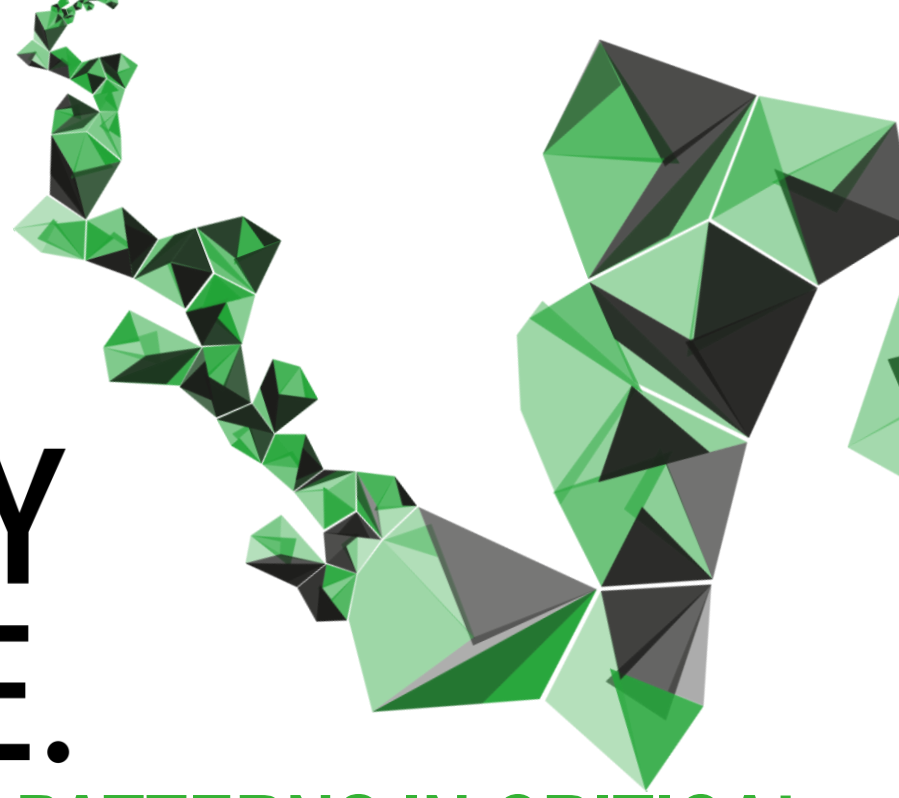
FACULTY OF BEHAVIORAL AND MANAGEMENT SCIENCES

DEPARTMENT OF COGNITIVE PSYCHOLOGY AND ERGONOMICS



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TEAM COMMUNICATION PATTERNS IN CRITICAL SITUATIONS

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WHAT DID WE DO?

- Live observations of 40 pediatric cardiac surgery cases in clinical setting
- Multi-method
- Trained human factors observers

Schraagen, J.M.C. et al., (2010). Assessing and improving teamwork in cardiac surgery. *Quality and Safety in Healthcare*, 19: e29, 1-6.

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HOW DID WE MAKE SENSE OF WHAT IS GOING ON HERE (OVER THE YEARS)?

1. 2010-2011: correlational analyses over all data obtained (questionnaires, observations, teamwork ratings, patient outcomes)
   a) Schraagen, J.M.C. et al., (2010). Assessing and improving teamwork in cardiac surgery. *Quality and Safety in Healthcare*, 19: e29, 1-6.
   b) Schraagen et al. (2011). A prospective study of paediatric cardiac surgical microsystems: Assessing the relationships between non-routine events, teamwork and patient outcomes. Br Med J, 20, 599-603
2. 2011: detailed analysis of four surgical procedures, controlled for complexity and patient outcome (2x2 matrix)
   a) Schraagen, J.M.C. (2011). Dealing with unforeseen complexity in the OR: The role of heedful interrelating in medical teams. T*heoretical Issues in Ergonomics Science, 12(3)*, 256-272.
3. 2015: Social Network Analysis of all team communication, with processes being contingent upon phase in the surgical procedure
   a) Barth, S., Schraagen, J.M.C., & Schmettow, M. (2015). Network measures for characterizing team adaptation processes. *Ergonomics*, *58*(8), 1287-1302.
   b) Schraagen, J.M.C. (2015). Resilience and networks. In: 6th REA symposium, 22-06-2015 - 25-06-2015, Lisbon.
4. 2019: Relational Event Analysis of team communication patterns
   a) Van den Oever & Schraagen (2019). Team communication patterns in critical situations. Paper presented at the International Conference on Naturalistic Decision Making, San Francisco, CA, June 23, 2019.

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CORRELATIONAL ANALYSES: SOME SURPRISING FINDINGS[1]

- No association between teamwork and outcome
  - In fact, we found an inverted U-curve showing first increased teamwork by surgeons as patient outcomes worsened, then decreased teamwork as patient outcomes continued to deteriorate

- No association between teamwork and non-routine events
  - However, during cardiopulmonary bypass: significant correlation (r=0.66, p<.01) between surgical decision making and number of NREs (the more NREs, the better the decision making)

- Mental and physical preparation beforehand was not predictive of patient outcome; questionnaire immediately afterwards on unexpected events and team processes predicted 30% of the variance in 30-day postoperative outcome

[1] Schraagen et al. (2011). A prospective study of paediatric cardiac surgical microsystems: Assessing the relationships between non-routine events, teamwork and patient outcomes. Br Med J, 20, 599-603

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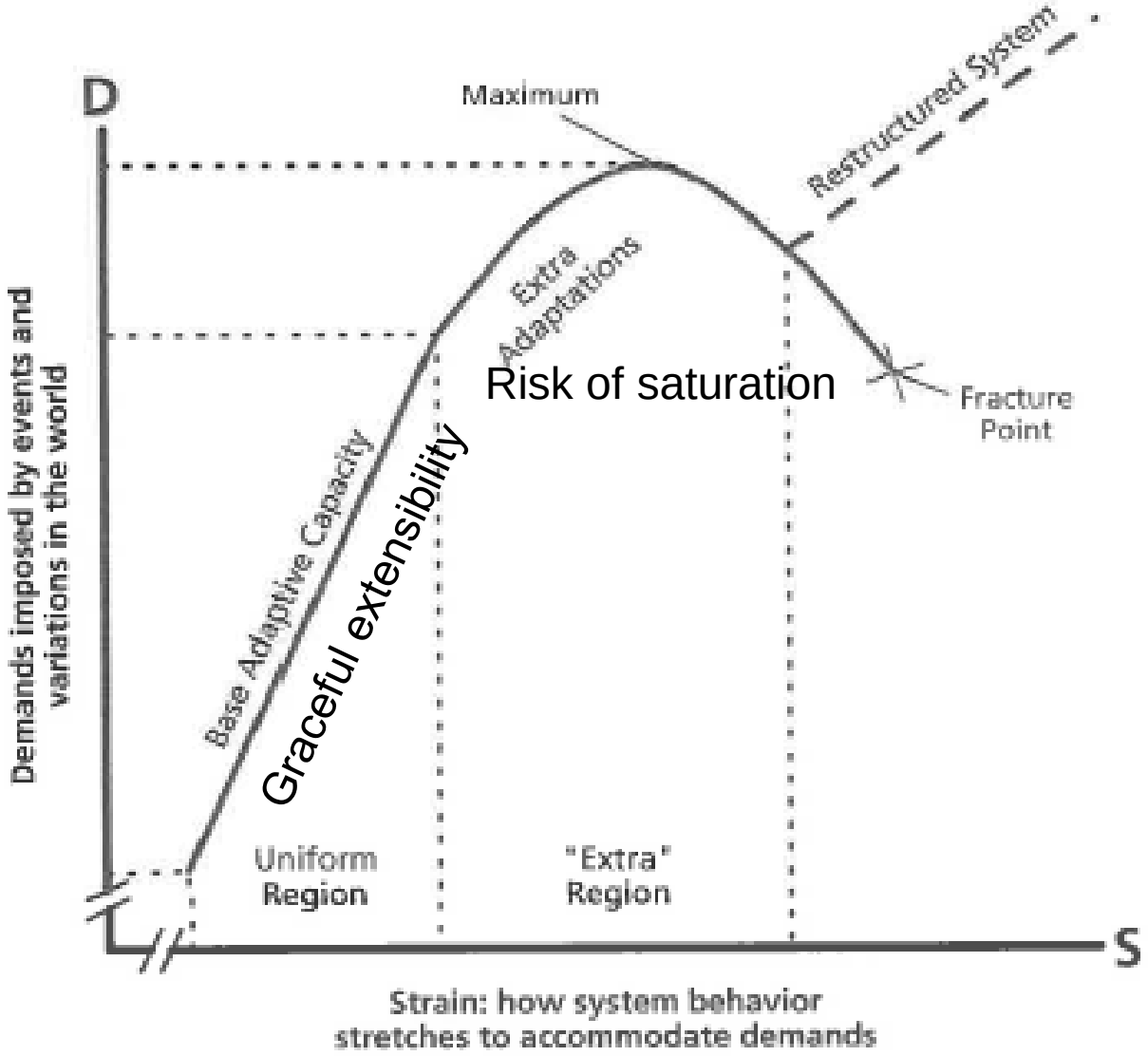

Figure 4.3 Stress-Strain State Space diagram

Source: From Woods and Wreathall, 2008.

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WHAT HAVE WE LEARNED SO FAR?

- Law of Fluency might explain the inverted U-curve:
  - First, teams extend gracefully by employing their team resources
  - However, as demands increase, they run the risk of saturation, and team processes decrease in quality

- However, ‘teamwork’ was rated very coarsely using vague, high-level constructs, such as ‘leadership’, ‘situation awareness’, ‘decision making’, etc.
- Also, ‘teamwork’ was not seen as a dynamic construct, whose underlying processes can change and adapt to the demands of the situation
- Hence, we need to look at team processes in more detail, using real-time measures

PROCESS FLOW IN PCS DURING THE VARIOUS EPOCHS

Epoch	Process flow	Domain
1	Patient in surgical holding area. Pre-operative events and medication. Patient transported to OR	Transport to OR
2	Patient in OR. Induction of anesthesia, insertion of lines.Preparing for surgery	Pre-surgery/Anesth. induction
3	Incision. Desection. Canulation	Surgery/pre-bypass
4	Go on cardiopulmonary bypass (CPB). Identification of structure. Surgical repair	Surgery/bypass
5	Off CPB. Heparine reversed. Hemostasis	Surgery/post bypass
6	Chest closed. Prepare for move and update ICU. Team leaves with patient to ICU	Transport to ICU
7	Arrival at ICU. Nurses take over. Anesthetist/surgeon inform ICU attending	Handoff

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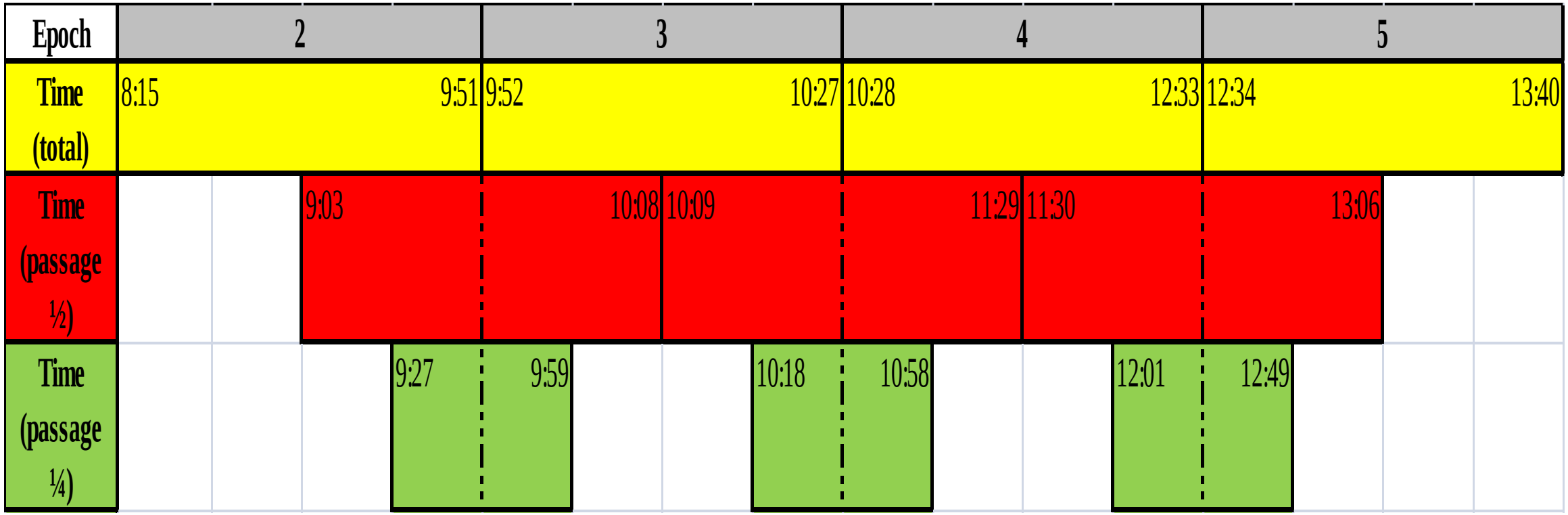
EXAMPLE OF EPOCHS AND CRITICAL TRANSITION PERIODS



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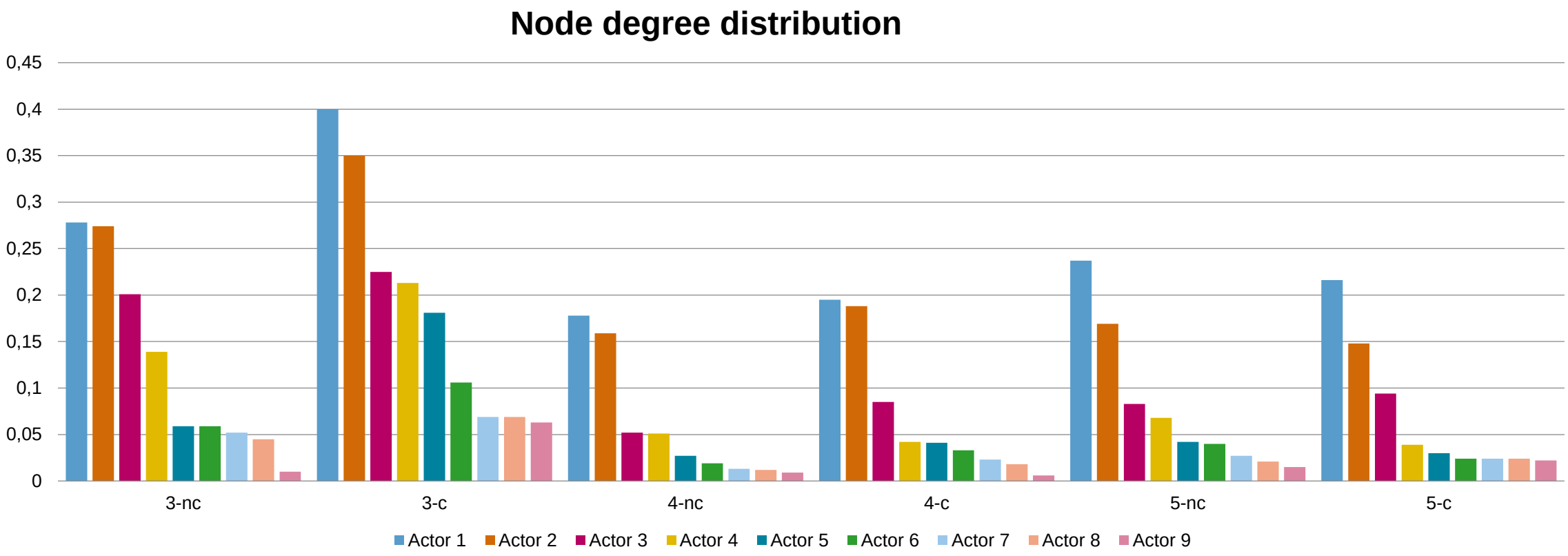
SCALE-FREE NETWORK STRUCTURE OF MEDICAL TEAM



Schraagen, J.M.C. (2015). Resilience and networks. In: 6th REA symposium, 22-06-2015 - 25-06-2015, Lisbon.

Schraagen, J.M.C., & Post, W.M. (2014). Characterizing naval team readiness through social network analysis. *Proceedings of the Human Factors and Ergonomics Society 58th Annual Meeting* (pp. 325-329), Chicago, Il., October 27-31, 2014.

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RESULTS ON COMPLEXITY OF PROCEDURES (MEDIAN SPLIT)

- More complex procedures:
  - Have flatter communication structures, are less hierarchical
  - Show higher levels of reciprocity

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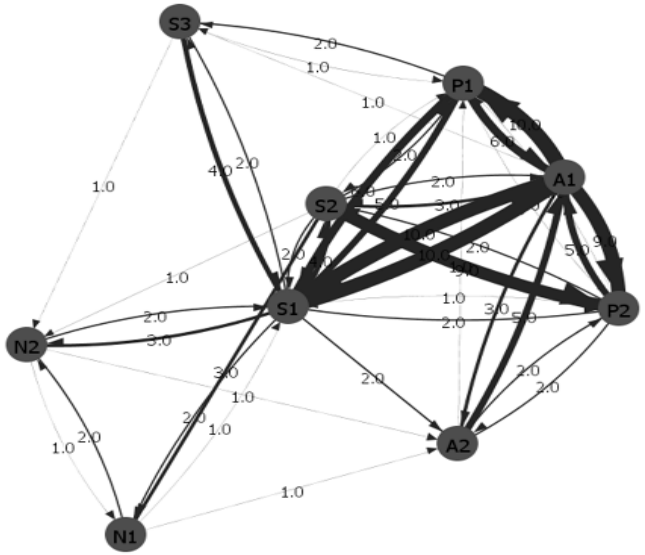
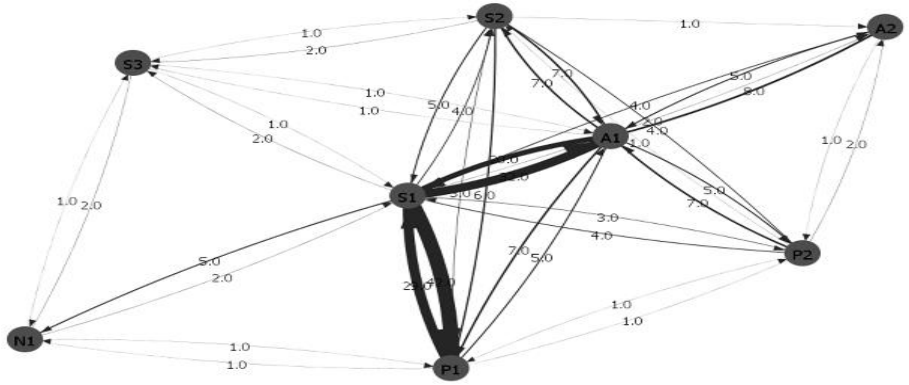


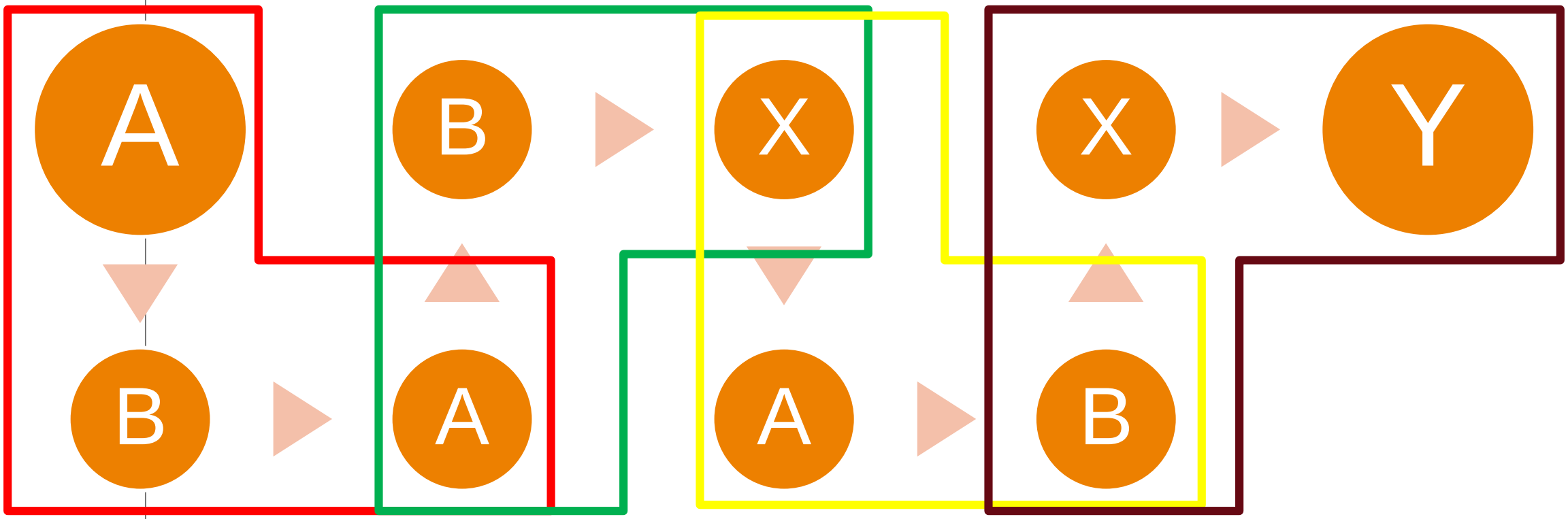


“If the first surgeon is too busy, I’ll take over the communication with the rest of the team”

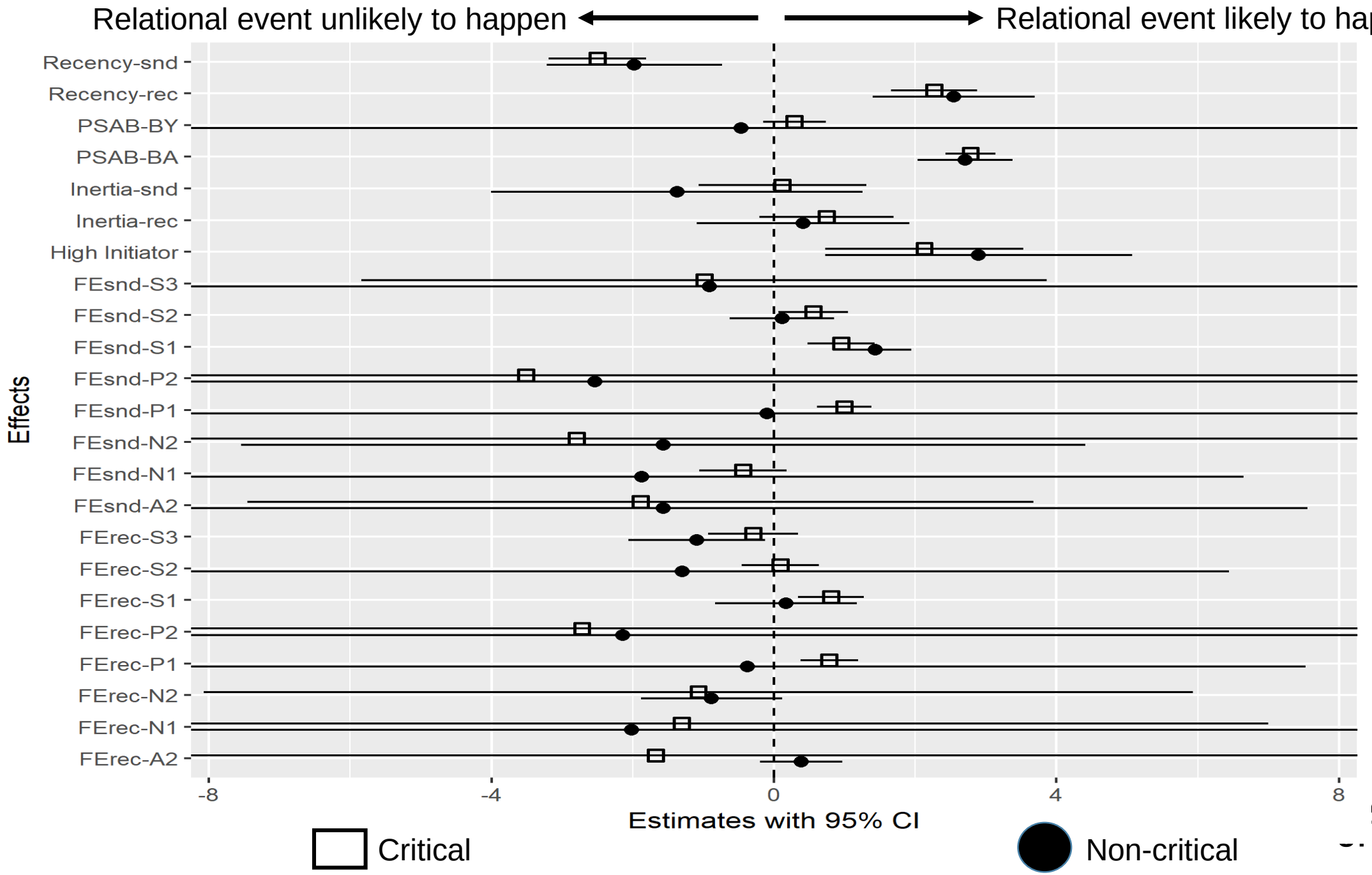
Assisting surgeon

Barth, S., Schraagen, J.M.C., & Schmettow, M. (2015). Network measures for characterizing team adaptation processes. *Ergonomics*, *58*(8), 1287-1302.

Relational event models

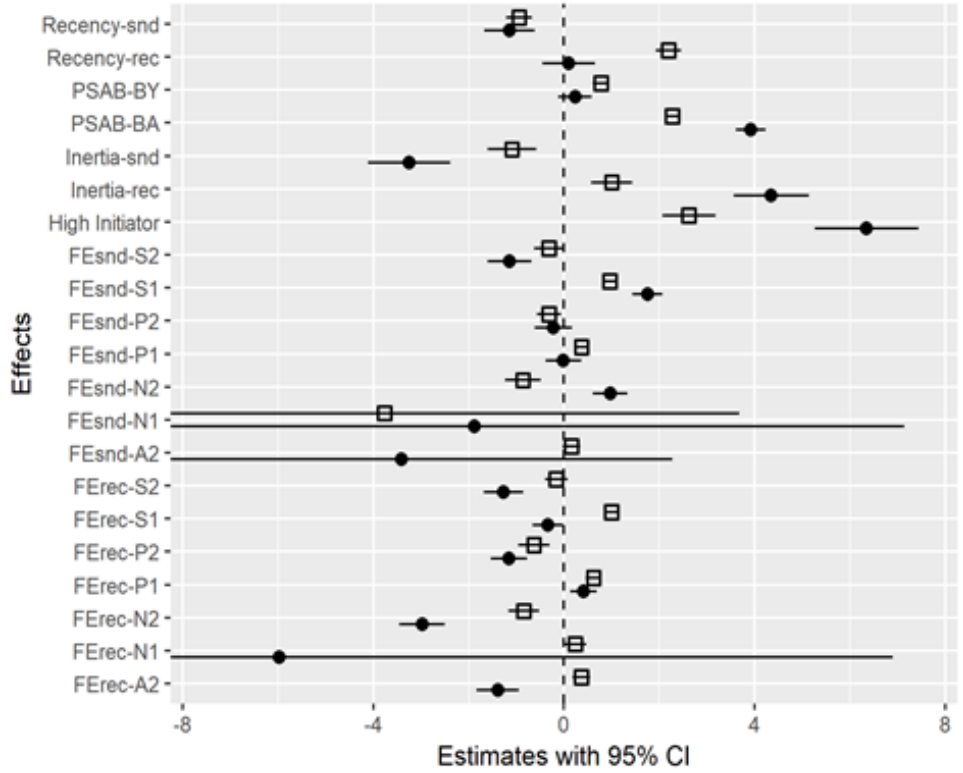


Van den Oever, F. & Schraagen, J.M.C. (2019). Team communication patterns in critical situations. Paper presented at the International Conference on Naturalistic Decision Making, San Francisco, CA, June 23, 2019.



RESULTS RELATIONAL EVENT ANALYSIS

- Surgical team showed few changes in communication patterns:
  - But does change when more extreme situations are chosen (3 most critical vs. 3 least critical)
  - Changes with 8-member team as well (right panel)



Similar analyses done with Apollo 13 Mission Control team and Air France 447 team
David, L.Z., & Schraagen, J.M.C. (2018). Analysing communication dynamics at the transaction level: The Case of Air France Flight 447. *Cognition, Technology & Work, 20*(4), 637-649.

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CONCLUSIONS

- Findings indicate that teams adapt communication patterns in critical situations.
- They still adhere to institutional roles, closed-loop communication, and information seeking behavior in both critical and non-critical situations.
- However, they decentralize communication structures in critical situations.

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BACK TO THE EXAMPLE OF STUDYING A SURGICAL TEAM AT WORK

- Telephone call was a non-routine event
- Anesthesist was caught in a double-bind: both answering the phone and taking the cardioplegia line
- Team members were very busy with their own coordination issues:
  - For 25 seconds, S1 and P1 were solving diminishing rate of return problem
  - Attention management: no one noticed A1 with phone, nor did A1 notify other team members (did he assess the workload of his fellow team members?)
  - S1 was simultaneously coordinating with S2 and N1
  - Scale-free network structure with S1 as single hub can be overloaded (in this case, S2 did not take over)