Human Interaction with Automation

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What is Automation?

- Execution by a machine agent of a function that was previously carried out by a human
- Levels of automation
  - not all-or-none
  - combination of “intelligence” and autonomy
- Why Automate?
  - Technological feasibility and cost
Incidents and Accidents

- Wiener (1980): DC-9 crew taking off from Denver in 1977, trusted the tactile and auditory alerts warning that a stall was imminent despite information to the contrary and aborted the take off resulting in injuries to passengers and severe damage to the aircraft.
  - pilots using FMS were unable to maintain awareness of which mode the aircraft was in.
Definitions

- Misuse = overreliance
- Disuse = underreliance
- Abuse = inappropriate application of automation
• Attitudes towards automation
  – perceived reliability
  \[\text{BUT}\]
  – individual differences

• Mental Workload
  – hypothesis that automation will reduce workload, and that operators will rely more on automation when workload is high
  – Little supporting evidence, rather individual differences
Automation Use (2 of 2)

- Cognitive Overhead: Decision to use the automation
- Trust
  - reliability
  - trust in a machine = trust between humans
    - Muir (1988)
- Confidence
- Riley’s model of automation
  - Figure 1
Automation Misuse (1 of 3)

- Excessive Trust/Overreliance
  - pilots’ reluctance to override automation
    - Riley (1994b)
- Decision Biases
  - representativeness heuristic
  - leads to errors of omission and comission
Monitoring Errors

- Mosier and Skitka (1996): once crew members entrusted task to automation, they assumed - and trusted - the system to perform the task correctly
- dual task performance
- automation reliability inversely related to detection rate
- automated monitoring: problem of infinite regression
- Improve detection through:
  - “direct” perception
  - adaptive automation
Automation Misuse (3 of 3)

• Consequences of Overtrust
  – “premature cognitive commitment”
  – loss of skill
  – reduced situation awareness
High rate of false alarms leads to undertrust

- Decision criterion
  - cost of missed signal vs. false alarm
  - instead of signaling all or none, signal possibility of an event, e.g., likelihood alarm

- Base rate
  - operators slower to respond when base rate is low
Automation Abuse

• Implementation of automation without regard for consequences of human performance
• Cannot remove human error by removing the operator
• Management practices and policies prevent human operators from using automation effectively
• Technology-centered approach reduces operator role
• Need for feedback increases as automation is given more authority
Influences on Use of Automation

- Expectations
- Individual differences