

Human Error and Decision-Making

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Engineers for Exploration, UC San Diego

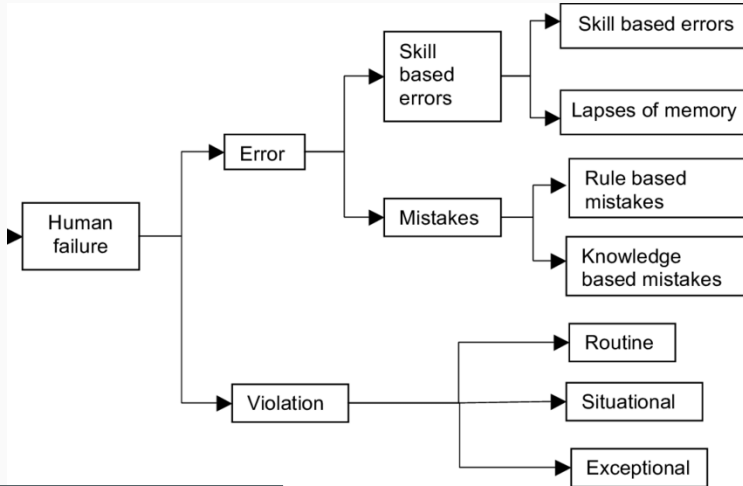
What are errors?

- Pilots make on average 3-6 “errors” per hour on the flight deck
- Unintended deviation from a preferred behavior

What is the preferred behavior?

- Often assessed from our own behaviors
- Often biased by complacency
- Determined by the community (peers/standards/best practices)

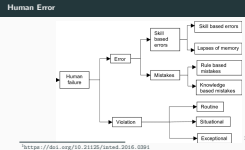
Human Error



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¹<https://doi.org/10.21125/inted.2016.0391>

Human Error



- Skill based error (“slips”) - example: logic bug. Hard to prevent other than over-practice.
- Lapses of memory (“lapses”) - example: syntax bug. Use of checks such as CI, regression tests, linters.
- Mistakes - think you are doing the right thing, but it is the wrong thing. Requires understanding of “right” to trap and mitigate. Checklists and standards can help, but they need to be standard!
 - Rule based mistakes
 - You drive over the speed limit because you get where you are going faster, and you get a ticket - bad rule that usually works
 - Incorrectly programmed a new infusion pump following the directions used for an older model and the pump failed - good rule in wrong situation
 - Knowledge based mistakes
 - You apply an incorrect technique using concepts you aren’t familiar with
 - You misdiagnose a bug and take inappropriate action to correct it

Design systems where:

- Likelihood of making an error is reduced
- Motivation for making violations is reduced
- When failures occur, we can do something about it

Safety is not just the absence of accidents and incidents, but rather the presence of barriers and defenses and the capacity of the system to fail safely - Todd Conklin

Why do violations occur?

- Always looking to be more efficient/effective
- Standards and best practices vs. efficiency and effectiveness
- Erosion of safety margins
- Most of the time, no adverse outcomes

How can we empower everyone to bring up errors?

Psychological Safety - a shared belief within the team that it is safe to take interpersonal risks

Psychological Safety

- Inclusion
- Learner Safety
- Contributor Safety
- Challenger Safety

└ Psychological Safety

- Inclusion
- Learner Safety
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- Challenger Safety

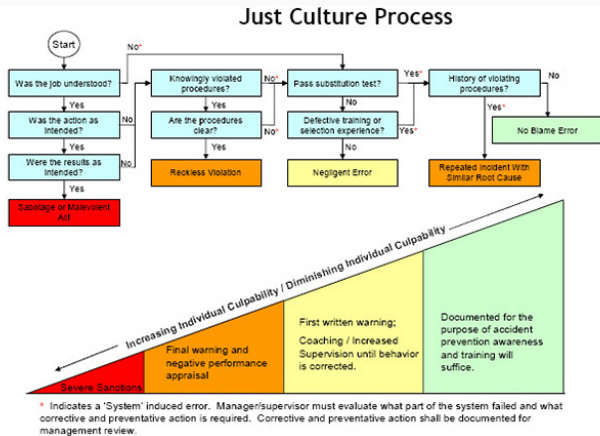
- Inclusion - make everyone feel welcome
- Learner Safety - normalize making mistakes, depersonalize feedback. Focus on observable actions, not about individuals
- Contributor Safety - normalize different approaches and novel contributions. Not “we’ve always done it this way”
- Challenger Safety - normalize raising concerns.
Leaders - ask for help, highlight own mistakes, be human

- Everyone is fallible, errors will happen
- However, willful negligence still needs to be held to account

[Just culture is] an atmosphere of trust in which people are encouraged (even rewarded) for providing essential information, but in which the line must be drawn between acceptable and unacceptable behavior.

- Context-rich stories
- Detailed analysis
- Evaluate rules
- Share learnings
- Apply rules in new situations
- Repeat

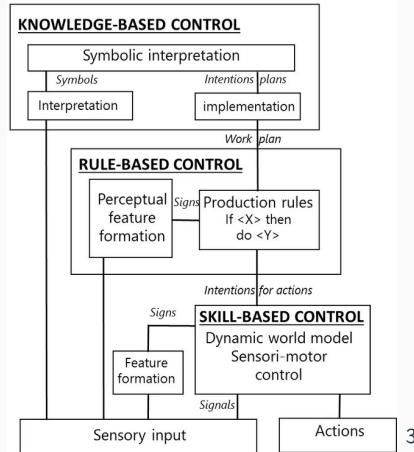
Just Culture in Medicine



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²<https://deptmedicine.arizona.edu/patient-care/blog/quality-safety-%E2%80%99%E2%80%99-provides-process-review-correct-mistakes-optimal>

SRK Decision-Making Model



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³<http://dx.doi.org/10.3917/th.801.0007>

Sources of Errors

- Skills-based errors - 1:10000
- Rules-based errors - 1:100
- Knowledge-based errors - 1:2

└ Sources of Errors

- Skills-based errors - 1:10000
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- Knowledge-based errors - 1:2

- Skills-based - errors associated with distractions. Improve through deliberate practice - perfect practice makes perfect.
- Rules-based - errors associated with applying wrong rule. Improve through exposure to different situations with subtle differences to emphasize applicability of rules.
- Knowledge based - errors associated with lack of experience/knowledge. Improve by providing method/philosophy of approaching problems.