Managing chemical safety as a social construct: A paradigm shift in chemistry

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Paradigms

• In 1962, Thomas Kuhn put forth the idea that subject knowledge (especially in the sciences) moves forward at a steady rate based on what is accepted in the scientific community until enough evidence accumulates which cannot be supported by current theory and a “crisis” results in a paradigm shift.
Paradigms

• Transferring chemical safety information as rules and skills applies only to specific situations

• If workers are unable to see past these rules or no rules seem to apply to the current work, they are ill equipped to make appropriate decisions or

• They may not perceive the crisis (they don’t know what they don’t know)
Paradigms

• High-profile events which have occurred in academic research labs over the past decade may act as indicators of a type of “crisis” pressuring the current paradigm of safety to shift (i.e., failures of the “old paradigm”).

• Consider:
  – The deaths of Sheri Sangji at UCLA (2008) and Michele Dufault at Yale (2011)
  – The incidents with severe injury which occurred at Texas Tech (2010) and UH (2016)
The Social Construct
## Schools of Thought and Practice in Safety

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<td>Key Question</td>
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<td>What is the mechanics of safety?</td>
<td>How can people be controlled?</td>
<td>How many injuries would you like today?</td>
<td>How does organisation affect safety?</td>
<td>How does the organisation affect safety?</td>
<td>How can people minimise human error?</td>
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<td>Engineering, regulation</td>
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<td>Reforming organisations</td>
<td>Understand human error and systems</td>
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Long, R. “Transdisciplinary Thinking in Risk and Safety”
Of the systems characterized by Long, social psychological safety, (far right) focuses on safety culture as a social construct fostering the social arrangements and interpersonal relationships needed to facilitate better decision making.
What is a Social Construct?

• A social construct is defined as “an idea that has been created and accepted by the people in a society”.
• Social constructs develop as a means for humans to organize their interactions.
• Ideas are construct objects (knowledge) and culture is the way of life shared by a group of people (society).
Time is a Social Construct
For research safety to operate effectively as a social construct within the campus community, an individual’s concept of “safety” as a construct object must fit into the communal model.

Likewise, to shift culture, the society must value the change.

Because campuses are communities of diverse (and often compartmentalized) activities, creating a common structure for research safety is as important as it is complex.
Strategies to Develop to Shift the Paradigm

• Establish a Common Understanding of “Safety”
• Create Teams
• Educate the Next Generation in the New Paradigm
Define Safety
Safety Complexity on Campuses

• Many aspects of safety – personal, public, and research environments

• Numerous stakeholders – administrators, faculty, staff, graduate and undergraduate student workers must be considered as well as non-paid undergraduate students or interns working in research labs

• Faculty operate in communities of work (legal compliance and educational contract) and communities of practice (responsible conduct to academic freedom and scientific integrity)
Can You Define Safety?

• The International Labor Organization (ILO) defines occupational safety as...

• “...the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment.”
Shift the Paradigm – Common language

• Refining a broad definition such as the one used by the ILO to meet institutional needs will
  – (1) elevate safety to discipline status;
  – (2) focus consideration of the health and well-being of people and the environment into decision making for the community; and
  – (3) clearly indicate that using risk assessment to understand hazards is at the heart of safety science
Create Teams
Focus Question in Social Psychological Safety

“How do social arrangements affect decision making?”

Long, R. “Transdisciplinary Thinking in Risk and Safety”

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Input is Valued

• Environments where those in leadership value input from the “team” creates a culture where all group members feel comfortable contributing to safe work outcomes

• This approach has been used successfully in healthcare and aviation safety
Shift the Paradigm - Using A Team Approach

- Offers better management of the inherent risks present in novel research
- Can reduce incidents from human error
- Enables proactively implementing controls as part of the scientific method, thus reducing the perception of safety as a impediment to research
Addressing Safety Proactively

- Was recognized in 2007 by NIOSH and stakeholders in the “Prevention through Design” or PtD initiative.
- PtD is based on the principle that, “Anticipating and designing out hazards in tools, equipment, processes, materials, structures, and the organization of work is the most effective way to prevent occupational injuries, illnesses, and fatalities.”
Addressing Safety Proactively

- Operates at the highest level of the control hierarchy

**Control Hierarchy**

- **Elimination**: The initial design of the facility, equipment, chemicals, or process to remove hazards
- **Substitution**: Green Chemistry Principles, water based solvent vs organic, lower reaction temp or pressure, lower toxicity reagents
- **Engineering**: Ventilation, hoods, glove boxes, bio safety cabinets, snorkels, isolate with timing, shielding, inert atmospheres, guarding
- **Administrative**: Procedures and policies, Standard Operating Procedures (SOPs), training, reduced exposure times, signage, using best work practices, not working alone
- **Personal Protective Equipment**: Gloves, respirators, aprons, lab coats, goggles, ear plugs, face shields
Build Your Team

• Including students in the “team” facilitates transitioning their mind from a teaching lab perspective of “do your own work” to a research perspective where teamwork is valued.

• When students become part of a “team”, they are empowered to have input into their own safety which also helps them transition more successfully from a student to a professional chemist.
Consider Embedded Safety Professionals

• Housed locally, therefore can be involved in the “planning phases”
• Familiar with how academic research happens and understands how researchers work and think
• Can be faculty and report to the chair or dean
• Can be a liaison to EHS and represent faculty
• Focused on education and promotion of safe research
• Reduces “Us v. Them” dynamic
Educate the Next Generation in the New Paradigm
Language in the Social Construct

• In Long’s comparison chart he emphasizes that, “risks, intrinsic motivation, heuristics, learning, mind, conversation” are the language of social psychological safety.

• We use **heuristics** daily to make fast decisions based on the *knowledge we have* and rules often cannot provide students with the knowledge needed to evaluate new situations.
  
  – Common sense
  – Rules of thumb
  – Educated guess
Transferring Knowledge

• Kuhn pointed out that in the sciences, textbooks are the primary way that established paradigms are communicated to new learners

• Because lecture textbooks rarely discuss the safety aspects of science, attitude and knowledge gaps are built into the professional scientist’s educational process – “setting them up for failure”
Shift the Paradigm – Transferring Knowledge

• Chemistry laboratory procedures and lecture textbooks need to include concepts of safety science

• Transfer of safety information will improve when as it is included regularly in research papers, presentations, and posters

• Lessons learned must be shared to help students further develop critical thinking skills and reinforce a generative safety culture
Shift the Paradigm – Safety Education

• Creates knowledgeable students who
  – become empowered workers and informed mentors
  – can find reliable safety information beyond the Safety Data Sheet (SDS) allowing understanding of hazards and risks
  – can implement hazard controls more effectively using improved heuristics
  – engage their team in informed conversations when feeling unsafe
Looking Forward

(K) SAFETY INFORMATION TRANSFER...
...is based primarily on training compartmentalized topics built on compliance with regulations
...involves developing chemical safety competencies by including chemical information literacy, communication, teamwork, and ethics learned as educational subjects integrated into the curriculum

(S) TECHNICAL ASPECTS OF SAFETY ARE TRANSFERRED...
...as procedural skills learned during laboratory work and as “common sense”
....by teaching students to control risk using hazard identification and risk assessment applied to laboratory work

(A) THE SAFETY CULTURE PARADIGM IS BASED ON...
...enforcement & compliance
....leadership and empowerment

SAFETY MANAGEMENT IS BASED ON...
...a bureaucratic system which relies on training, rules, and punishment & control
...the development of a social construct that is resilient, transferrable, sustainable, and compatible with discovery research
The New Paradigm

• Shifting paradigms does not necessarily mean that all aspects of the existing one should be thrown away
• Rules must still be utilized for novice workers and to create learning competencies that will be deepened and broadened by students
• Training is still needed for specific tasks
• Regulations must be addressed – the laws of the society cannot be broken under the cover of academic freedom.
The New Paradigm

• Rules, regulations, and training do not create a generative safety construct for academic research

• A community approach with a common language, teamwork, and education is needed

• Safety culture will improve as competencies in the discipline of safety are added to the curriculum and texts (from high school through graduate school)

• “The (new) way we do things”
Questions???