COGNITIVE FACTORS IN THE DESIGN OF EFFECTIVE MEDICAL EDUCATION

Alan Lesgold, May, 2007

How We Think

Implications for Teaching Medicine

Two Big Issues

- How do effective physicians think?
- How do they learn to think that way?

Special Characteristics of Medical Thinking

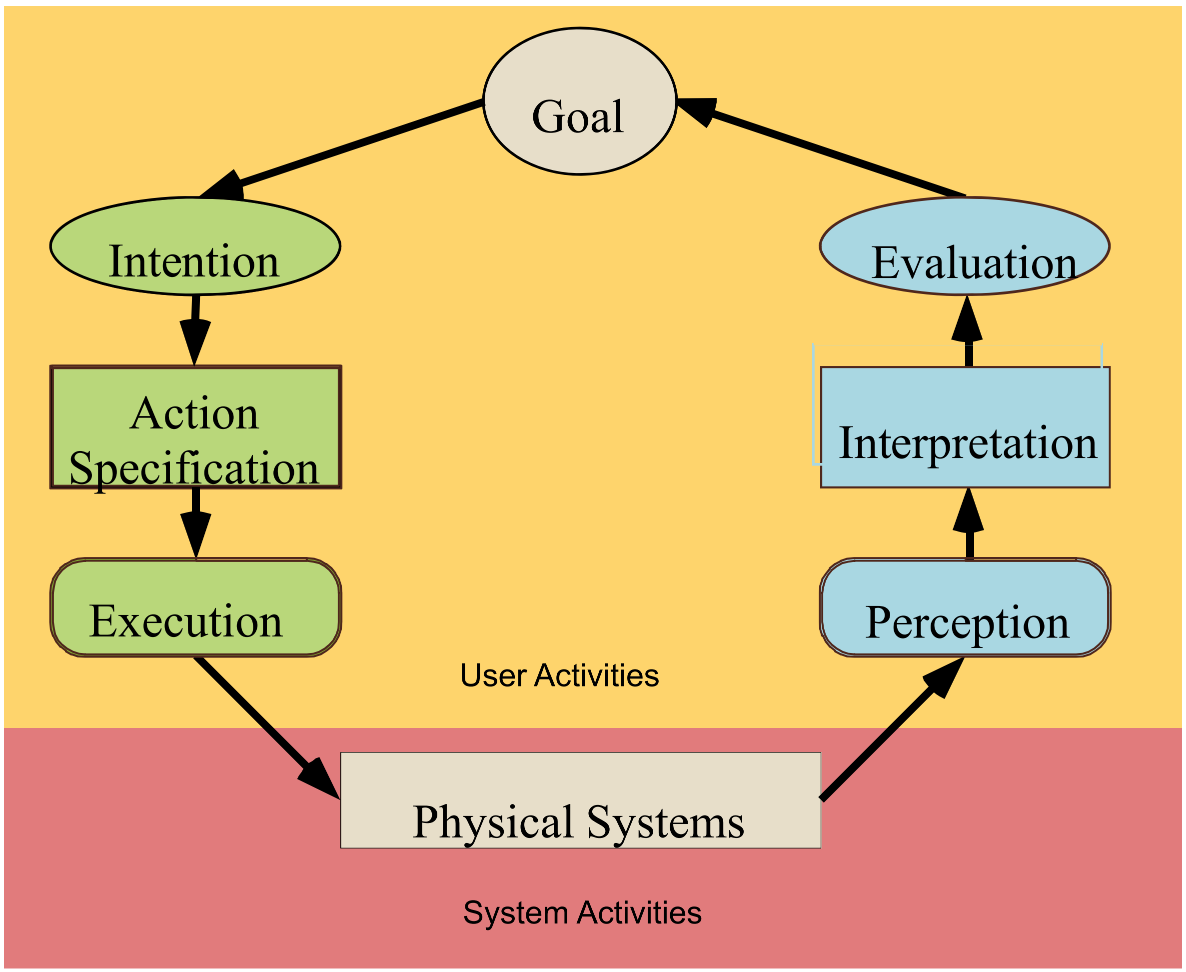
- Multi-tasking and rapid context shifts
- Complexity
  - Multiple body systems
  - Clearest manifestation of one disease may most often indicate a different disease – probabilistic complexity
  - Noisy data – patient variability in what they say and what it might mean
- High stakes

Two Useful Models of Expert Thinking

- Norman’s Model of Slips and Mistakes
- Rasmussen’s Model of Expert Problem Solving

Norman's Action Theory

(graphics borrowed from Vimla Patel)



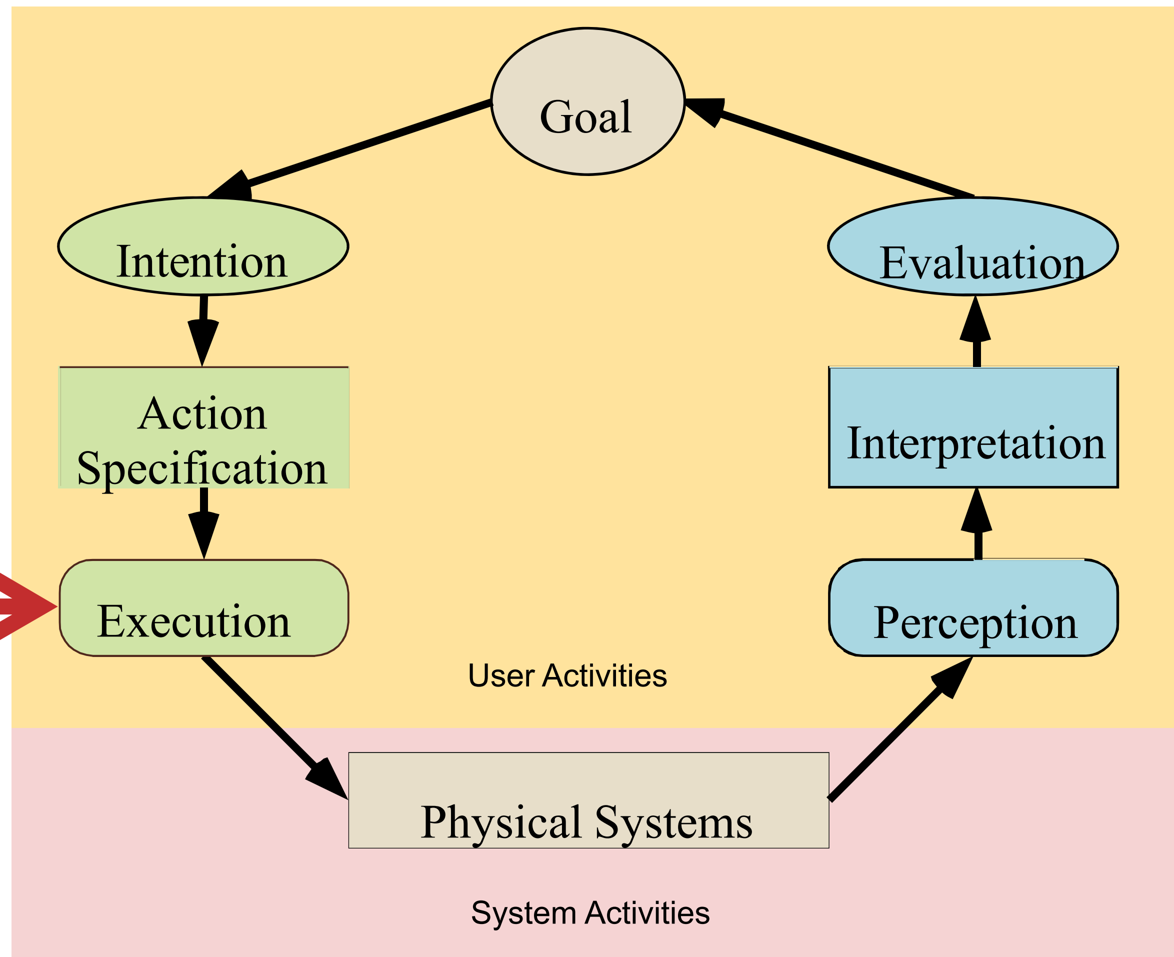
Slips and Errors

- Slips: Program doesn't execute as it should
- Mistakes: Information not analyzed or processed correctly

Interventions for Slips

Example: Interventions at execution step

- Automation
- Visualization
- Display design
- Reduce interruption
- Memory aids



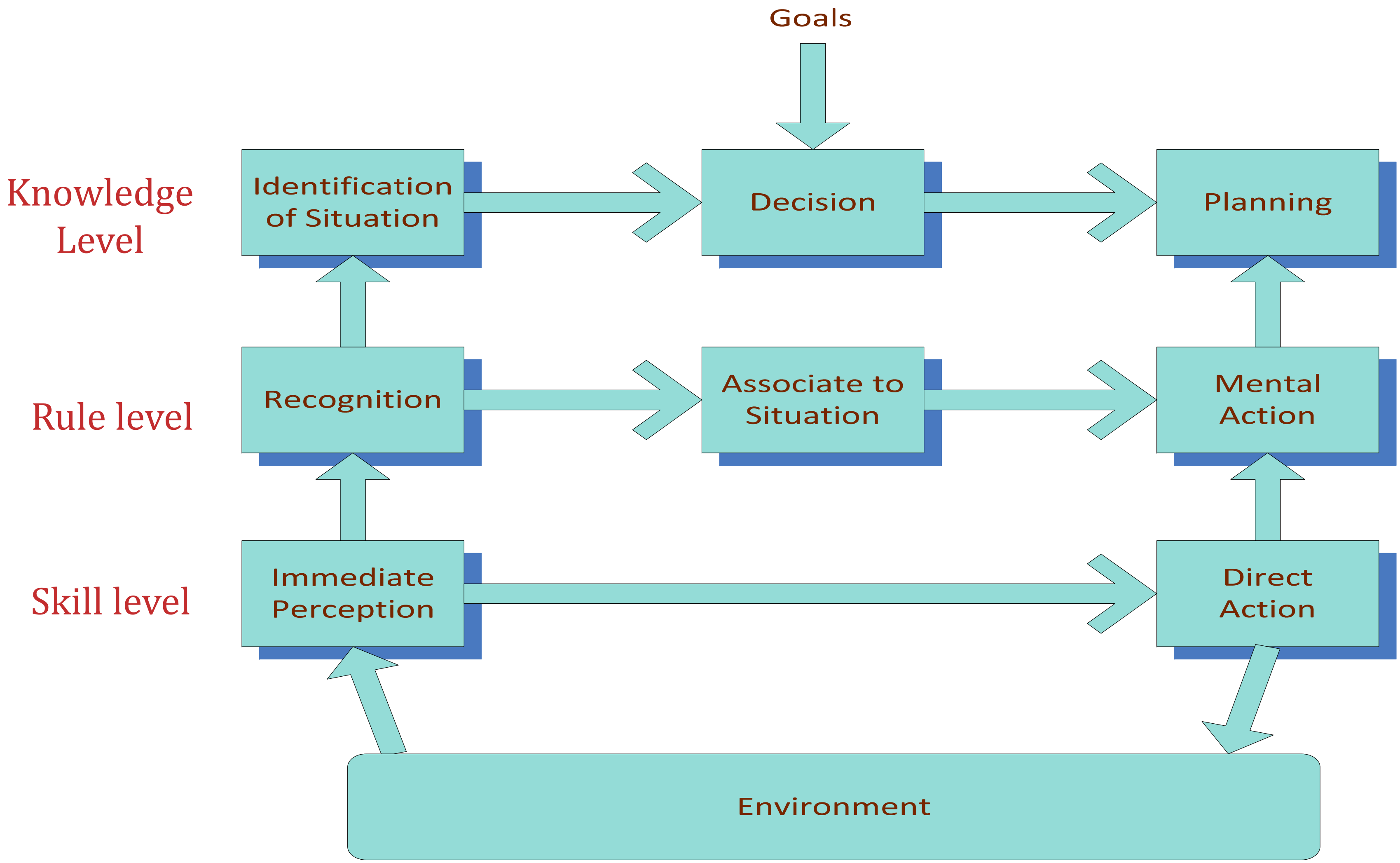
The Norman Approach to Training

- Design training and procedures to make responses to problem situations more reliable
- Use tools and extended training to block slips
- Provide enough conceptual understanding to decrease mistakes

Rasmussen’s Insight

- Multiple levels of mental activity
- Each level learned differently

Rasmussen’s Ladder



Skill Based Behavior

- Perform routine tasks
  - Driving a car down an ordinary road
    - Automatic responses to small changes in the roadway
  - Intubations
    - You feel your way, in part, and automatically respond to what you feel
  - Routine diagnoses
    - You instantly know what to do because you do it many times a day – but there is need for considering alternatives – which requires rule and knowledge based processing

Rule Based Behavior

- Perform familiar tasks applying rules automatically to figure out what to do
  - For example, seeing a stop sign, until this becomes fully automated
    - Slow down and prepare to stop
    - Stop at appropriate distance
    - Look both ways
    - Proceed following turn-taking protocol
  - Experts often learn rules for checking whether an automatic decision is the right one: *"If my diagnosis is right, I also expect to see x, y, and z"*

Knowledge Based Behavior

- When rules don’t cover situation, reason (which means using more general reasoning rules applied to prior knowledge)
- For example, arrive at busy intersection, but traffic lights not operating
  - Come to stop
  - Evaluate situation
  - Proceed with caution
- Situation awareness: knowing how to interpret a situation to make rule-based processing practical

Medical Errors

Teaching to Reduce Medical Errors

Leveraging What We Know about Thinking

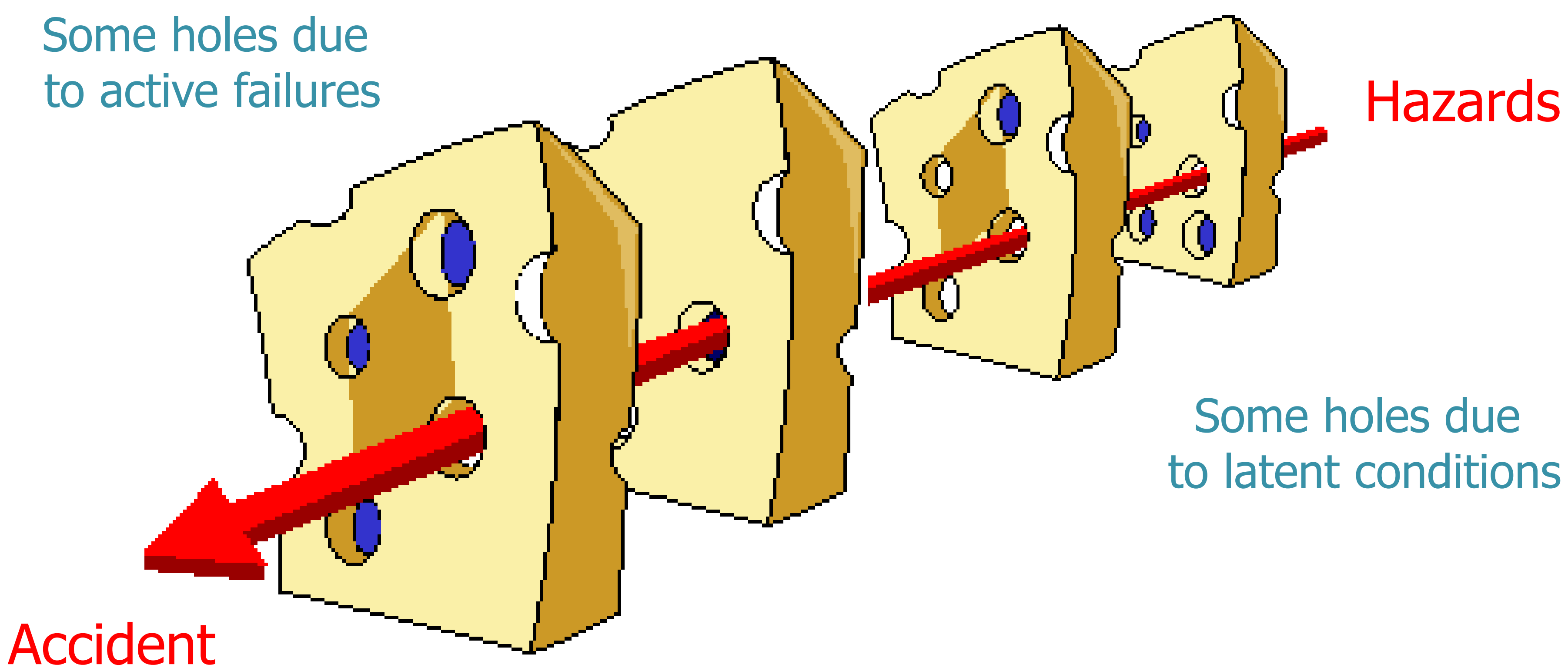
- Analyze medical errors and design approaches to limit slips and mistakes
- Automate error-checking rules and skills – build on situation awareness work of the military
- Teach about how errors happen so the development of error checking fully leverages self-knowledge and enculturated knowledge

Reason's Swiss Cheese Model

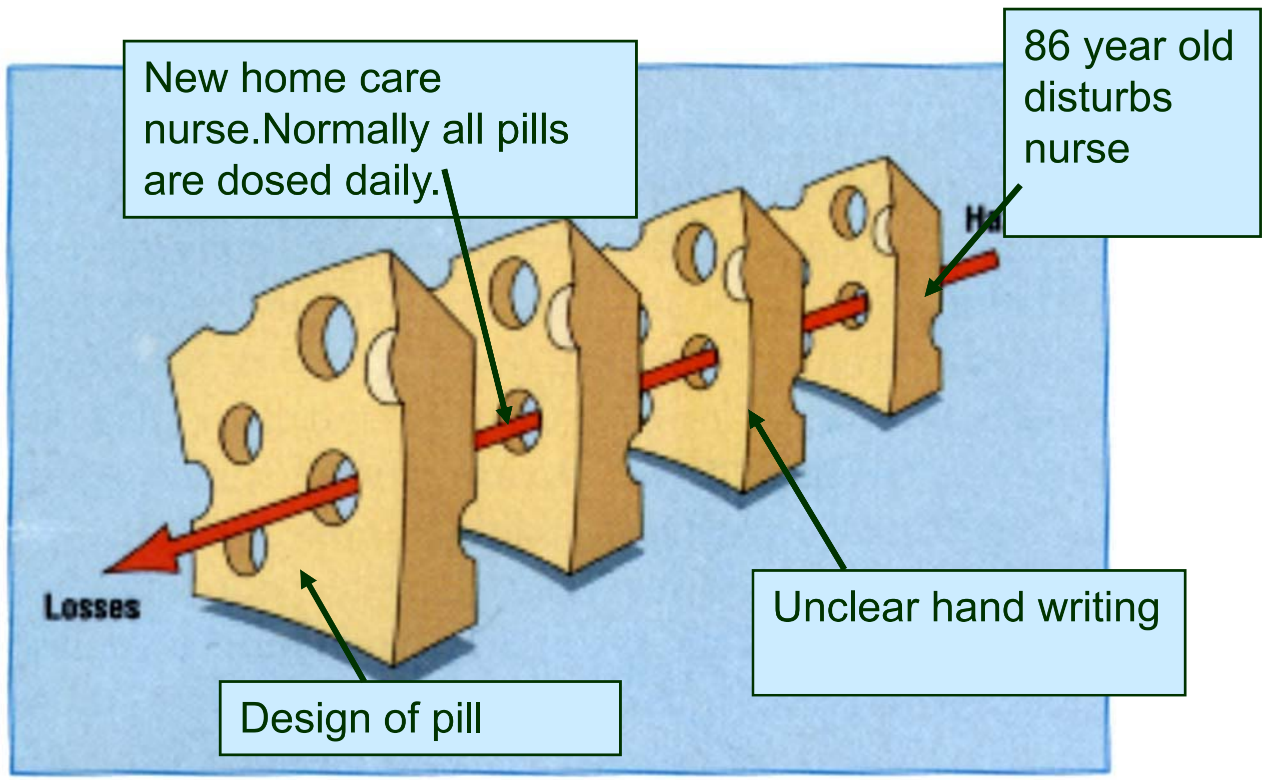
A simple but useful view of how errors happen when we are trying to prevent them

James Reason

The Swiss Cheese Model



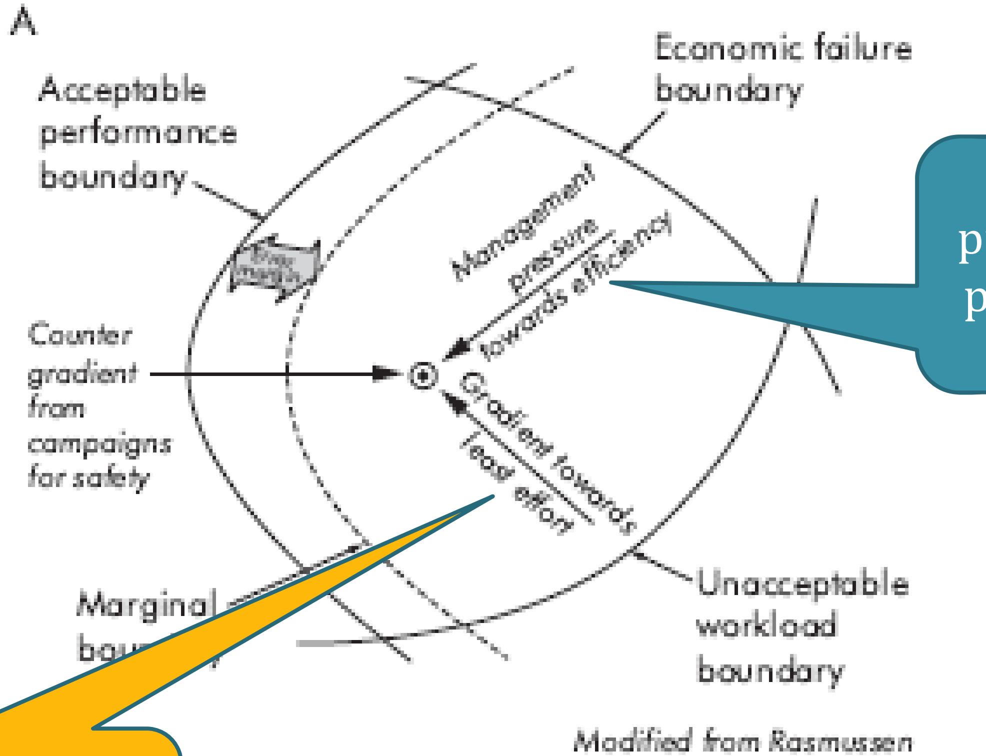
Woman Dies from Medication Error



Understanding How Error Evolves

- We engineer systems of practice to be safe – though we keep learning (as with hospital infections)
- Forces in the practice environment cause practice to evolve toward nonsafety
- We can teach people to predict and watch for such evolution

We Start Safe, but Failure Potential Can Evolve



Management pressures, but also public and patient pressures

Some of this is necessary coping with emergent events

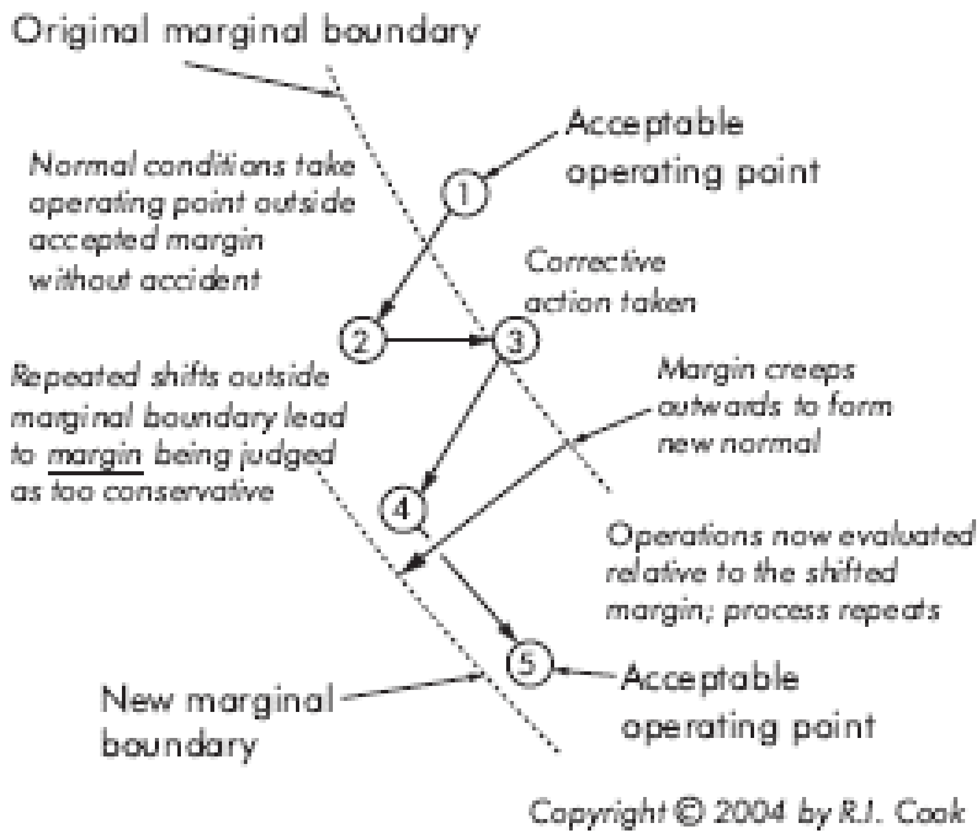
DPING RESEARCH AND PRACTICE

g solid'': a model of system dynamics and ...uences for patient safety

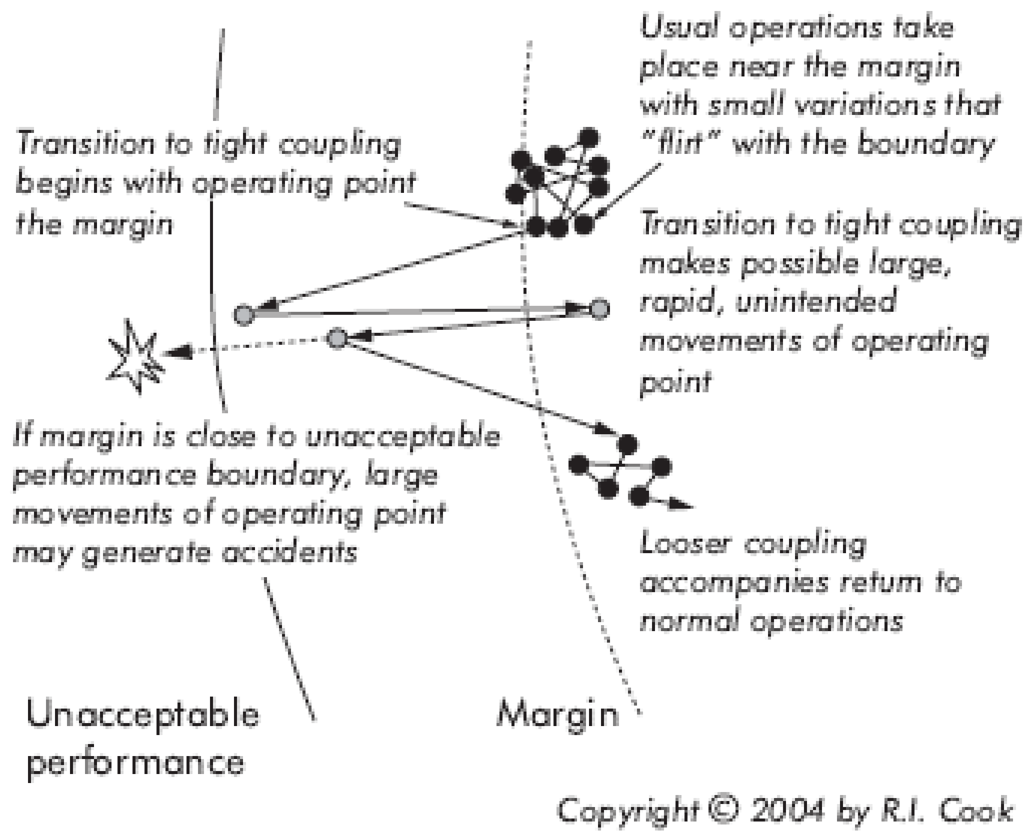
R Cook, J Rasmussen

Qual Saf Health Care 2005;14:130–134. doi: 10.1136/qshc.2003.009530

It Worked Last Time!



Tight Coupling of Process: Becoming Efficient Can Create Problems



Summary

- Understand affordances – what does environment allow/force us to do
- Understand human cognition – how do we learn good and bad practices & how do we use what we learn
- Understand human systems and how they fail
- Understand how potential for failure evolves because of predictable characteristics of human social activity
  - Desire to save time
  - Desire to save money
  - Initiatives at multiple levels
  - Likelihood of incomplete coordination