U.S. AIR FORCE

Human Factors of UAVs Workshop

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U.S. Military UAV Mishaps: Assessment of the Role of Human Factors Using HFACS

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Team Aerospace Begins Here!

UAV Reliability Study, 2003

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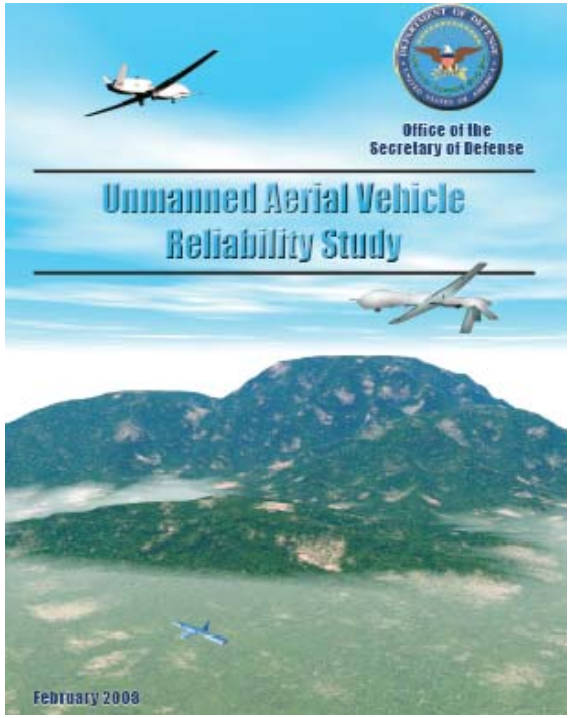
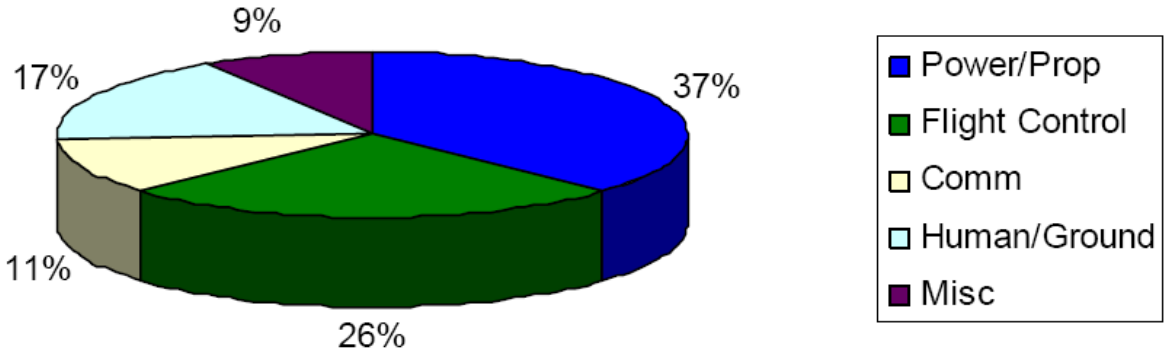


Mishaps per 100,000 flight hours

UAV mishaps	Aircraft mishaps
Predator – 32	F-16 - 3
Pioneer - 334	General aviation - 1
Hunter - 55	Large airliners – 0.01



Literature Review

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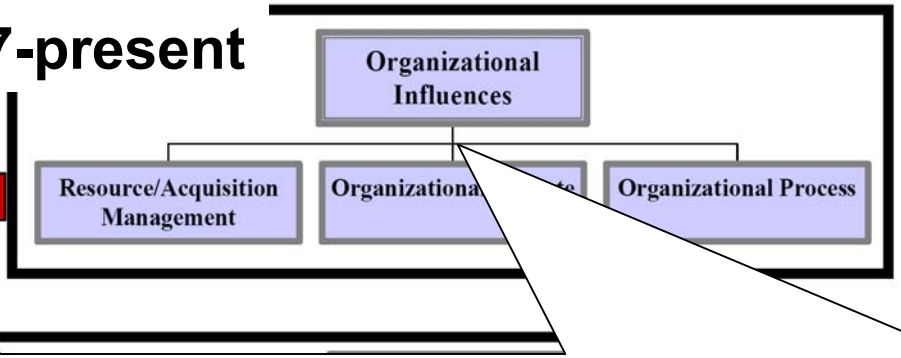
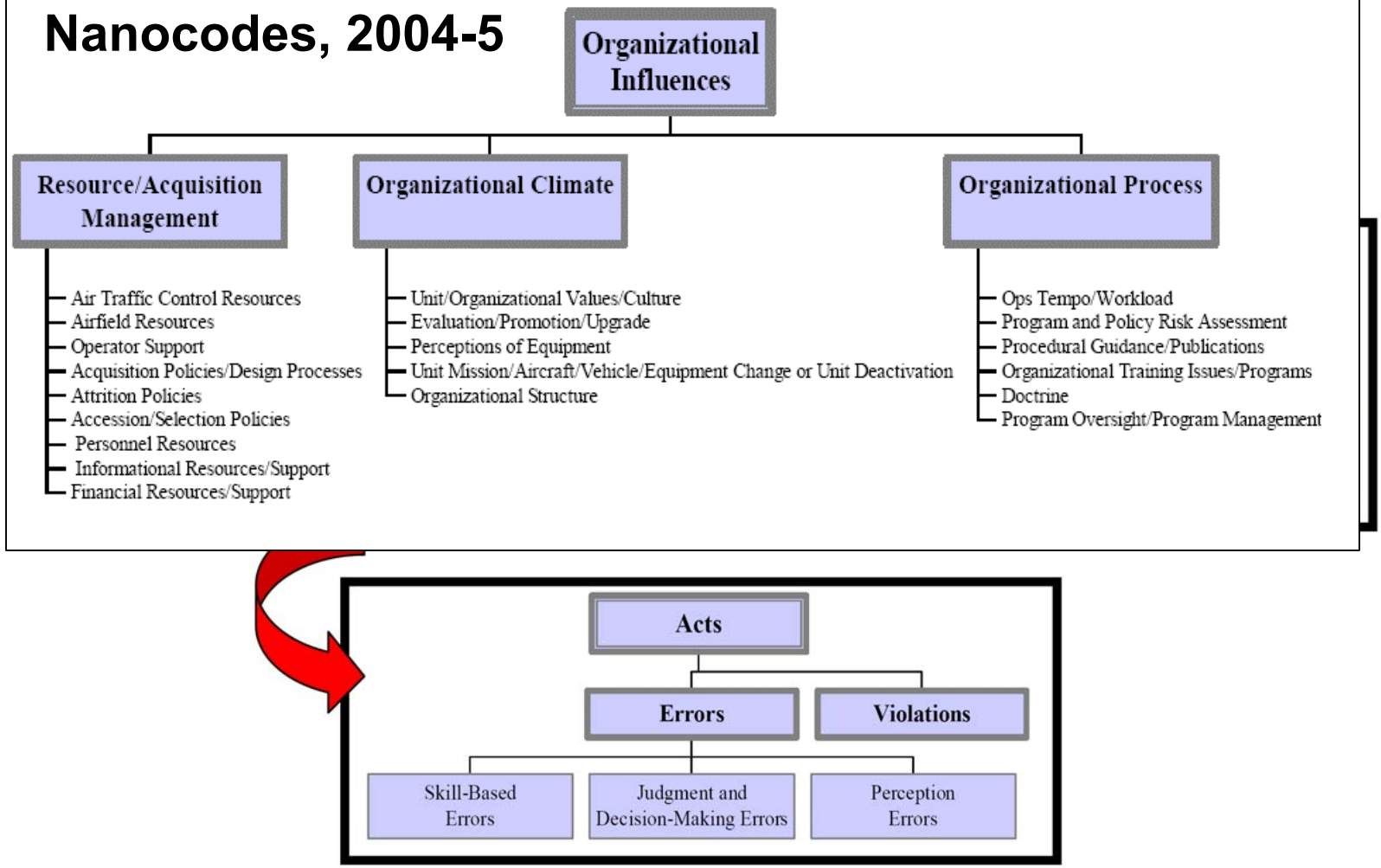
Study	Service	Human factors	Taxonomy
Schmidt & Parker, 1995	Navy	>50% (est)	None
Seagle, 1997	Navy	43%	Taxonomy of Unsafe Acts
Ferguson, 1999	Navy	59%	Taxonomy of Unsafe Acts
Manning et al., 2004	Army	32%	HFACS
Rogers et al., 2004	Air Force Army	69%	Human Systems Issues

HFACS, 1997-present



Nanocodes, 2004-5



Study Objectives

- **Primary objective**
  - **Role of human factors in UAV mishaps within the U.S. military services**

- **Secondary objective**
  - **Utilize standardized human factors taxonomy**
  - **Hierarchical analysis of human error**

Methods

- 10-yr cross-sectional quantitative analysis
- Class A/B/C UAV mishaps FY 94-03
  - Unmanned target drone aircraft excluded
- Mishap reports reviewed, coded using HFACS
- Service-specific binary regression models
  - Dependent variable = acts
  - Independent variables
    - Organizational influences (3 categories)
    - Unsafe supervision (4 categories)
    - Unsafe preconditions (9 categories)

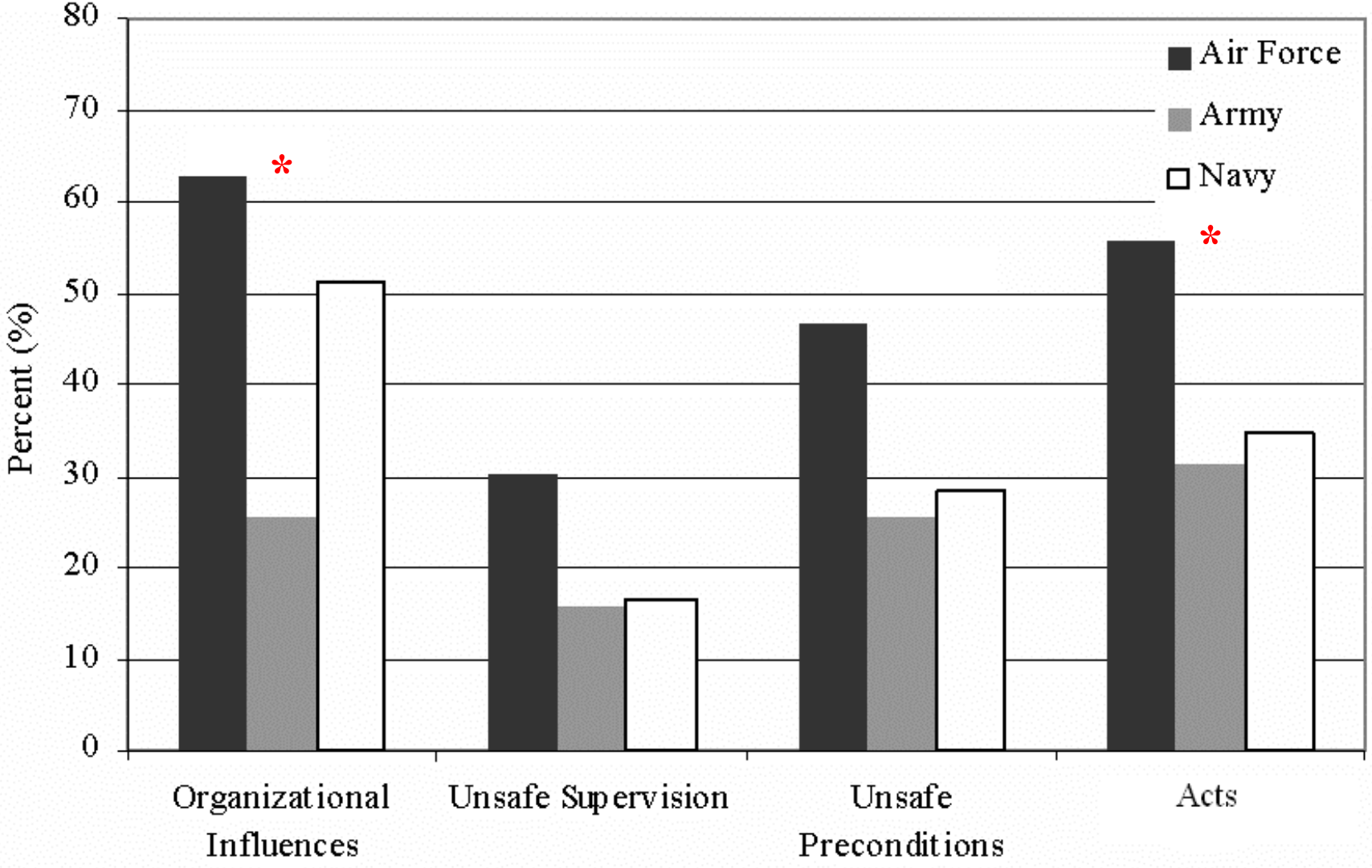
Results

- **Frequency of human factor mishaps**

DoD aggregate	Service-specific
60.2%	Air Force – 79.1%
	Army – 39.2%
	Navy/Marines – 62.2%

$P < 0.001$

Results



***statistically significant ($P < 0.050$)**

Organizational Influences

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- **Organizational influences → bimodal outcome**

Organizational influences categories	Mechanical OR (95% CI)	Unsafe Acts OR (95% CI)
Resources/Acquisition management	3.2 (1.5-6.6)	0.2 (0.1-0.4)
Organizational processes	0.3 (0.1-0.6)	4.3 (1.9-9.7)

Service Regression Models

- Air Force ($P < 0.001$)

Model variables	Associated nanocodes	Frequency
Technological environment		47.1%
	Automation	29.4%
	Instrumentation/Sensory feedback systems	26.5%
Cognitive factors		26.5%
	Channelized attention	14.7%

Service Regression Models

- Army ($P < 0.010$)

Model variables	Associated nanocodes	Frequency
Organizational processes		45.0%
	Procedural guidance/Publications	30.0%
	Organizational training issues/Programs	20.0%
Psycho-behavioral factors		30.0%
	Overconfidence	25.0%
Crew resource management		35.0%
	Crew coordination	20.0%
	Communication	10.0%

Service Regression Models

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- Navy/Marines ($P < 0.025$)

Model variables	Associated nanocodes	Frequency
Organizational processes		34.2%
	Procedural guidance/Publications	25.3%
Inadequate supervision		24.1%
	Supervision - policy	11.4%
Planned inappropriate ops	--	11.4%
Physical environment	--	10.1%
Technological environment	--	10.1%
Cognitive factors	--	19.0%
Psycho-behavioral factors		13.9%
	Complacency	11.4%

Service Regression Models

- **Navy/Marines factor analysis**

Model variables	Factors
Organizational processes Technological environment Cognitive factors Psycho-behavioral factors	Work and attention
Inadequate supervision Planned inappropriate operations Physical environment	Risk management

Acts

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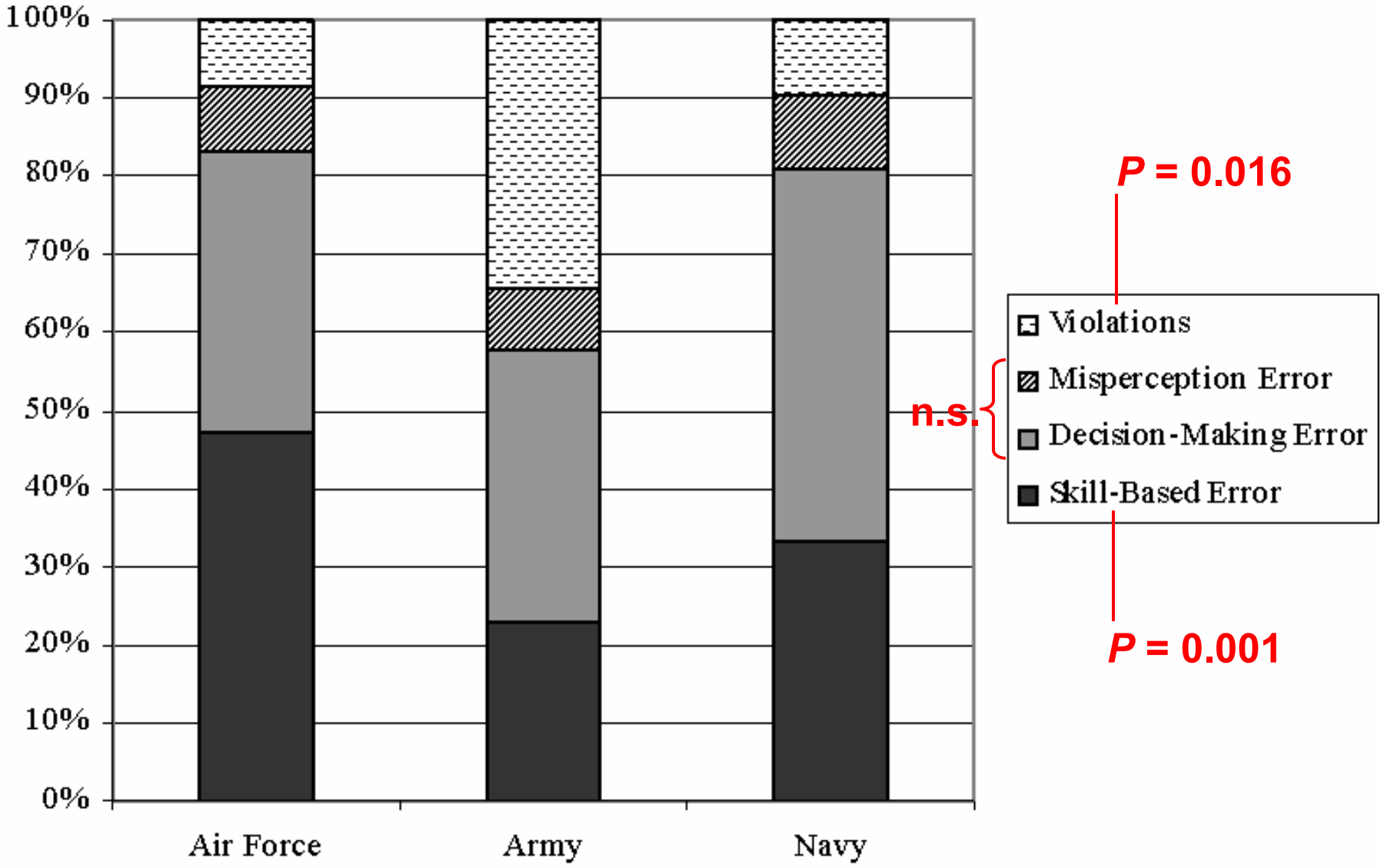

Conclusions

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- **Role of human factors in UAV mishaps within the U.S. military services**

60.2% of UAV mishaps

Pattern of latent and active failures differed between services

Organizational latent failures contributed most to UAV mishaps

- **electromechanical failures**
- **acts**

Questions

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