SW & Human Errors:
Its Applications & Implications

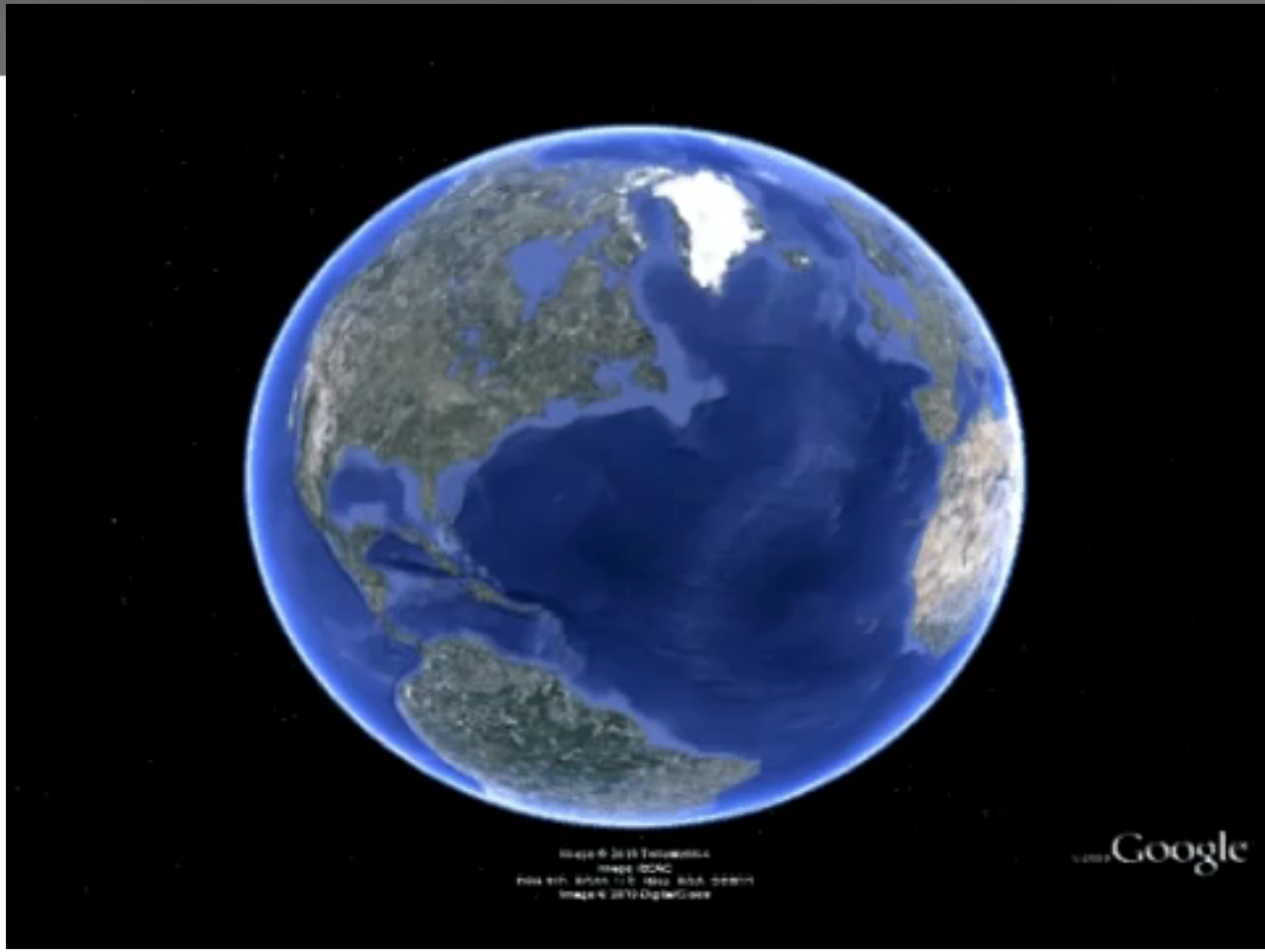
Prof. Hokyoung Ryu

- Arts & Technology

- Technology & Innovation Management

Hanyang Univ., Korea

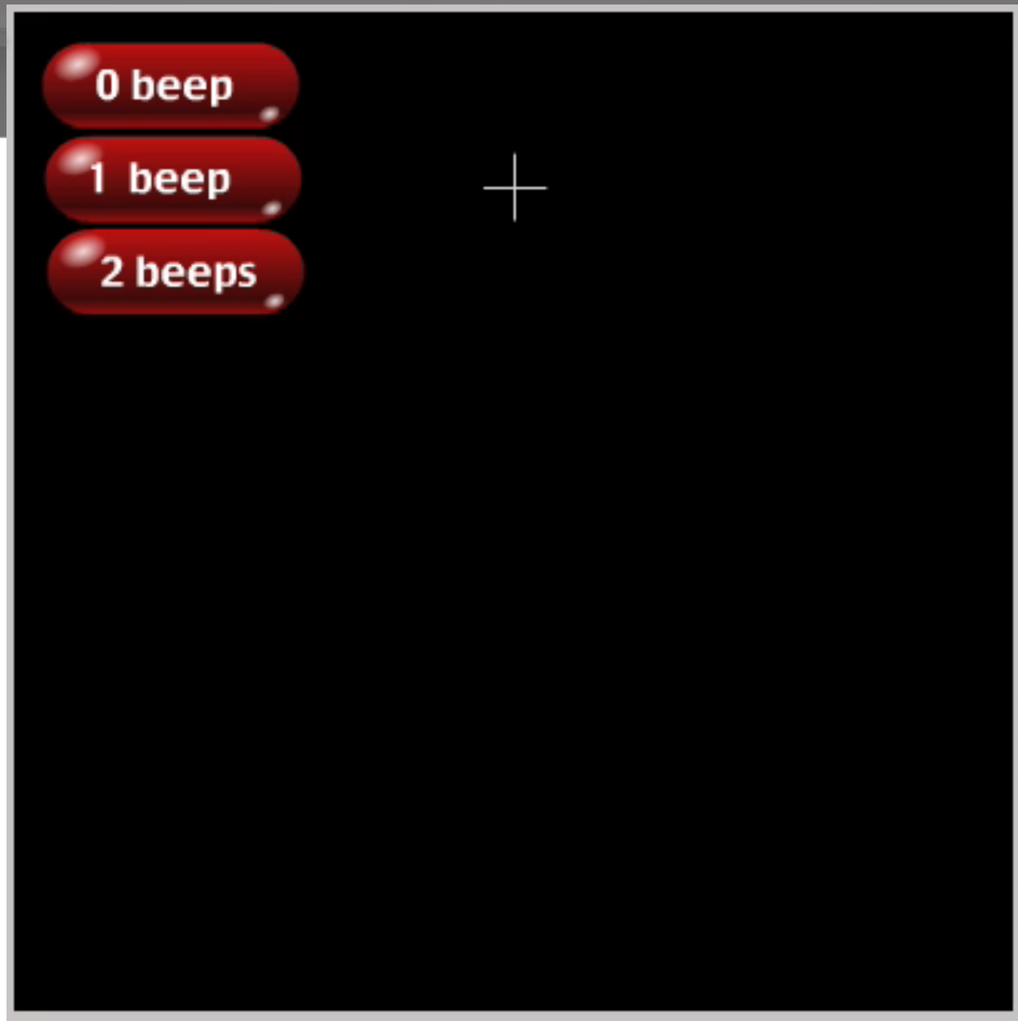
Tenerife disaster (1977)



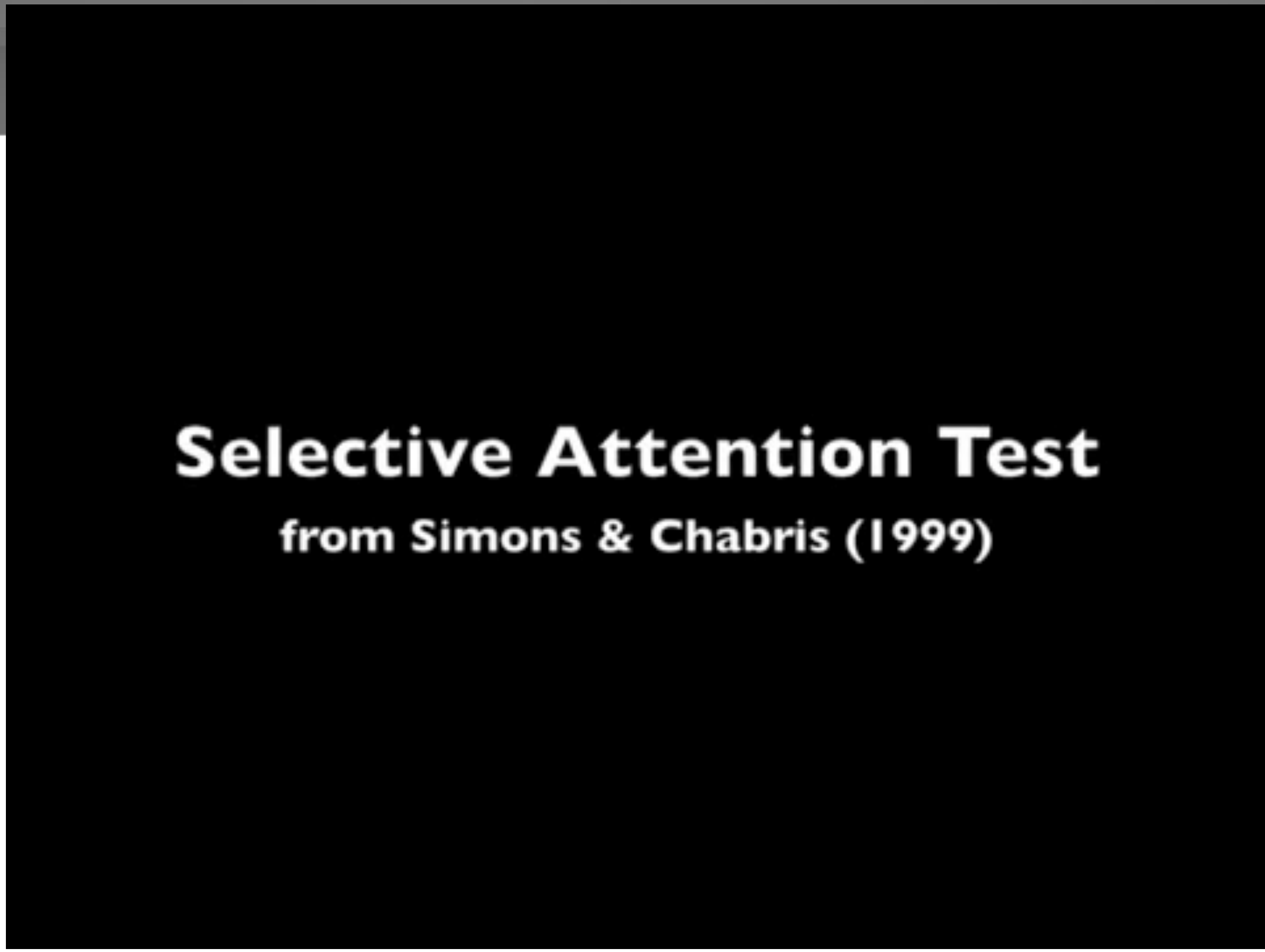
SW & Accidents

- SW failure directly leads to hazard
  - E.g., blackout
- Safing SW fails to work
  - E.g., Fires in tunnels or bridges
- Controlling/monitoring SW fails to detect failure
  - E.g., monitoring system for lifts, friendly fires or aeroplane disasters

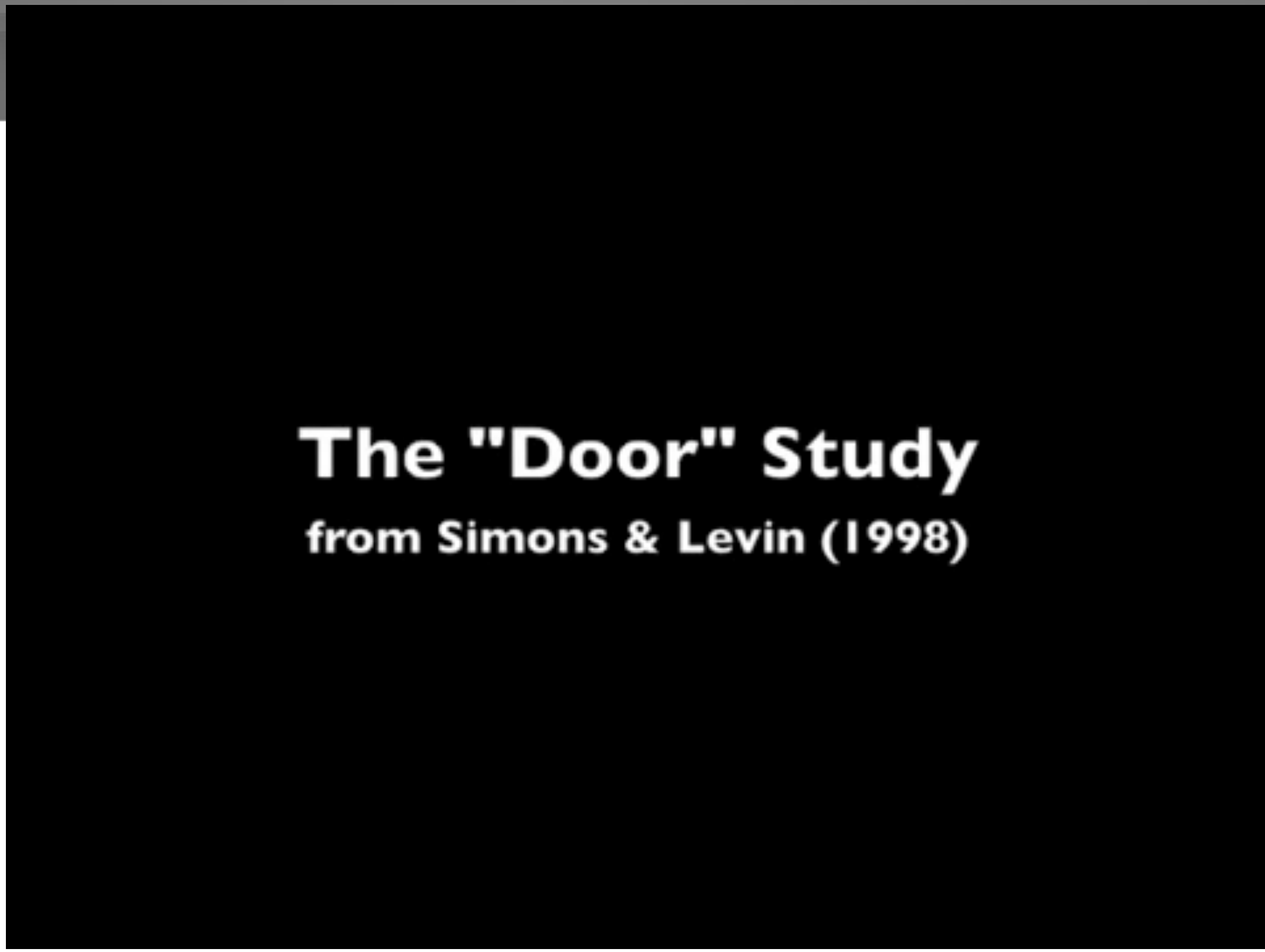
To Err is Human



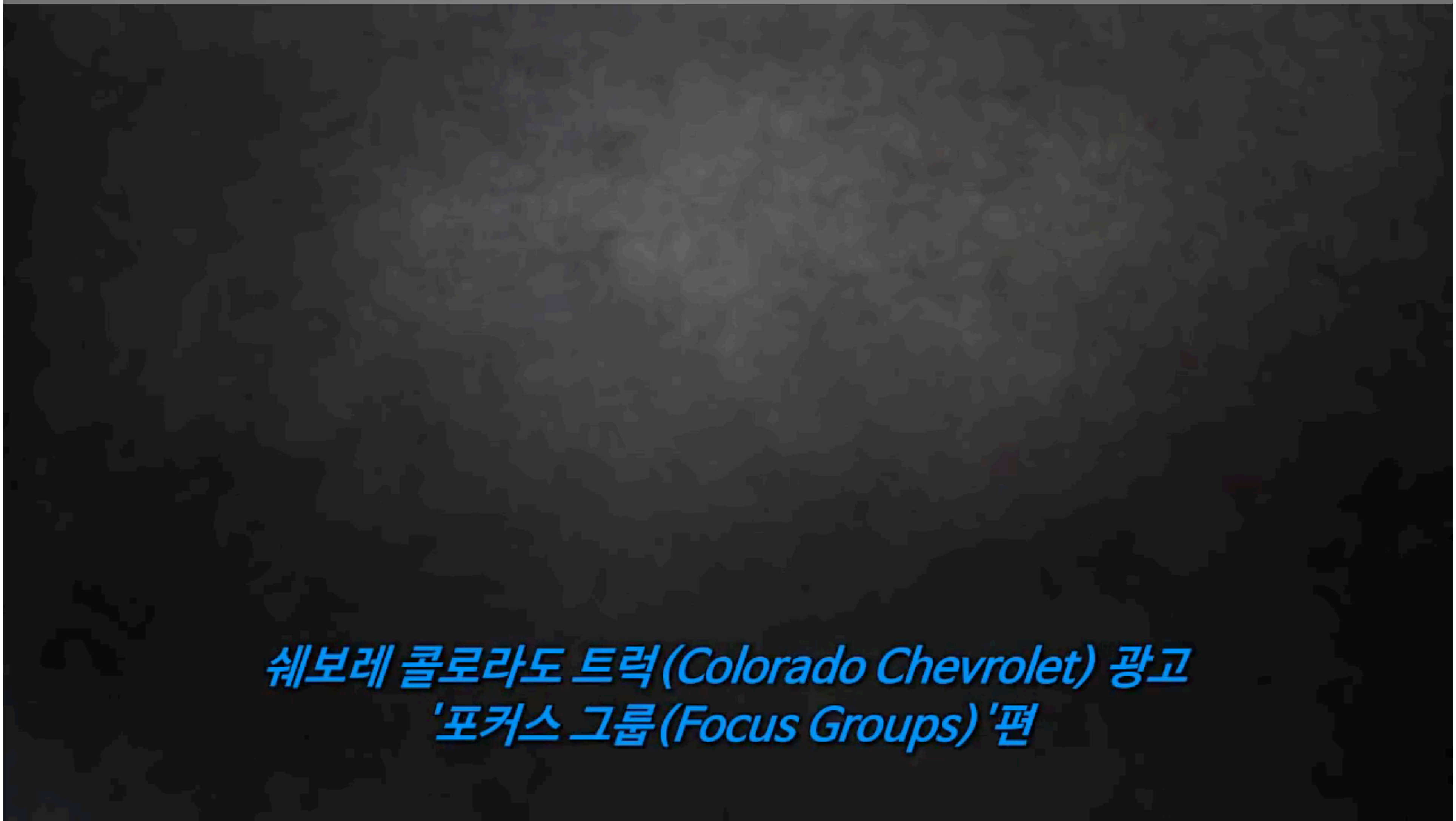
To Err is Human



To Err is Human



To Err is Human

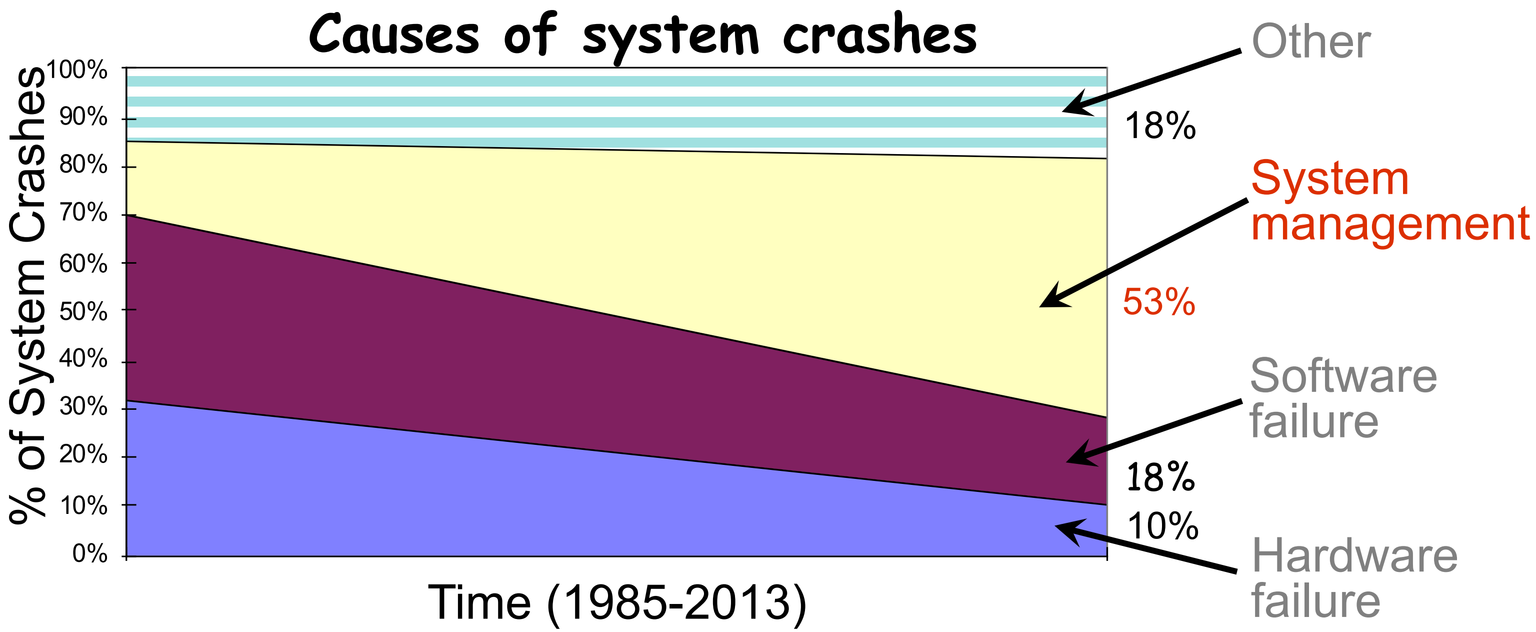


To Err is Human

- The importance of the human being in system dependability
  - human operator errors are the largest single source of failures in many systems
  - human errors are inevitable despite the best training
- we might capture human error behavior in dependability benchmarks
  - how we might build dependable systems that tolerate human error.

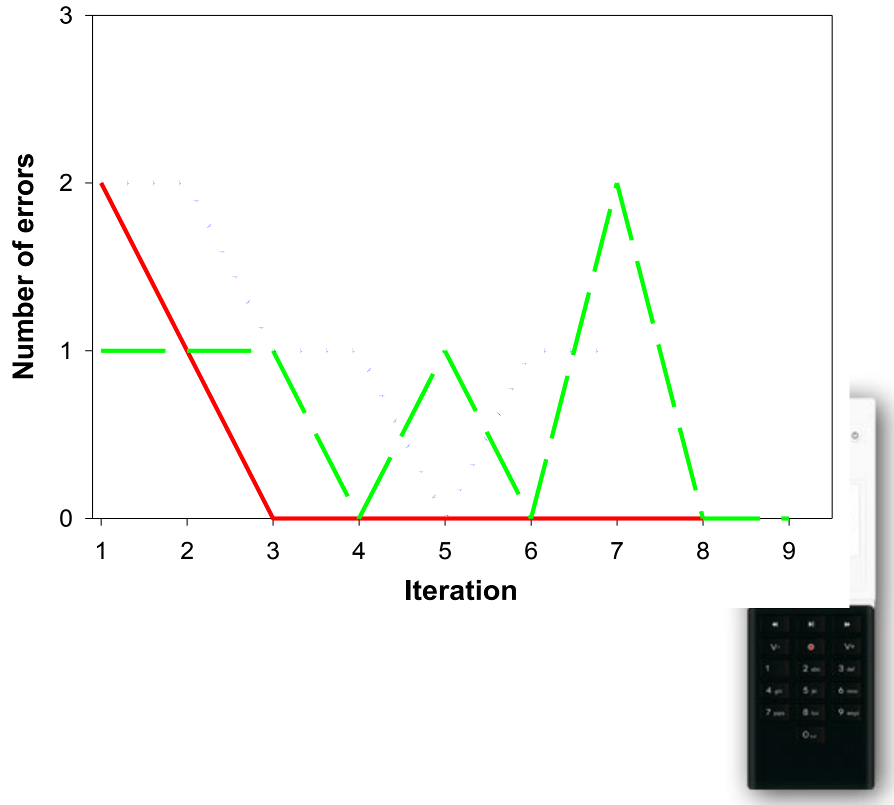
Humans cause failures

- Human error is the largest single failure source



Errors occur despite experience

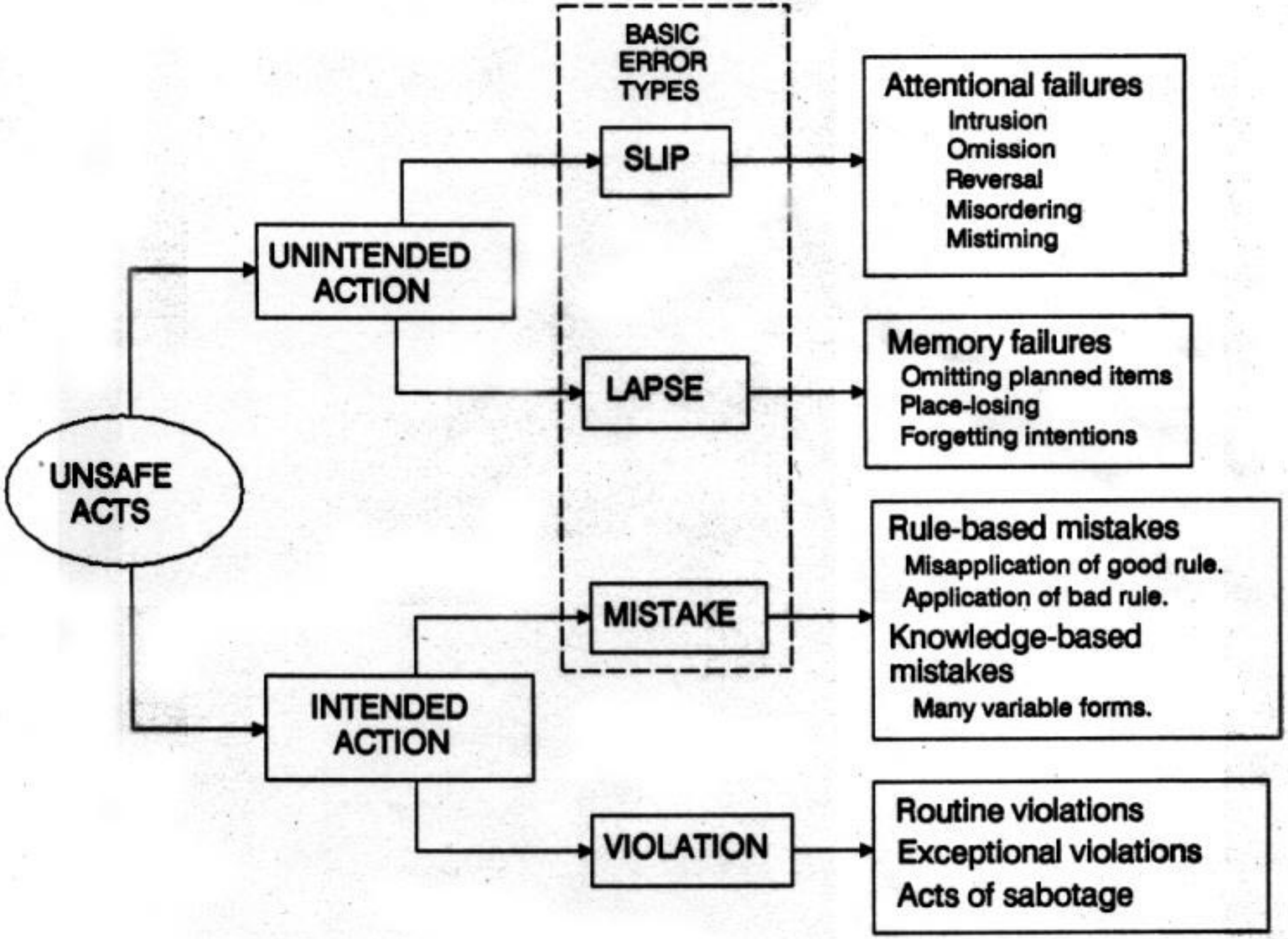
- Training and familiarity can't eliminate errors
  - Mistakes mostly in 1st iterations; rest are slips/mishaps
- System design affects error-susceptibility



•

•

•


UNSAFE ACTS
UNINTENDED ACTION
INTENDED ACTION
BASIC ERROR TYPES
SLIP
LAPSE
MISTAKE
VIOLATION
Attentional failures
Intrusion
Omission
Reversal
Misordering
Mistiming
Memory failures
Omitting planned items
Place-losing
Forgetting intentions
Rule-based mistakes
Misapplication of good rule.
Application of bad rule.
Knowledge-based mistakes
Many variable forms.
Routine violations
Exceptional violations
Acts of sabotage

What can we do?

- Human error is inevitable, so we can’t avoid it

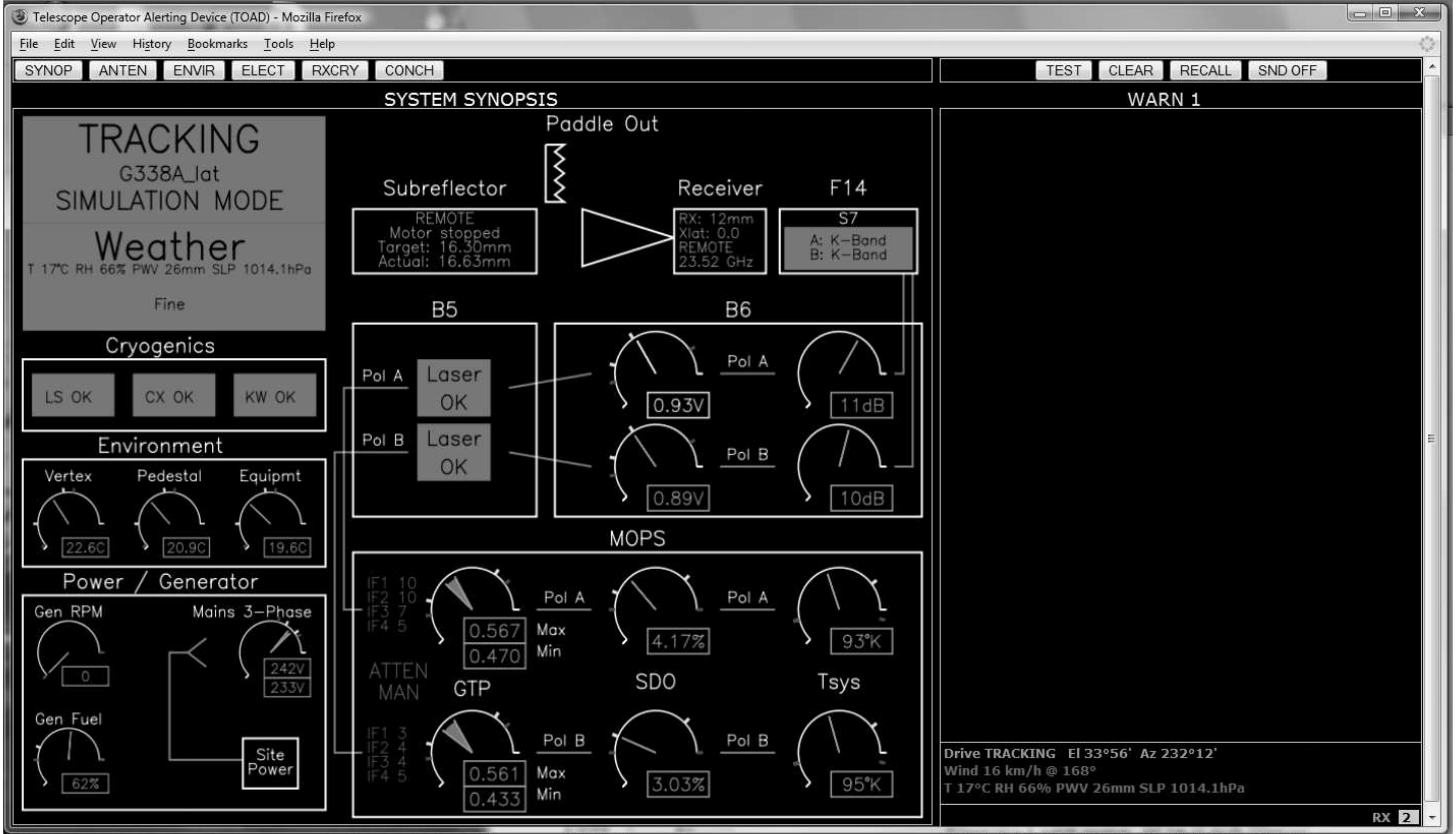
  If a problem has no solution, it may not be a problem, but a fact, not to be solved, but to be coped with over time” — Shimon Peres

- We must build dependable systems that can cope with human error
  - and even encourage it by supporting trial-and-error
  - Allow operators to learn from their mistakes
- Dependable human-operated systems
  - automation: reducing human involvement
    - SW: self-tuning, no-knobs, adaptive systems, ...
    - HW: auto-sparing, configuration, topology discovery, ...
    - but beware of automation bias!
  - training: increasing familiarity with system
    - training on realistic failure scenarios
  - *avoidance is only a partial solution*
    - some human involvement is unavoidable
    - any involvement provides opportunity for errors

The key to dependability?

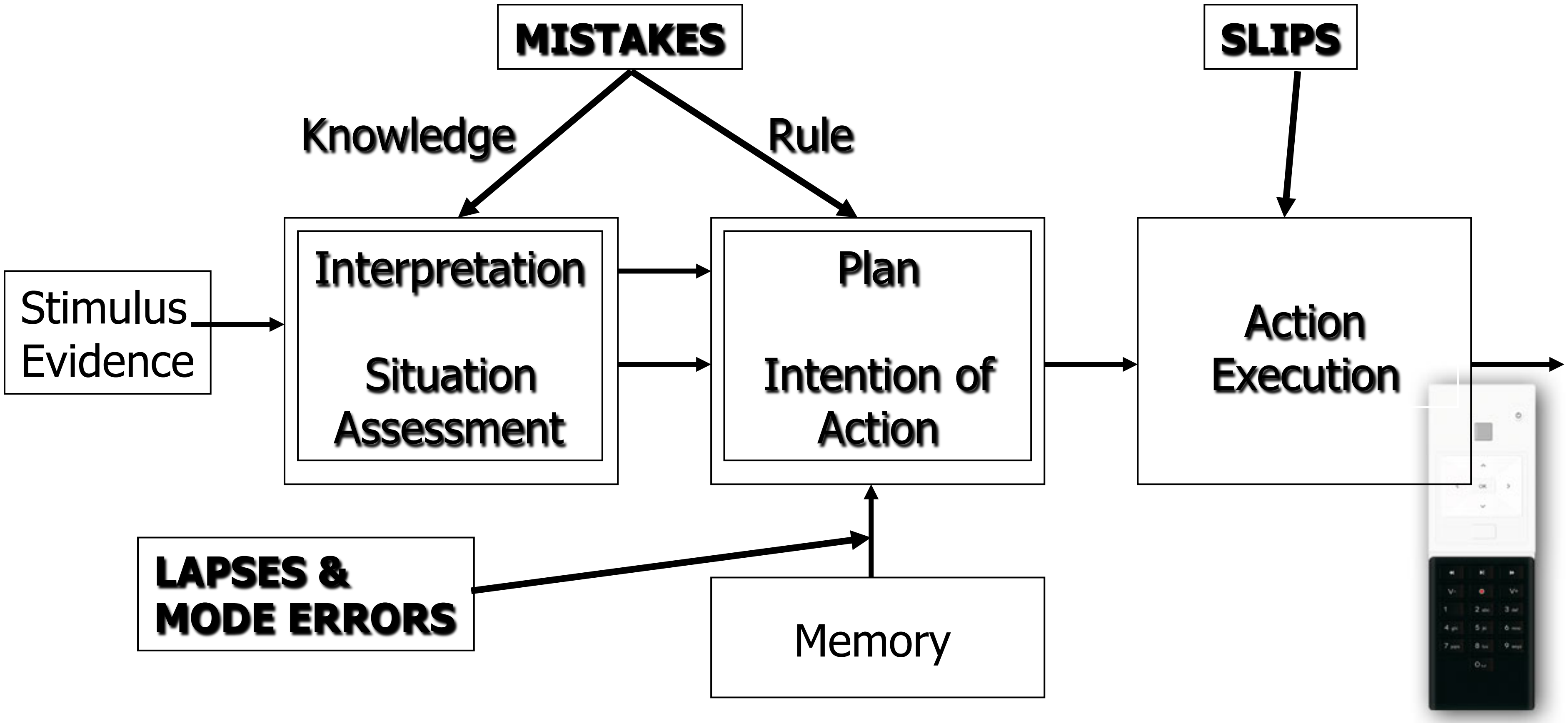
- Building tolerance for human error
  - accept inevitability of human involvement and error
    - focus on *recovery*
  - **undo:** the ultimate recovery mechanism?
    - ubiquitous and well-proven in productivity applications
    - familiar model for error recovery
    - enables trial-and-error interaction patterns
  - undo for system maintenance
    - “time-travel” for system state
    - must encompass all hard state, including hardware & network configuration
    - must be flexible, low-overhead, and transparent to end user of system

The key to dependability?



IMAGINE LAB
A&Tech ARTS & TECHNOLOGY

Conclusions



Conclusions

- Task Design – design tasks with working memory capacity in mind
- Equipment Design
  - Minimize perceptual confusions – ease of discrimination
    - E.g., airplane controls that feel like what they do (flaps, wheels)
  - Make consequences of action visible – immediate feedback
    - E.g., preview window in some software programs
  - Lockouts – design to prevent wrong actions
    - E.g., car that will not let you lock door from outside without key
  - Reminders – compensate for memory failures
    - E.g., ATM reminds you to take your card

Conclusions

- Training – provide opportunity for mistakes in training, so can learn from them
  - E.g., Simulation
- Assists and Rules – checklists to follow
  - E.g., Pilot pre-flight checklist
- Error-tolerant systems – system allows for error correction or takes over when operator makes serious error
  - E.g., Undo button

Q&A

- Hokyoung Blake Ryu
  - hryu@hanyang.ac.kr

  - artech.hanyang.ac.kr
  - hci.hanyang.ac.kr
  - Imagine.hanyang.ac.kr