

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
- Sarter and Woods (1994): Mode errors
 - 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

Automation Use (1 of 2)

- Attitudes towards automation
 - perceived reliability
 - 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 commission
 - “cognitive laziness”, Mosier, et al. (1996)

Automation Misuse (2 of 3)

- 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

Automation Disuse

- 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