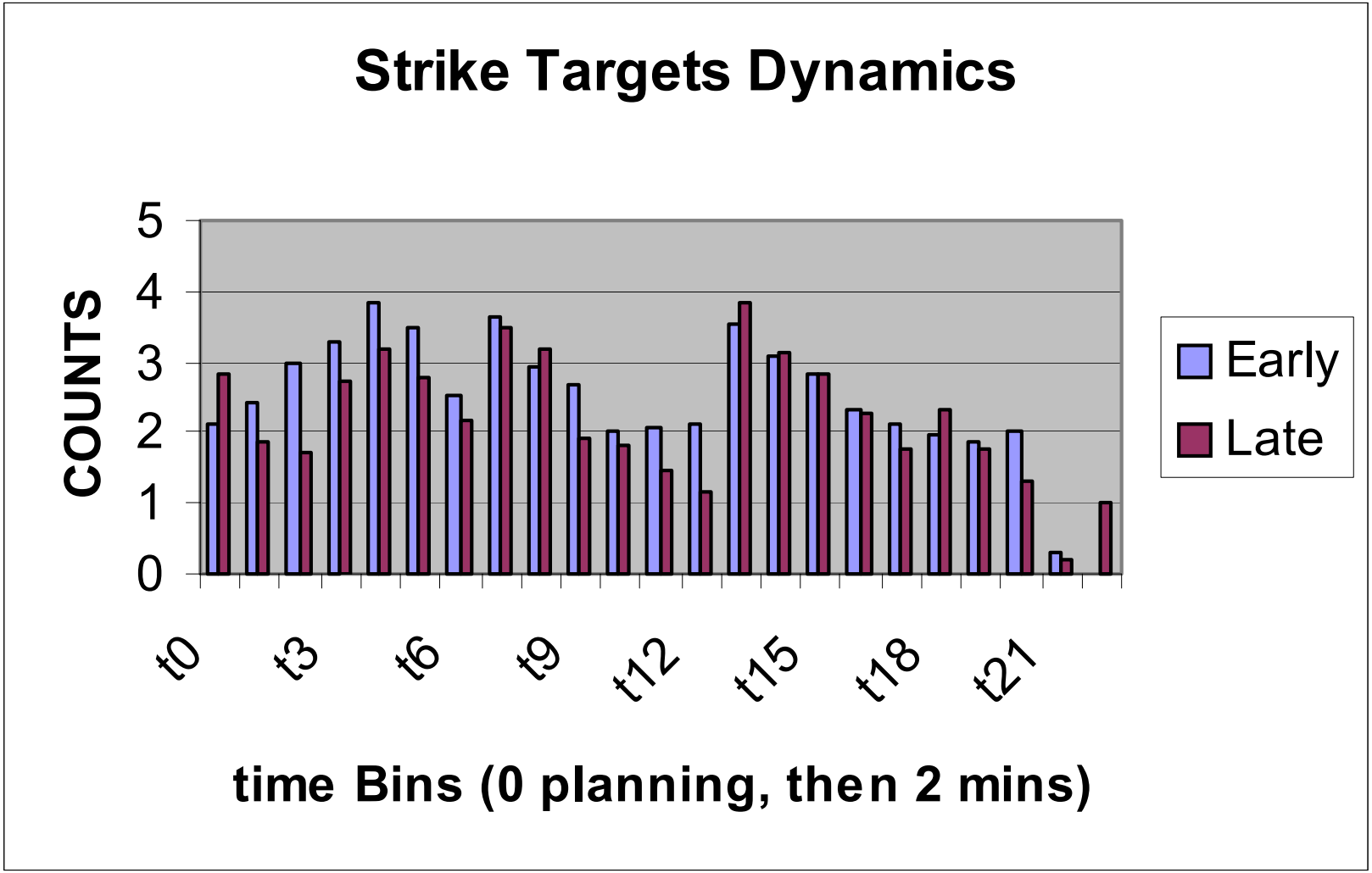
Not Significant: early vs. late



"Team doctrine correlation"
early vs. late: VERY SIGNIFICANT



Other ways to measure team fatigue: role action latency



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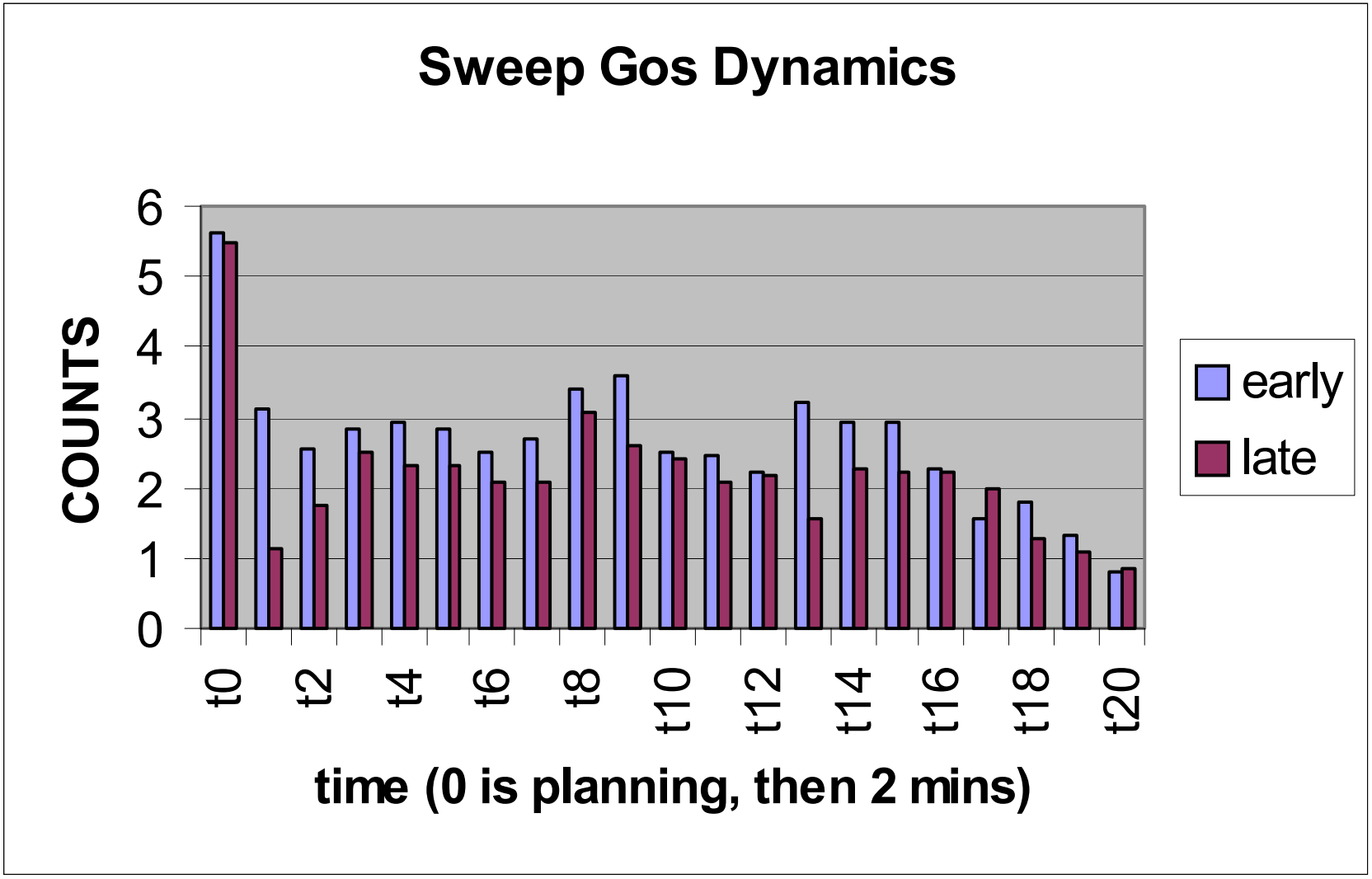

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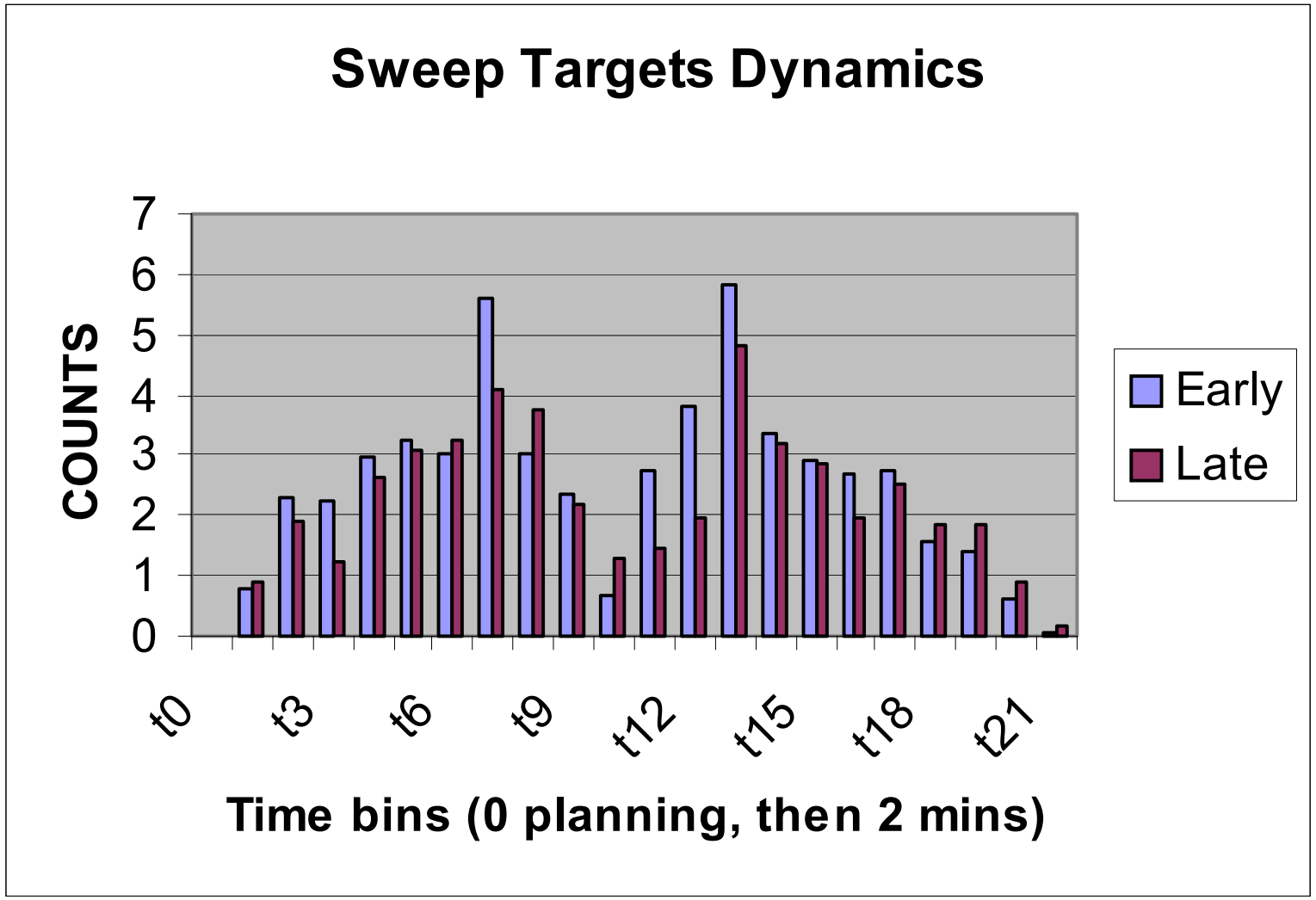

Conclusions

- 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