ASQ Reliability Division Webinar
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Catalysts for Human Error in Complex System Design: Glitches and Representations in Thought and Action

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Why Explore Human Error

Understanding internal mental states and processes of human beings has become a vital concern as a consequence of complex systems design in the 21st century.

Research and Practice Motivation

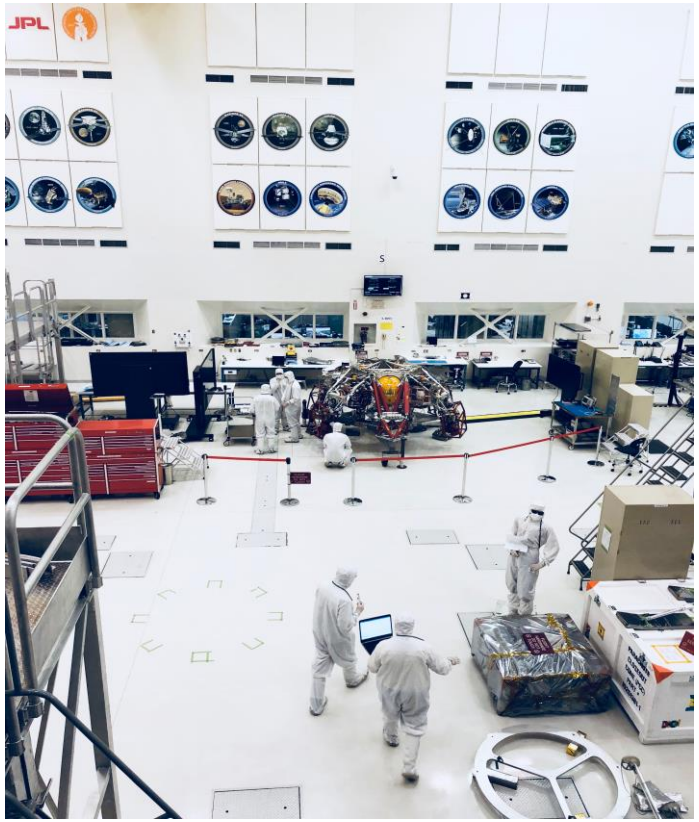
Curiosity for how the world works, physical and non-physical, integrated with research and practice.

Statistics on Human Performance Errors

70% to 90%

across a variety of domains

Consequences of Complexity Systems Design



Practitioners who engage with complex systems experience:

Task Complexity ⇒ Opportunities for Human Error ⇒ Malfunctions ⇒ Unintended Consequences ⇒ Whole System Malfunctions ⇒ Catastrophic Events

Goals for Complex Systems Design

Complexities of Human Error

Internal Thinking Processes

- *underlying structures* (example: forces likely to influence human error)
    - ways organizations get things done - vision/strategy/goals vs.
    - ways organizations really get things done - structures/beliefs/shared assumptions/stories/feelings/emotions/ unwritten rule book
- human *actions and events* and *anticipation and future responses* are interdependent

Interrelationship Factors

- *procedural knowledge* (knowing how) and *declarative knowledge* (knowing that)
- *context is often overlooked* but matters greatly in understanding human error
- *control is fundamental* to either the system or to the practitioner

Glitches and Representations
Goals and Purpose of Human Thought and Action

Glitches

Bias in systemic patterns of thinking:

- Involves preferences and beliefs
- Consciousness for consideration of contradicting information is void

Representations

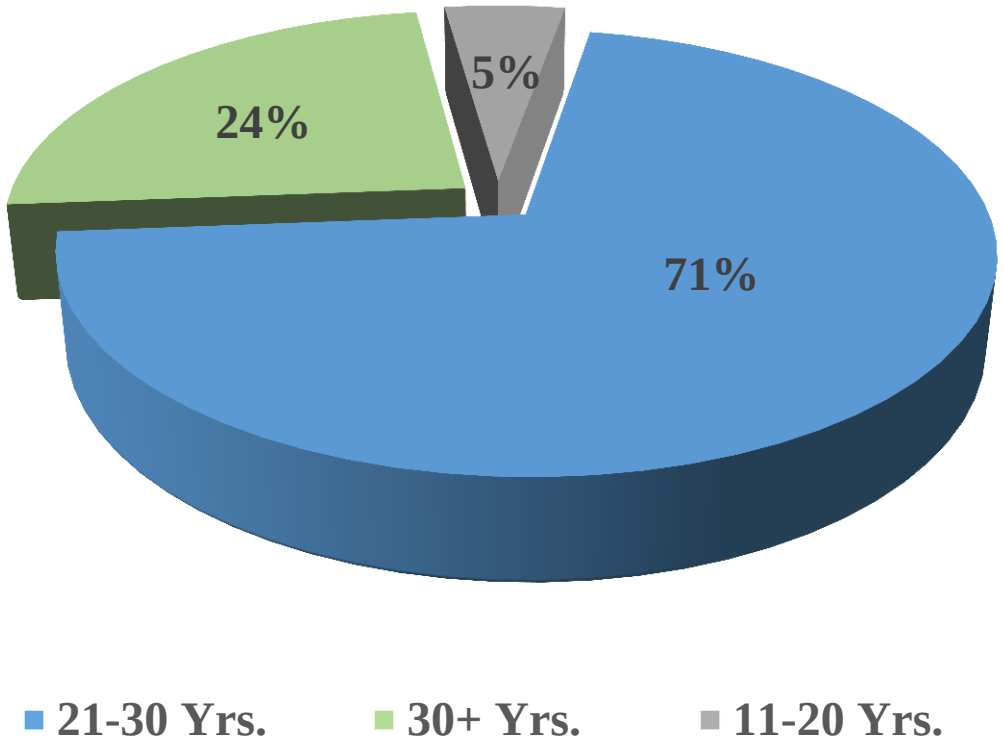
Informs and facilitate thinking:

- Underlying structures in the mind
- Underpins preferences, actions, behaviors
- Inform ways human beings act on their environment (i.e. an inviting space with privacy can encourage purposeful dialogue among teams)

Thought and Action in Human Errors

Frames	Familiarity	Flexibility
• Complete thought worlds	• Expertise and experience	• Switching between concepts, images, feelings, emotions
• Involves assumptions	• Fixed order	• Multiple responses to a problem
• Pre-structured problem solutions	• Perception	• Generation of new ideas

Dissertation Research: Seventeen (17) STEM Career Professionals Practitioner Years of Experience



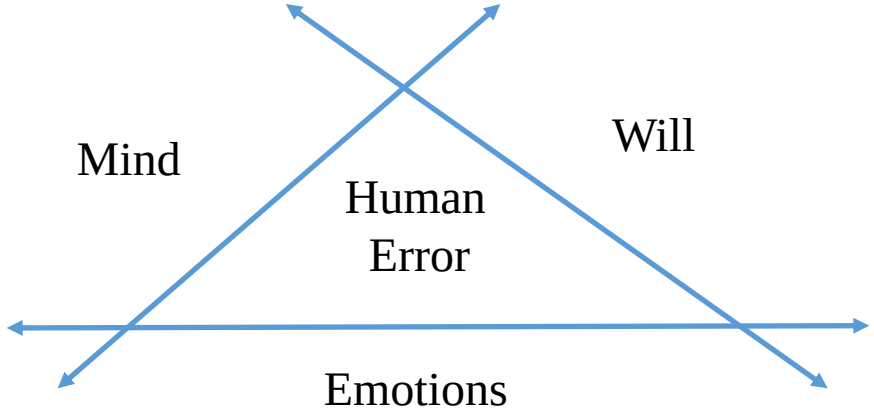
Dissertation Research: Industry & Practice

Industry	Practice
• Aerospace	Engineers: Quality Assurance, Aviation, Mechanical, Electrical
	Information Technology and Information Systems
	Project Management
• Computing Consulting	Enterprise Software Management, Project Management
• Healthcare	Nursing Director, Software Engineering & Operations, Rehabilitation
• Software	Vice President - Design

Dissertation Research: Key Findings

Patterns derived from themes	Patterns of human emotions derived from themes
Reflection	Feelings of anxiety
Intuition	Anxiety of Learning
Over estimation of performance	Positive anxiety of learning
Underestimation of performance	Emancipation of thinking
Forethought	Feelings of uncertainty
Introspection	Emotionally weighted thinking
Organized methods of thinking	What-if worry
Association to prior knowledge	Wishful thinking
Divergent thinking	Cognitive distortions

Research Findings: What Does This Mean for Human Errors in Complex Systems Design



- The complexity of human error seemly intersects with the mind, will, and emotions of human beings.
- Fuzzy and powerful forces suggests a high probability of influence on human thought and action in unpredictable and uncontrollable ways.

Research Findings: Relevance in Complex Systems Design for Human Error

Significance

How human beings:

- adapt to their environments
- apply previous experience (ambiguous)
- act on underlying structures (influences) for thoughts and actions

Application

Specific purposes:

- design
- analysis
- evaluation
- interpretation

Implications for Complex Systems Design

Embrace a holistic (internal and external) view –

- Human beings and their environments cannot be separated when seeking viable solution
- Harness complexity and ambiguity as tools to explore and recognize human errors – discover underlying simplicity that inform and facilitate thinking

Recap - Glitches and Representations in Thought and Action

Task complexity can lead to catastrophic events

Puzzle metaphor - predict, prevent, analyze, and interpret for human error

Internal process and interrelationship factors are critical

Glitches *bias in systemic patterns of thinking*
Representation *informs and facilitate thinking*

THANK YOU!

Q & A

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Professional Biography
Audrey M. Murphy, Ph.D. Candidate

Audrey M. Murphy is an innovator in the adult learning experience within the context of organizational life. As a STEM professional, she has 22+ combined years of work experience in the aerospace and technology industry at NASA-Jet Propulsion Laboratory (JPL) and the California Institute of Technology (Caltech). In her role as an information systems practitioner at JPL and Caltech, Audrey championed the paradigm shift of knowing information to novel thinking strategies for learning and problem solving. Her contributions earned a reputation for promoting unconventional ways of learning that facilitated fresh ways of thinking and learning for technical and non-technical staff members. Audrey is also an allied professional to local and global organizations as a webinar presenter, conference presenter and virtual conference call participant in the following organizations: In2:InThinking Network, American Society for Quality – Reliability & Risk Division, The Society of Hispanic Professional Engineers, Project Management Institute, Western Academy of Management, and Grant McEwan University School of Business.

Grounded in a scholar-practitioner model, Audrey has published peer reviewed papers at the national and international level. She also received a nomination from the Western Academy of Management for Best Ph.D. Student Paper Award for her research in Metacognition in Organizational Life. To broaden the scope of her professional practice, Audrey is a candidate for the Doctor of Philosophy Degree in Cognitive Psychology for Social Systems Sustainability with a specialization in Metacognition from the Fielding Graduate University, Santa Barbara, CA. Audrey also holds a Bachelor's of Science Degree in Business Administration and a Master's Degree in Information Systems and Information and Communication Technology from the University of LaVerne, LaVerne, CA.

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