NRC·CNRC

The User's Guide to Evacuee Behavior

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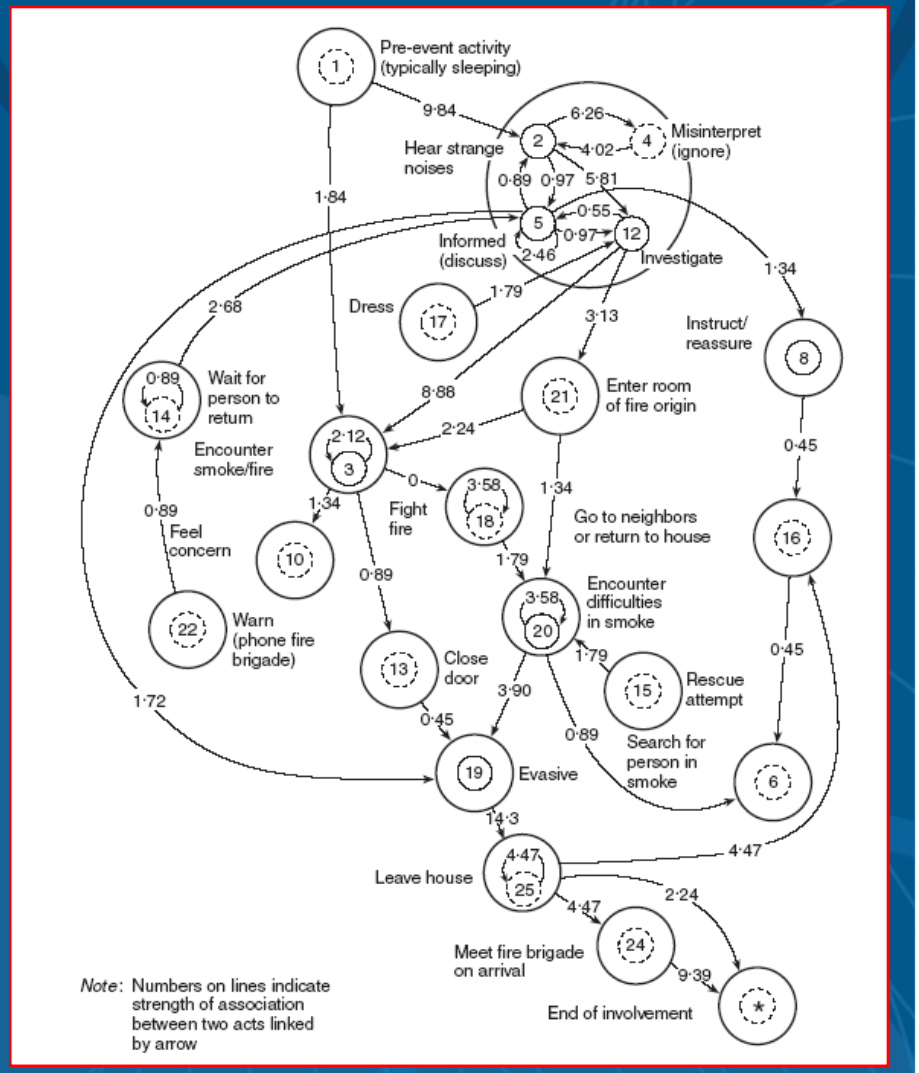


[Canter, Breaux and Sime – 1980]

Overview

- Describe current subject matter understanding.
- Provide a set of core behavioural ‘statements’.
- Outline their impact on model development, application and procedural design.
- I would like to acknowledge:
  - *Erica Kuligowski (NIST), Lynn Hulse (UoG), Mike Kinsey (Arup)…*two articles in the pipeline.

Development

- Human Behavior in Fire - emerged from *practice*, rather than driven by *theory*. Still immature.
- Traditionally evacuee performance ignored, factored out, represented implicitly and/or deemed beyond consideration.
- More accepted now, but effort still required to develop the theoretical/empirical credentials.
  - Enhance acceptance of subject matter and the modelling of the subject matter.
  - Develop **skeptical advocacy**.
- Especially given evolving regulatory environments.

What is the problem?

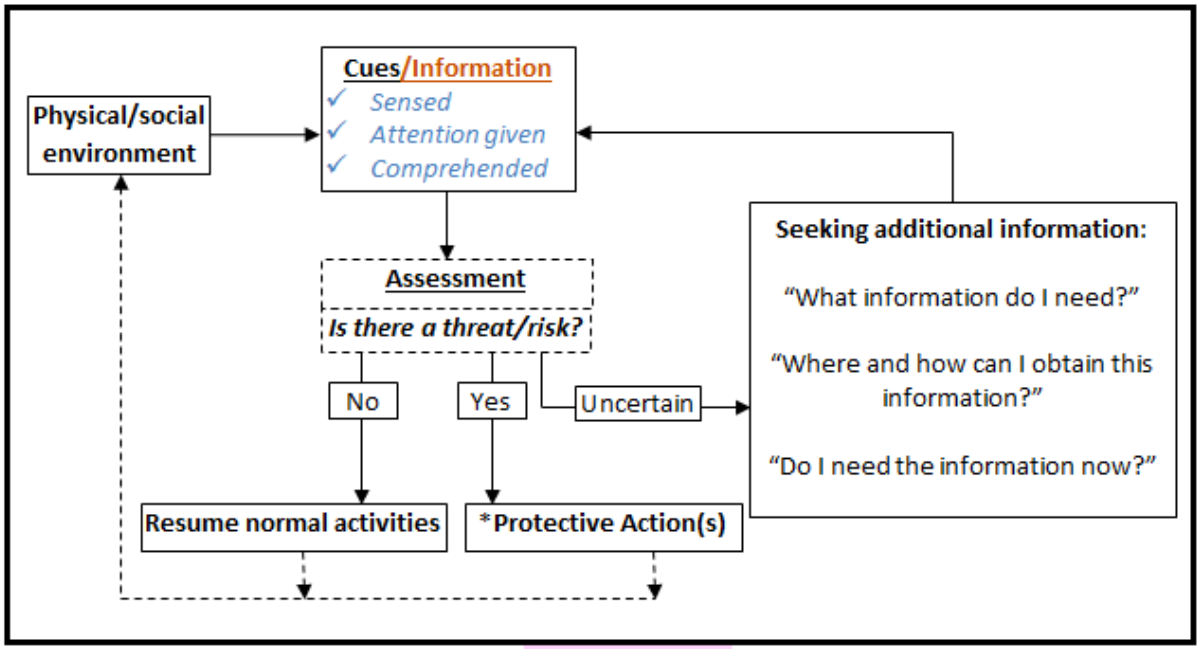
- No overarching theory - media plugs gap:
  - Pyrolysis vs Panic

- Variability in assumptions made by practitioners, stakeholders, regulators and clients: affects model selection, application and interpretation – and acceptance.

- Theory / Data is not
  - Sufficient in scope or content.
  - Universally accepted or applied.
  - Tested and constructed to the same degree of rigour.
  - *Described consistently and simply.*
  - *Equally accessible.*

What is the problem?

- This is an attempt to address these last two points.
- Behavioral ‘statements’–derived from observations, research and practice related to evacuee behaviour.
- Understanding critical in developing/applying models and in real world applications – *not art for art’s sake*.



Kuligowski 2011

Key Behavioural Elements: Summerland, UK (1973); 50 fatalities.

news.bbc.co.uk / Sime (1999)

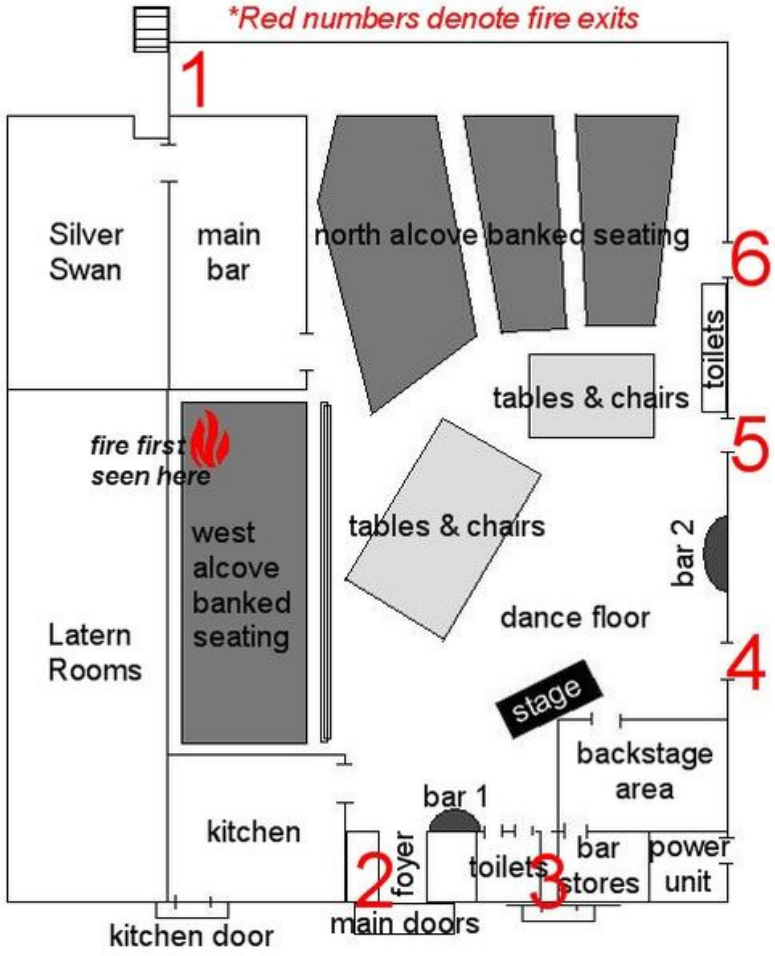
Social identity matters. People do not necessarily move directly towards safety.

Key Behavioural Elements: King's Cross Fire, UK (1987); 31 fatalities.

news.bbc.co.uk / Donald and Canter (1990)

Non-emergency use influences emergency use.
People respond to authority figures.
People respond to the information available.
Conflicting information available and communicated.

Key Behavioural Elements: Stardust Nightclub, Dublin,Eire (1981);48 fatalities

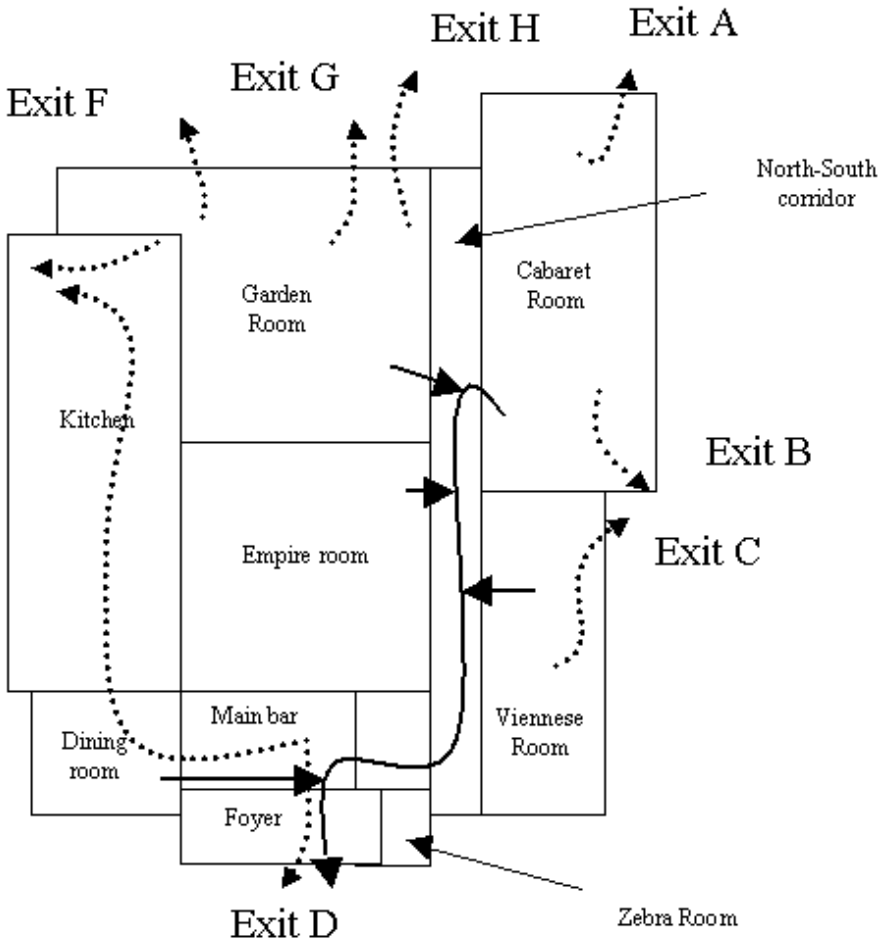


Relationship between safety and security.
Initial movement towards incident.
Use of familiar route.
Misjudgement regarding speed of fire development.
Initial stages of incident characterized by ambiguity.

http://essexfiresafetytraining.com/Are-Fire-Marshals-necessary/1981-Dublin

Key Behavioural Elements:
Beverly Hills Supper Club, US (1977); 164 fatalities

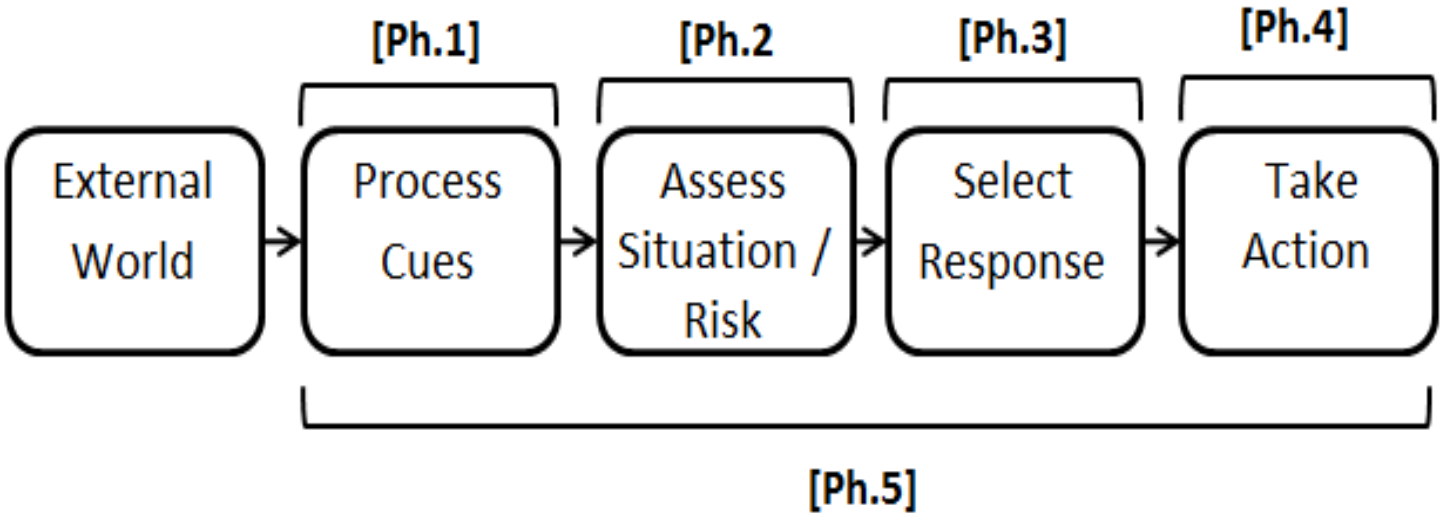
enquirer.com



Panic was not the dominant response.
Staff actions had an impact.
Route familiarity / availability a factor.
Access to information.

Derived Behavioural Statements

- These behavioural statements may:
  - Provide benchmark against which models might be compared.
  - Suggests factors to be included in a scenario by a user.
  - Suggests ***future*** functionality to be included by the developer.



- Increase sensitivity of practitioners to underlying subject matter.
- *What egress scenarios can the model represent?*

[Phase 1] Process Cues/Information - What influences cue perception? Examples…

- [Ph1.1] Content of the cue matters.
- [Ph1.2] Authority of information source affects content credibility.

[Phase 3] Select Response –How does an individual select an action given their understanding of the situation? Examples…

- [Ph3.2] Presence of smoke does not preclude the use of a route.
- [Ph3.4] Pre-event commitment to a particular activity may cause individuals to decide against protective action.

[Phase 4] Action – What factors influence action selection? Examples…

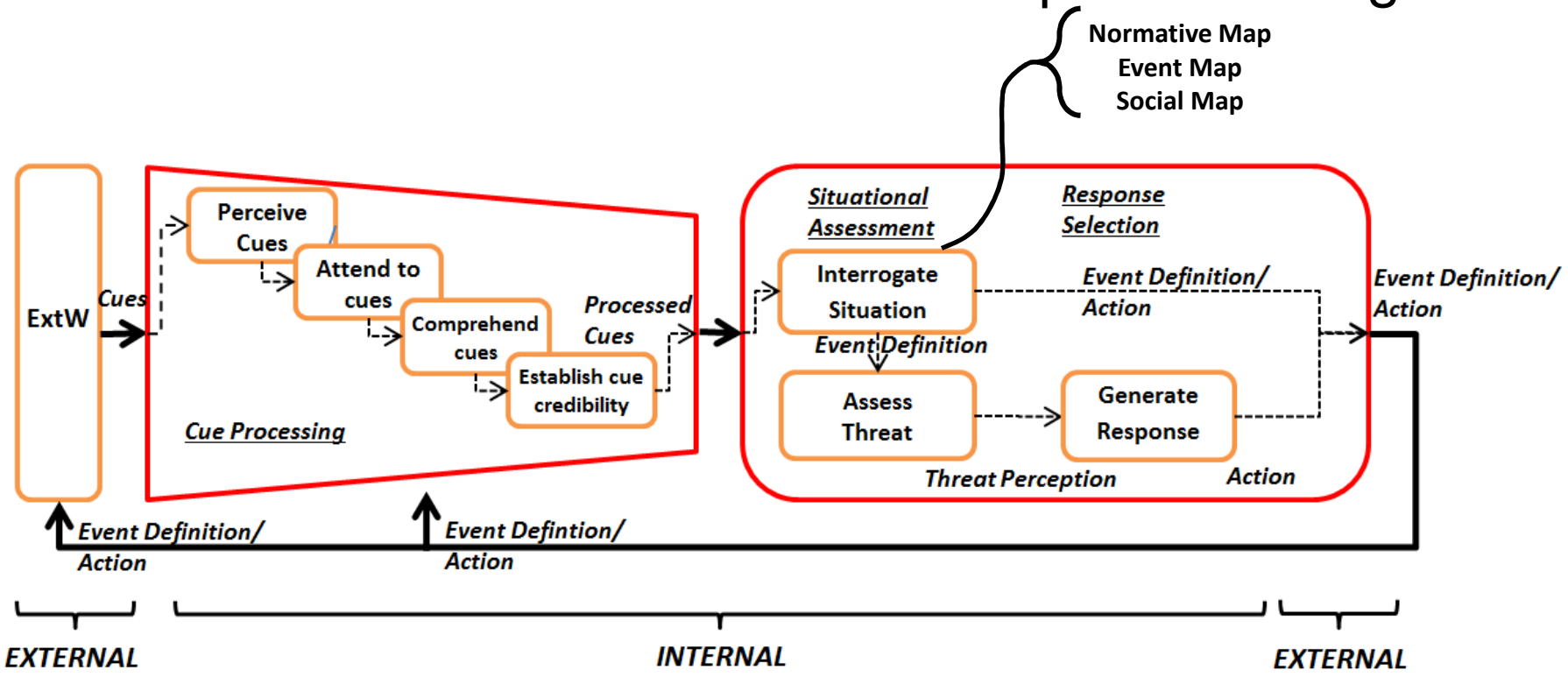
- [Ph4.3] People engage in protective actions.
- [Ph4.4] People move towards the familiar (people, places, etc.).

[Phase 5] Overall – What factors influence the overall decision-making process? Examples…

- [Ph5.1] Typically evacuees behave in a rational/altruistic manner; panic rarely dominates response.
- [Ph5.4] Evacuation is a social process.

Guidance for the Model Developer

- Currently no model is able to successfully account for all of these statements.
- Not art for arts sake – has **direct** impact on design.



Guidance for the Model User

- Basic Engineering Elements – all models quantifying performance include:
  - [Pre-Ev]pre-evacuation time – the time for evacuees to commence movement to a place of safety
  - [T.Sp]travel speed – the maximum unimpeded walking speed,
  - [F] Flow conditions / constraints – the relationship between speed/flow and population density.
  - [R_A] Route availability –routes available to the evacuees,
  - [R_U] Route usage/choice –routes selected by evacuees.

Guidance for the Model User

Phase	Behavioural Statement	[Pre-Ev]	[T.Sp]	[F]	[R_A]	[R_U]
[Phase.1] Process Cues/Information	**[1]** Content of the cue matters: The precision, credibility, clarity, comprehensiveness, intensity and specificity of the external cues will affect the assessment of the information in the individual's decision-making process.	X	X		X	X
	[2] Authority of the information source affects how credible someone perceives the information to be.	X	X			X
	[3] The actions of the surrounding population can influence the internal processes and the actions of the individual; e.g. the use of routes/space by others increases their attractiveness.					X
	[5] Previous experience of false alarms / frequent drills can reduce sensitivity to alarm signal.	X				
	[6] Habituation, focus and stress can narrow the perception field, and thus, not all available cues will be internalized.	X				X
	[7] Sensory impairments can inhibit the perception of cues.	X			X	X

ASET = 180s ↓

Pre-Evacuation time (sec)	Proportion of population using the main exit					
	0.5	0.6	0.7	0.8	0.9	1
0	94	113	131	150	169	188
30	**124**	143	161	180	199	218
60	154	173	191	210	229	248
90	184	203	221	240	259	278
120	214	233	251	270	289	308
150	244	263	281	300	319	338
180	274	293	311	330	349	368

←ASET = 240s

←ASET = 300s

Why does it matter? *Panic Model*

The Procedure… *Process Model (PADM)*

- Indication of an incident may lead to rapid, simultaneous response – potentially overloading exits.
- Response will be uncontrolled and competitive – ‘stampede’.
- Process will contaminate observers.
- Information provided may not have desired impact.

Pc	Perception: Whether it is possible for the information to be perceived
At	Attenttiveness: Whether the information available is noticed
Co	Comprehension: Whether the information noticed is understood.
Cr	Credibility: Whether the information that is understood is deemed to be credible.
Ps	Personalisation: Whether the credible information is deemed to be pertinent.
Ac	Action: Whether the pertinent information indicates an appropriate action.

Kuligowski et al [2011].

Procedural Development: Panic-based alarm design

- Procedural Impact given assumed evacuee panic:
  - Delay notification.
  - Quietly inform some people.
  - Content is irrelevant, provide a bell. Coverage should still be checked.
  - Deploy staff to control evacuees.
  - No basis for further analysis – evacuees insensitive to guidance.

Procedural Development: Process-based alarm design

Pc	Perception: Whether it is possible for the information to be perceived	PD1: COVERAGE . REDUCTION OF NOISE. ADDRESS SENSORY IMPAIRMENTS.
At	Attenttiveness: Whether the information available is noticed	PD2: REMOVE DISTRACTIONS – NATURE OF THE ORIGINAL ALERT
Co	Comprehension: Whether the information noticed is understood.	PD3: PICTOGRAMS, GRAPHICS, SIMPLE PHRASING, MULTIPLE LANGUAGES
Cr	Credibility: Whether the information that is understood is deemed to be credible.	PD4: AUTHORITATIVE REPRESENTATIVE MAKES ANNOUNCEMENT.
Ps	Personalisation: Whether the credible information is deemed to be pertinent.	PD5:TAILOR ANNOUNCEMENT. IDENTIFY THOSE WHO NEED TO ACT.
Ac	Action: Whether the pertinent information indicates an appropriate action.	PD6: SAY WHAT THEY SHOULD DO, WHEN THEY SHOULD DO IT.

- Derived from Lindell and Perry [2004] and Mileti and Sorensen [1990]. Categorization produced by Kuligowski et al [2011].

Summary

- *Compilation of behavioural statements represents current understanding – partial and incomplete.*
- *Understanding evacuee response critical in developing credible conceptual models.*
- *Employing credible conceptual models key for developing scenarios of interest and for developing anaytical/computational tools to assess performance.*
- *Quantifying and quantifying performance can provide evidence for safety of design.*
- *Help to produce a more informed, evidence-based and transparent design procedure.*