

FACTORING IN THE HUMAN: HUMAN FACTORS IN ROOT CAUSE ANALYSIS TO IMPROVE PATIENT SAFETY

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DISCLOSURES

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Can You find the the MISTAKE?

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**HUMAN FACTORS**

- Human Factors is a field dedicated to studying how humans interact with technology within systems and with each other
- Reduce errors
- Increase productivity
- Increase safety
- Increase comfort



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**Human Factors is a broad term**

**Specialization Domains**

Human Factors: Cognition or cognitive ergonomics	Ergonomics: Physical	Macroergonomics: Overall work system
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**ORIGINS OF HUMAN FACTORS**

- Frank and Lillian Gilbreth
- Motion studies
- Introduced concept of organizing surgical instruments and surgical tech passing them



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**WORLD WAR II**



- Airplanes were crashing for unknown reasons
  - Ergonomics
  - Display design

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**VIGILANCE**



- British radar operators were missing the blip on the screen indicating the approach of another vessel
- Mackworth commissioned to study why this was occurring
  - Vigilance decrement

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**ROOT  
CAUSE  
ANALYSIS  
(RCA)**

- History
- Limitations (Hollnagel et al., 2015; Parady, Carl, Wang, & Dixon-Woods, 2017; Perrow, 1984; Weiss, 2008)
  - "5 whys"
  - Linear thinking
  - Not taking the analysis far enough
  - Trying to "fix" the individual
  - Trying to find the one root cause
  - Not truly fixing identified issues
- Alternative approaches

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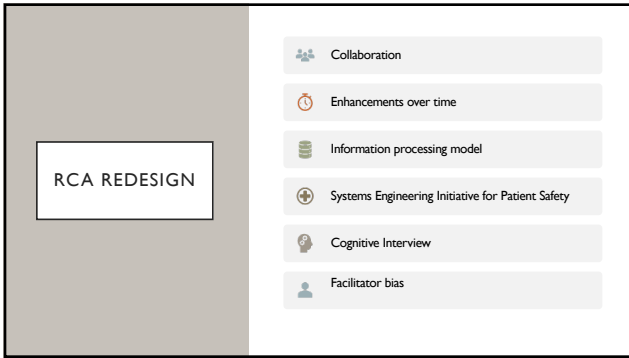
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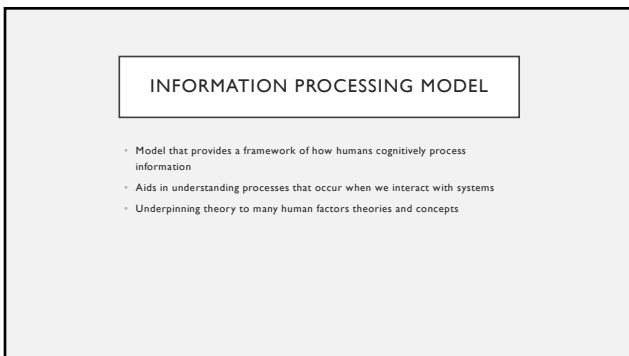
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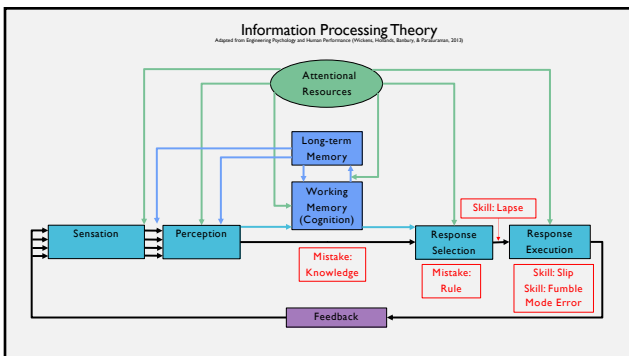
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**SENSATION**

- Moment environmental stimuli are make contact with sensory organs
- Short Term Sensory Store: < 1 sec

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**PERCEPTION**

Occurs when sensory impulses reach the brain and the messages are interpreted based on past experiences, memory comparisons, and decisions. Assign meaning to incoming stimuli.

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**ATTENTION**

- Acts as filter
- Selects some information to process further while discarding other information
- Provides resources to complete other stages of information processing

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**ATTENTIONAL CAPACITY**

- Affects our ability to sense, perceive, and respond to stimuli
- The resources that we have available can change with task familiarity and task demands

Task Type	Load (Blue)	Spare (Green)
Cognitive	100	0
Associative	75	25
Autonomous	25	75

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**AUTOMATICITY**

- Also referred to as automatic processing
- Unconscious/involuntary action or response
- Requires little or no attentional resources (implicit memory)
- Examples:
  - Driving a car
  - Riding a bike
  - Tying your shoe
  - Walking
  - Typing on keyboard

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**AUTOMATICITY**

**Pros**

- Reduces attentional burden thus freeing up mental resources
  - Allows for rapid, unconscious response (implicit)
- Allows us to multitask (to an extent)
- Can be more immune to distractions

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**AUTOMATICITY**

Cons

- May forget if a step was performed
- If learned incorrectly it is much harder to relearn the correct method
- Can be difficult to explain/teach automatic tasks to someone else

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**TRAINING**



- Well designed training is imperative for setting people up to successfully execute tasks
- A change in a process requires the opportunity for teammates to practice the new process
  - Deliberate practice

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**PERFECT**

DOES PRACTICE MAKE PERFECT?

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**OTHER ASPECTS OF ATTENTION**

- Divided attention
  - Multitasking
  - Wickens's Multiple Resource Theory
- Sustained/Focused attention
  - Vigilance
- Selective attention
  - Attending to limited stimuli in the environment
  - Inattention blindness

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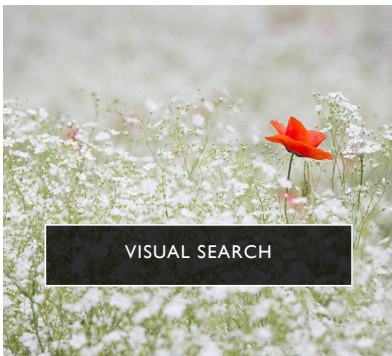
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Perceptual task requiring directing attention on a visual task and looking for a particular object or feature of an object among other objects

In display and label design it is possible to make features pop out to help direct our attention to important elements

- Large
- Bright
- Color
- Blinking
- Unusual

**VISUAL SEARCH**

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**LONG TERM MEMORY**

Experiences can be encoded and stored in long term memory

- Limited
- Permanent

Affects our processing of new information

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**LONG TERM MEMORY**

**Explicit**

- Declarative: Facts and events
- Episodic: experience
- Semantic: facts

**Implicit**

- Procedural and unconscious
- How to do something
- Skills and habits

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**WORKING MEMORY**

- Temporary storage
- Rapid decay
- Can hold  $7 \pm 2$  chunks of information (Miller, 1956)
- Manipulates information
- Thinking and decision making
- Can update previously stored long-term memories with new information

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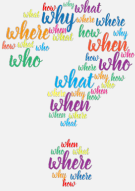
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**RESPONSE SELECTION**

- Making the decision about what response to make
- Decision may also be to not respond



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**RESPONSE EXECUTION**

The physical act of responding to a stimulus from the environment or a cognitive thought process

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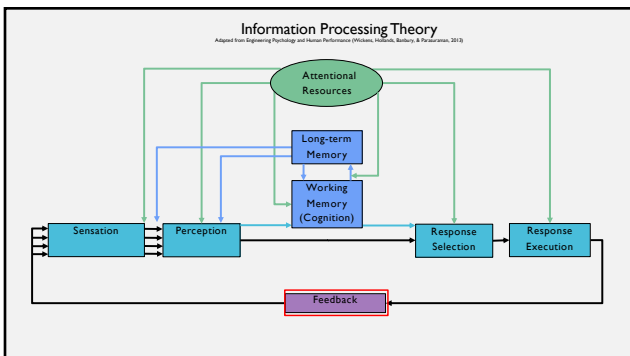
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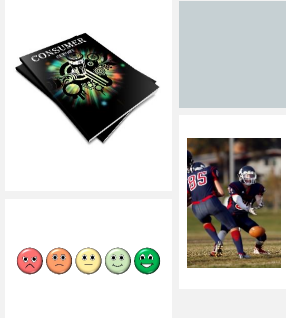
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**FEEDBACK**

Actions are either sensed or observed  
Often best if feedback is quick, relevant and accurate  
However, feedback may not occur or may be very delayed



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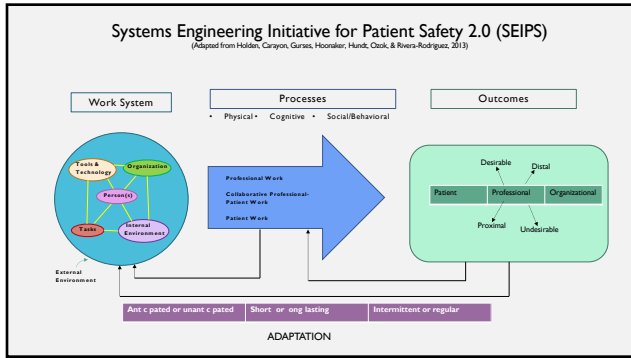
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### WORK SYSTEM: PERSON

- Center of the sociotechnical system
- Can be individual or team
- Can be clinician, patient, caregiver
- Consider
  - Age
  - Expertise
  - Physical and cognitive capabilities

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### WORK SYSTEM: TASKS

- The actions that must be carried out as part of a larger goal
  - Easy
  - Hard
  - Simple
  - Complex
  - Sequence

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**WORK SYSTEM:  
TOOLS AND  
TECHNOLOGY**

- Anything used to accomplish the tasks
- Physical devices
- Information technology
  - Automation
  - Usability
  - Accessibility
  - Familiarity



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Structures that organize the work system (time, space, resources)

- Culture
- Work schedules
- Incentives
- Training

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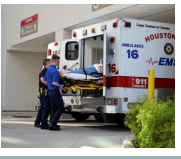
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**WORK SYSTEM: INTERNAL ENVIRONMENT**

Physical environment in which tasks are executed

- Lighting
- Noise
- Vibration
- Space design and layout





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### WORK SYSTEM: EXTERNAL ENVIRONMENT

External organizational factors that affect the organization (society, ecology, government)

- Weather
- Govern ng bodies
- ACGME
- CMS
- Jo nt Comm ss on

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PERSON: Proximate Failures		
Includes clinician, patient, caregiver, team, environmental services, biomedical technician, food services, etc.		
A1	Did <b>internal distractions</b> (e.g., fatigue, high mental workload, stress, worry, anxiety) contribute to the event (affected attention and/or caused a lapse)?	(A1) Internal Distraction
A1	Did the <b>needs</b> (e.g., hunger, thirst, fatigue, hot, cold) for the people involved contribute to the event?	(A1) Internal Distraction
A1	Did <b>external distractions</b> (e.g., noise, light, competing tasks, people interrupting, phones calls) contribute to the event (affected attention and/or caused a lapse)?	(A2) External Distraction
A1	Was the person on <b>autopilot</b> (e.g., performed a task without conscious thought, habit intrusion), which contributed to the event?	(A3) Autopilot
A1	Did the person experience <b>information overload</b> (e.g., too much sensory/cognitive information present, overwhelming attentional resources), which contributed to the event?	(A4) Information Overload
A1	Did the person lose consciousness for performing a task while actively engaged in that task resulting in <b>forgetting</b> ?	(A5) Forget
A1	Did the person lose <b>situation awareness</b> (e.g., did not perceive something, did not understand something occurring, failed to project to the future state and plan accordingly), which contributed to the event?	(A1) Internal Distraction, (A2) External Distraction, (A3) Autopilot, (A4) Information Overload, (CT3) Situational Awareness
CT1	Did <b>biases/heuristics</b> affect decision making (e.g., mindsets, tunnel vision, bandwagon effect, confirmation bias, stereotyping), which contributed to the event?	(CT2) Biases/Heuristics
CT1	Did the <b>preferences</b> (e.g., for medications, products, devices, treatments) of the people involved contribute to the event?	(CT1) Biases/Heuristics, (C1) Conformity, (C2) Normalized Deviance

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PERSON: Proximate Failures		
Includes clinician, patient, caregiver, team, environmental services, biomedical technician, food services, etc.		
CT1	Did the <b>goals</b> (e.g., patient centered care, privacy, reduce wait time, improve efficiency, complete EMR) for the people involved contribute to the event?	(CT2) Biases/Heuristics, (C1) Shortcuts, (C2) Normalized Deviance, (C3) Unmotivated, (C4) Reckless
A1	Did the <b>expertise level</b> (e.g., education, skills, knowledge, neurocognitive) of the people involved contribute to the event?	(A1) Autopilot, (CT1) Situation Awareness, (CT2) Biases/Heuristics, (CT3) Inadequate Knowledge, (CT4) Incorrect Assumption, (CT5) Misinterpretation, (P2) Information Deficit
CT1	Did the person make an <b>incorrect assumption</b> (e.g., failed to validate something, overconfident and did not seek additional input), which contributed to the event?	(CT2) Biases/Heuristics, (CT4) Incorrect Assumption
CT1	Was correct information <b>misinterpreted</b> (e.g., spatial disorientation, misunderstood information that was heard/communicated/observed), which contributed to the event?	(CT5) Misinterpretation
A1	Did the <b>physical characteristics</b> (e.g., strength, height, age, eyesight, hearing, weight, illness) of the people involved contribute to the event?	(P2) Physical Capability
CT1	Did the <b>behavior</b> (e.g., shortcuts, normalized deviance, indifference/unmotivated, recklessness) of the people involved contribute to the event?	(C1) Shortcuts, (C2) Normalized Deviance, (C3) Unmotivated, (C4) Reckless
A1	Did lack of a <b>shared mental model</b> (e.g., similarity of knowledge, areas of discrepancy) for the people involved contribute to the event?	(A1) Autopilot, (A4) Information Overload, (CT1) Situation Awareness, (CT2) Biases/Heuristics, (CT3) Inadequate Knowledge, (CT4) Incorrect Assumption, (CT5) Misinterpretation, (CT6) Miscommunication
CT1	Did the level of <b>team cohesiveness</b> (e.g., shared goals, good teamwork) for the people involved contribute to the event?	(CT1) Situation Awareness, (CT2) Biases/Heuristics, (CT3) Inadequate Knowledge, (CT4) Incorrect Assumption, (CT5) Misinterpretation, (CT6) Miscommunication
CT1	Did <b>communication</b> (e.g., good, poor, handoffs, verbal, written, electronic, nonverbal) for the people involved contribute to the event?	(A4) Forget, (CT1) Situation Awareness, (CT2) Biases/Heuristics, (CT3) Inadequate Knowledge, (CT4) Incorrect Assumption, (CT5) Misinterpretation
A1	Did <b>external factors</b> (equipment failure, external trigger) contribute to the event?	(E1) Equipment Failure, (E2) External Trigger

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ORGANIZATION (cont.): System Failures		
Structures that organize processes (e.g., time, activities) of the institution and patient's setting (e.g., home)		
03	Did lack of resources (e.g., staff, equipment, products, medications, time, tech/IT support, Clinical Engineering support, budget, infrastructure including space, power, wi-fi) contribute to the event?	(O1) Leadership, (O3) Resources
03	Did training and education (e.g., PowerPoint, ACE module, brochure, simulation, preceptorship) to establish competency in knowledge and skills contribute to the event (e.g., inappropriate, inadequate, non-existent)?	(O1) Leadership, (O3) Resources, (O4) Training and Education, (O5) Job Functions
03	Did work assignments/job functions (e.g., functions assigned to someone without appropriate training/knowledge, too many essential tasks to perform, essential functions overlapped roles, gaps in critical role assignments) contribute to the event?	(O1) Leadership, (O3) Resources, (O4) Training and Education, (O5) Job Functions
04	Did policies, protocols, and job aids (e.g., unavailable, not understandable, not usable (difficult to locate, poorly presented), lacked credibility, inappropriate, incomplete, outdated) contribute to the event?	(O1) Leadership, (O6) Job Aids, Policy, Protocol, (T3) Usability, (T9) Accessibility
04	Did communication channels (e.g., call centers, dissemination of critical information, ROC, equipment failure response) contribute to the event (e.g., not clearly defined, difficult to access, uncertain who to contact)?	(O1) Leadership, (O7) Communication Channel, (T5) Ambiguity, (T9) Accessibility
05	Did patient setting factors affect team/provider care of the patient (e.g., living arrangements, finances, work and life schedules, family obligations, relationships), contributing to the event?	(E1) Economic, (E2) Societal, (E3) Ecological, (E4) Regulatory, (E5) External Transfer

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INTERNAL ENVIRONMENT: System Failures		
Physical environment where work occurs, including office, hospital, patient's home, ambulance, etc.		
05	Did the physical layout of the environment (e.g., flow/traffic patterns, large/short distances of travel, sight lines affecting visualization, potential for repetitive steps or traffic jams) contribute to the event?	(E1) Physical Space and Design, (O1) Leadership
05	Was the available space in the environment non-adjustable (e.g., anthropometrics - too large, too small, too high, too low, too short, too wide, too narrow) contributing to the event?	(E1) Physical Space and Design, (O1) Leadership
05	Did the work station design for individual work (e.g., poor layout and use of space, lack of adjustability, visualization, teamwork/communication) contribute to the event?	(E1) Physical Space and Design, (O1) Leadership
05	Did the environment's lighting characteristics (e.g., too bright, too dim, flickering, color) contribute to the event?	(E2) Lighting, (O1) Leadership
05	Did the environment's climate (e.g., temperature, humidity, pressure (too high or low), and air quality (pollution, pollen) contribute to the event?	(E3) Climate, (O1) Leadership
05	Did the environment's noise characteristics (e.g., high ambient noise from conversation, machines, music alarms, HVAC, intermittent loud noise) contribute to the event?	(E4) Noise, (O1) Leadership
05	Did motion in the environment (e.g., acceleration, deceleration, vibrations from ambulance or helicopter) affect ability to execute tasks, contributing to the event?	(E5) Motion
05	Did comorbidity in the environment (e.g., disruptive person, emergency response, people jostling into each other) affect ability to execute tasks or concentrate, or cause distractions, contributing to the event?	(E4) Noise, (E5) Motion

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EXTERNAL ENVIRONMENT: System Failures		
Macro-level factors external to the organization including regulatory mandates and environmental factors		
01	Did economic (e.g., local, state, or national laws, socioeconomic status, tax rates, insurance policies, personnel pay levels, budget/cost of products) factors impact professional work or the patient/caregiver (access to, or use, of care), contributing to the event?	(E1) Economic, (O1) Leadership
01	Were there any shortages or recalls of any involved medications, products, or equipment that contributed to the event?	(E1) Economic, (O1) Leadership, (O3) Resources
02	Did societal (e.g., social or religious beliefs, biases, customs, education, housing, patient demographic) factors impact professional work or the patient/caregiver (access to, or use, of care), contributing to the event?	(E2) Societal, (O1) Leadership
03	Did ecological (e.g., natural disasters, air quality, severe weather, water purification, spread of infection) factors impact professional work or the patient/caregiver (access to, or use, of care), contributing to the event?	(E3) Ecological, (O1) Leadership
04	Did regulatory (e.g., Joint Commission, DNV, ACGME, CMS, restriction of work hours, mandates for adoption of health IT, CMS measures for length of stay, readmissions, insurance and Medicare/Medicaid) factors impact professional work or the patient/caregiver (access to, or use, of care), contributing to the event?	(E4) Regulatory, (O1) Leadership
05	Was the patient transferred from an external healthcare system (limiting access to previous records, including alerts, poor handoff), which contributed to the event?	(E5) External Transfer, (O1) Leadership, (T9) Accessibility

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CONDUCTING COGNITIVE INTERVIEWS

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TRADITIONAL VS COGNITIVE INTERVIEW (CI)

"Traditional interviewers try to elicit information by asking many good questions; they target a question for each content area that they need to address. The cognitive interview, on the other hand, is in some ways a questionless interview. The goal is to ask as few questions as possible so that witnesses give you long narrative responses that each contains that much more information than a traditional interview. The goal is to try and elicit information, not extract information.

Ron Fisher

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QUESTIONS 

Start interview as semi structured with free recall questions

Once free recall is complete use open ended questions (CI)

Finish with neutral probing questions

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**COGNITIVE INTERVIEW**

- Cognitive interview is a toolbox
  - Do not need to use all elements during the interview
- Do not interrupt
- Silence is OK
- Minimize guessing state I am not sure
- Ask the interviewee to report everything even details that seem trivial



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**COGNITIVE INTERVIEW**




**Eyes Closed**

- Ask interviewee if comfortable to close eyes while recalling and describing the event



**Recall events in a different order**

- Recall backward
- Start in middle and work forwards or backwards



**Reconstruct the event circumstances**

- Think about environment details (weather, lighting, etc.)
- Recall emotional state

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**COGNITIVE INTERVIEW**



**Change Perspective**

"Sometimes you need to look at Life from a different perspective."

Have the interviewee describe the event as if they were one of the other team members



**Recall the event in a different way**

- Sketching
- Re-enactment

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### OUTCOME BIAS

Definition	Example
<ul style="list-style-type: none"> <li>• Outcome bias occurs when we judge a decision based on its eventual outcome instead of considering the decision at the time it was made</li> </ul>	<ul style="list-style-type: none"> <li>• You hear about a surgery where a surgeon cut the surgical sponges in half to fit through the laparoscopic portals to pack a bleed and it was celebrated. The patient had a successful recovery.</li> <li>• You think: "Wow, that was a smart decision to cut the sponge to stop the bleed!"</li> <li>• A few months later, you are facilitating an RCA where a similar event occurred, but in this case half of a sponge was left behind resulting in a retained foreign object and an infection.</li> <li>• You think: "That was a terrible decision to cut the sponges in half!"</li> </ul>



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### HINDSIGHT BIAS

Definition	Example
<ul style="list-style-type: none"> <li>• Hindsight bias is the tendency of seeing an event that has occurred as predictable ("Knew it all along")</li> </ul>	<ul style="list-style-type: none"> <li>• You are facilitating an RCA where a patient with a history of suicide attempts was discharged from behavioral health and committed suicide 10 hours post discharge</li> <li>• Your response is to think: "Why did they discharge this patient? Anyone could see this was going to happen."</li> </ul>



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### CONFIRMATION BIAS

Definition	Example
<ul style="list-style-type: none"> <li>• You only consider information that "confirms" an idea you have and you discard any information that does not confirm your idea</li> <li>• Prevents you from adequately diagnosing something/determining true root cause</li> </ul>	<ul style="list-style-type: none"> <li>• You are facilitating an RCA where a nurse called for team assistance but did not get a response</li> <li>• You believe the cause of the event was non-collaboration</li> <li>• You are biased to only look for information to confirm the view and push aside information that contradicts the view</li> <li>• This prevents you from recognizing that the unit was severely short-staffed and the team was assisting with an emergency</li> <li>• The true cause was related to resource allocation</li> </ul>



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