An investigation of the safety attitudes of designers in the Safety-Critical Industries

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Background

- High hazard industries – nuclear, offshore, industrial construction
- Design phase highly regulated
  - Internal, external and regulator checks
- Up to 90% of human errors might be attributable to design decisions
- Role of designer largely neglected compared to front-line operators

Designers and Risk

- Designers rarely have first hand knowledge of operations
- Often located distally from fabrication and operation
- Do not personally bear risks themselves
- Latent risk in design
  - Not detected by internal and external checking procedures
  - May not reflect design intention – assumptions concerning operations, operator behaviour, environmental conditions
  - Might reflect unintentional errors by designer

- Unintentional cognitive error and intentional use of potentially risky design protocols

Possible Influences

- Job characteristics
- Safety climate – perceived and aggregate
- Personality
  - Extraversion X
  - Emotional stability ✓
  - Conscientiousness ✓
  - Agreeableness ?(✓)
  - Openness ?(X)

Methods(I)

- Background questionnaire for stable factors

- PDAs four times per day for up to four weeks (roughly three-four weeks apart)
  - Hourly measures to increase accuracy

Compliance rate > 25% included

- >165 participants
- > 40 design teams across engineering disciplines
- 6515 observations (μ compliance = 62%)

Methods(II)

- Questionnaire
  - Goldberg Big 5
  - Designer safety climate
  - Autonomy, support, demands, clarity, perceived risk in work
- PDAs
  - Hourly unintentional cognitive errors (e.g. recall) – 3 items
  - Hourly use of risky design protocols (e.g. make assumptions about operator behaviour) – 4 items (items 0,1 coded)
- Analysis using HLM-3
  - Control for compliance rate, sector, day of week, time of day, wave of study
  - Perceived and design team aggregate of safety climate
  - All tests one-tailed (unless otherwise stated)

Cognitive Error (fixed effects portion)

	B	p
Team safety climate	.16	
Job autonomy	-.01	
Workplace social support	-.09	
Job demands	.02	
Role clarity	.03	
Perceived risk	.04	
Perceived safety climate	-.13	<.05
Extraversion	.08	<.05
Emotional stability	-.09	<.05
Conscientiousness	-.13	<.05
Agreeableness	.06	
Openness	-.07	

Risky design protocols (fixed effects portion – Poisson regression)

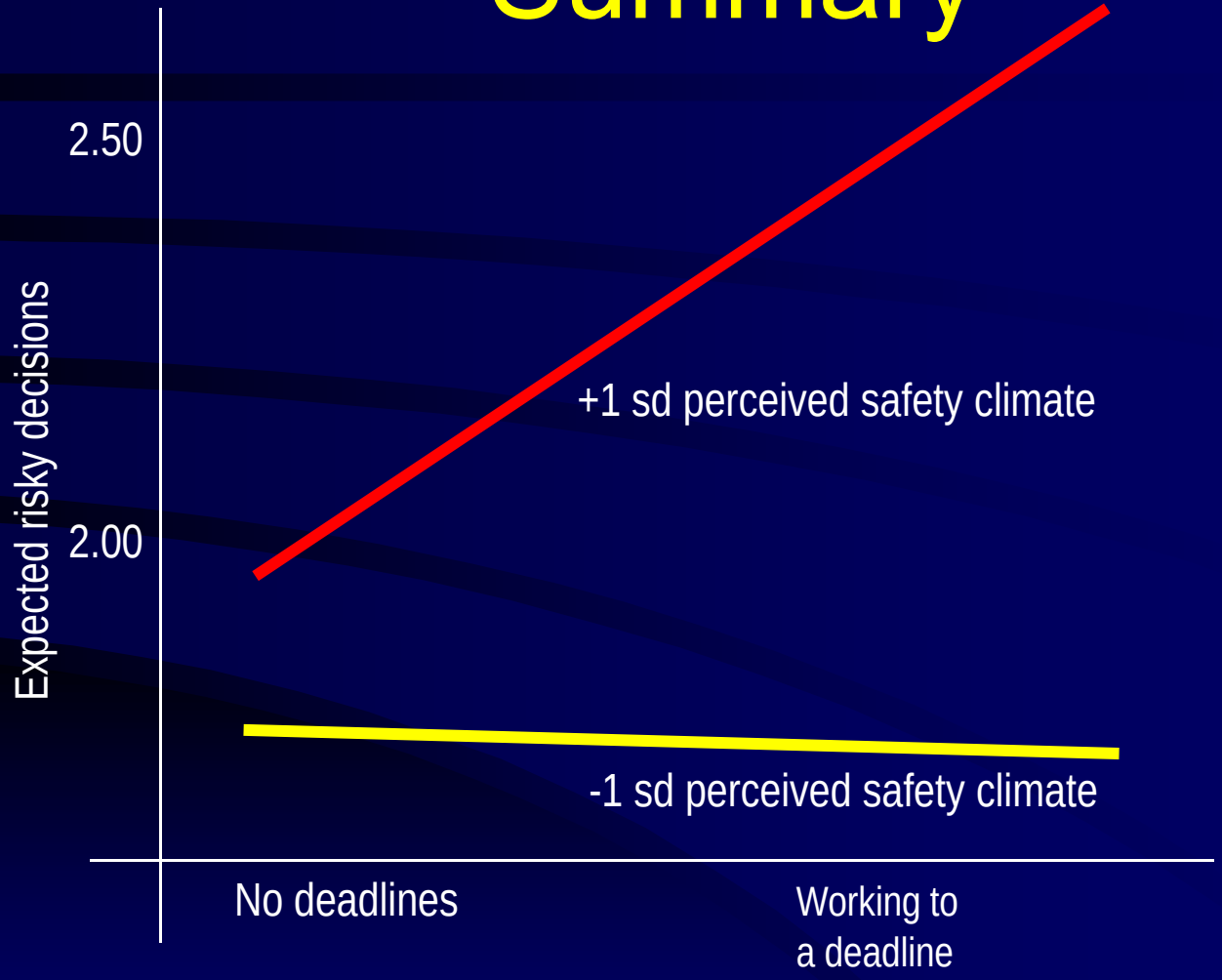
	B	p
Team safety climate	-.27	<.10
Job autonomy	-.31	<.005
Workplace social support	.02	
Job demands	.22	<.05
Role clarity	-.02	
Perceived risk	.03	
Perceived safety climate	.28	<.05*
Extraversion	-.05	
Emotional stability	.04	
Conscientiousness	.02	
Agreeableness	.08	
Openness	.04	

* two-tailed test

Summary

- Personality predicts unintentional cognitive error
  - Extraversion, emotional stability and conscientiousness
- Job characteristics predict intentional use of risky decisions
  - Job autonomy, job demands
- Contrast effects for perceived safety climate?
  - Good for unintentional error but is there a social loafing effect?

Summary


2.50
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Expected risky decisions
+1 sd perceived safety climate
-1 sd perceived safety climate
No deadlines
Working to
a deadline

Implications

- Job redesign with transient workers and demands to produce designs
- Safety climate, loafing and flexible organisations
- Results suggest importance of job and cognitive processes (climate and personality)

Current work

Loughborough University

Designing for innovation and safety: how can designers do both?

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