

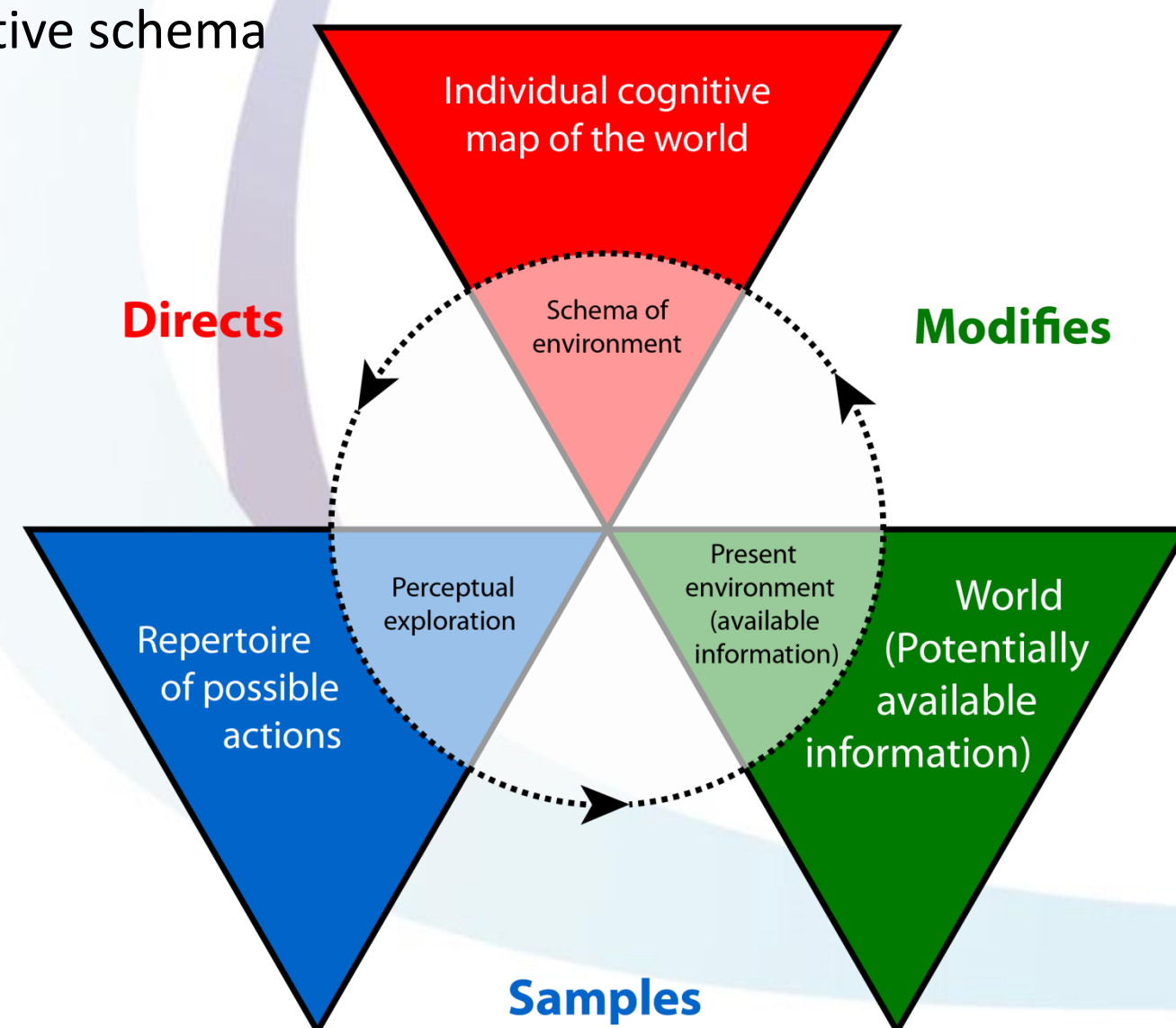
A critical incident in the cockpit: Analysis of a critical incident interview using the Leximancer™ tool



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Perceptual Cycle Model and Human Error

- The Perceptual Cycle Model (PCM) presents the view that human thought is closely coupled with a person's interaction in the world
- A reciprocal, cyclical relationship between person and environment is presented;
- Knowledge (**SCHEMA**) leads to the anticipation of information
- This directs behaviour (**ACTION**) to seek certain types of information and allows information to be interpreted
- Environmental experience (**WORLD**) can modify and update cognitive schema



Aim: Compare Leximancer™ output to a manual analysis using a coding scheme based on the principles of the PCM

Method

- Single case study design
- **Critical Decision Method** ² (CDM): knowledge elicitation tool uses cognitive probes to understand expert decision making in non-routine situations
- **Leximancer** ³ Software tool for performing rapid conceptual analysis of qualitative textual data
- Participant: 39 year old, male helicopter pilot (3000 flying hours)
- Procedure: Retrospective, semi-structured interview. Recall a critical incident, defined as
"a non-routine or un-expected event that was highly challenging and involved a high workload"

What is a schema? An organised mental pattern (templates) of thoughts or behaviours to help organise world knowledge. Neither new behaviour or a repetition of old behaviour.

- Human error requires an explanation rather than it being the explanation of failure ¹
- Understanding how people's actions and assessments made sense to them at the time can help understand *why* an error occurred
- The PCM offers a theoretical framework to explore error in context – a human-in-the-system approach is provided

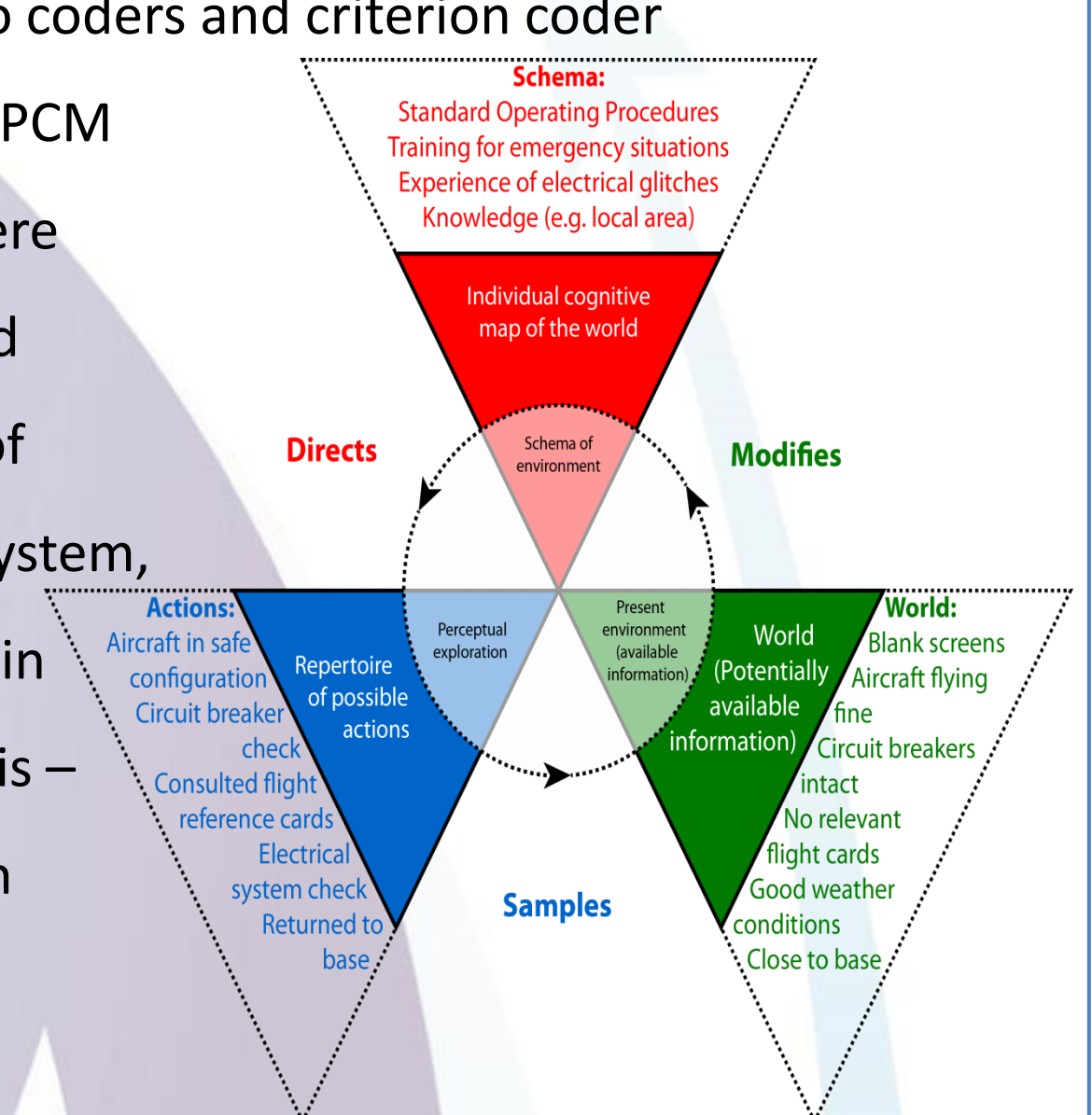
Critical incident: During a SAR winning exercise, all 4 display screens went blank when a waypoint was entered into the nav.system. Fault diagnosis involved looking for popped circuit breakers, checking the flight reference cards and assessing whether the electrical power and generators were functioning. Decision made to return to base.

Results: Manual Analysis

- Data transcribed and coded into the categories of the PCM
- **Schema** - "...can pretty much guarantee one on most flights...the expectation is that there will be some sort of glitch"
- **Action** - "...entered destination into the navigation system"
- **World** - "...the screens went blank..."

- Inter-rater reliability calculated for 32 segments of text, 86% agreement between two coders and criterion coder

- Data modeled into the PCM
- Diagnostic attempts were based on experience and expectations (**schema**) of the aircrafts' electrical system, which led to interaction in the **world** (fault diagnosis – **action**) being focused on the electrical system, rather than taking other factors into consideration
- All data were accounted for by the PCM

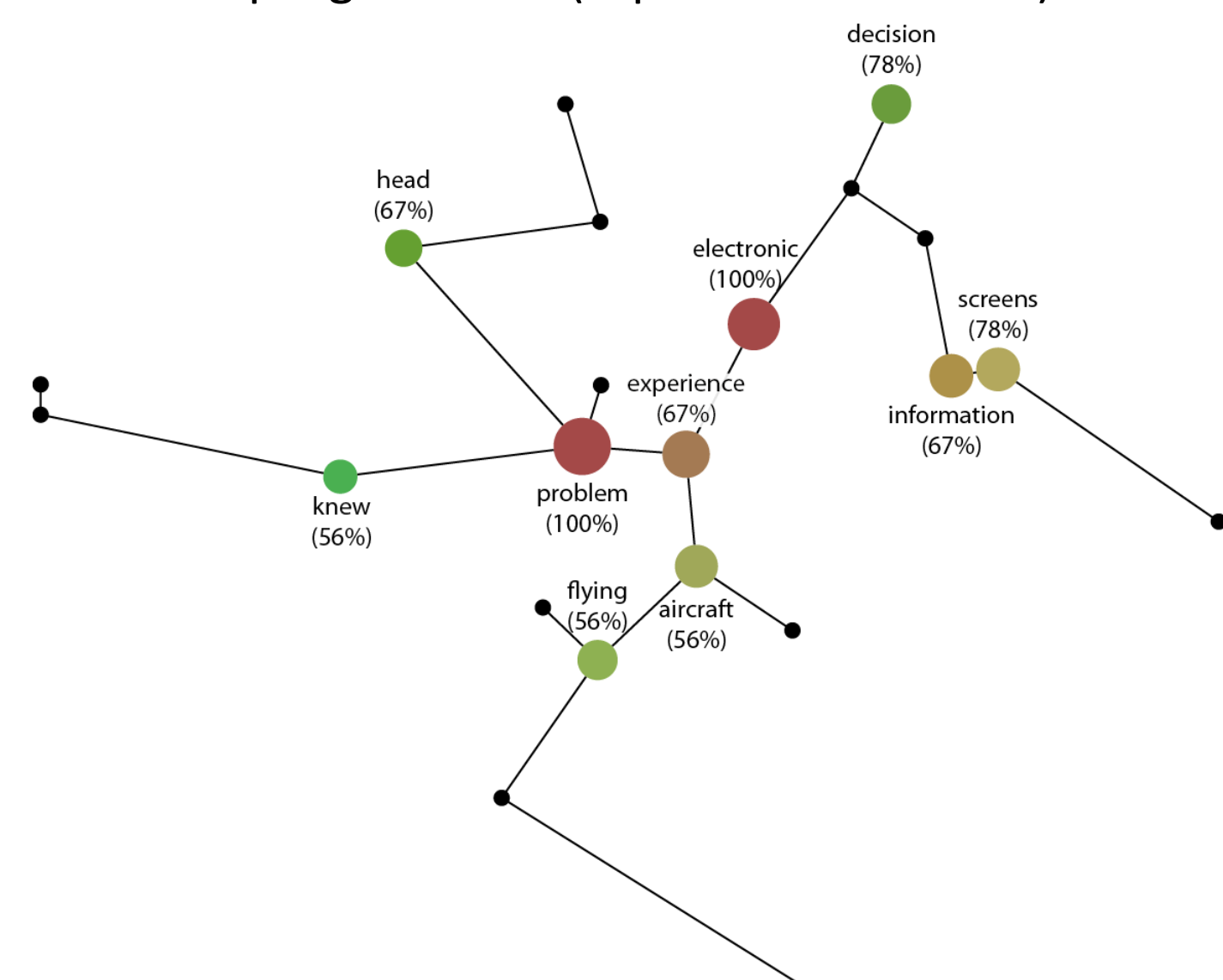


Coding category	% of data (manual)	% of data (Leximancer)
Schema	49	12
Action	29	30
World	22	38

Results: Leximancer™ Analysis

Concepts:

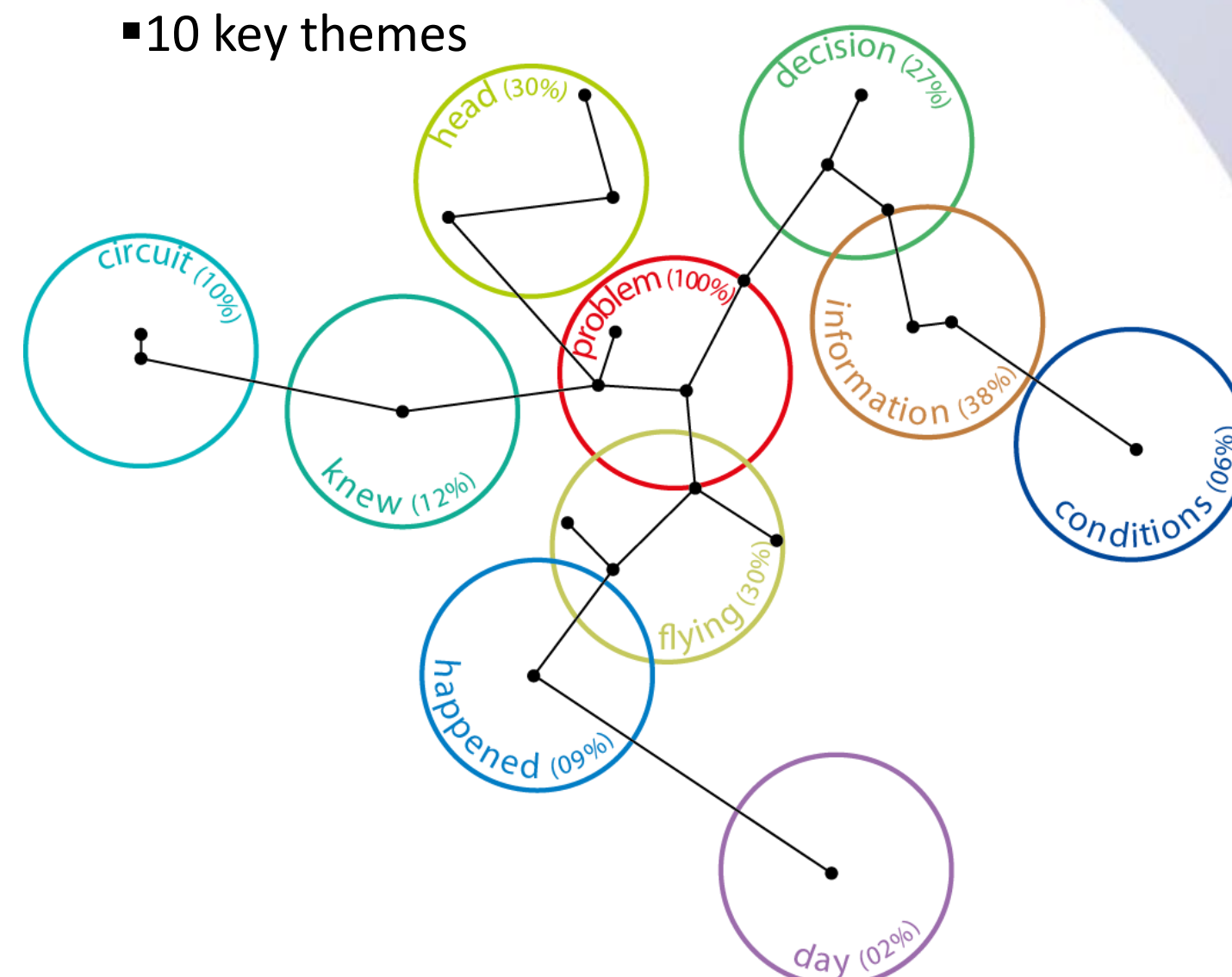
- Collection of words that 'travel together' throughout the text
- Weighted according to their frequency, assigned a percentage relevance value
- 22 concepts generated (top 10 shown below)



- Problem / electronic (100%), experience/knew, information, flying all featured as concepts

Themes:

- Groupings of concepts, increase analysis from individual items to broader, highly connected clusters
- Assigned a percentage relevance value
- 10 key themes



- Problem (100%), information (38%), flying (30%) and knew (12%) feature as themes

- Logical that *problem* was the most relevant concept and theme as the data discussed problem solving due to an assumed electrical fault

- Leximancer concepts and themes are comparable with manual analysis themes:

- Contrast between manual and Leximancer analysis and amount of relevance

- placed on each theme (see table in manual analysis results)

- Ecological (Leximancer analysis) vs. cognitive (manual analysis) approaches to design

Manual code	Leximancer concept / theme
Schema	Experience / knew
Action	Flying
World	Information

Conclusions

- In the manual analysis all data were coded against the PCM
- CDM appears to elicit information that can be analysed in terms of the PCM and Schema Theory
- Schema appear to be influential during decision making in critical incidents in the cockpit
- Many overlaps between manual and Leximancer analysis, suggesting schema are utilised when making decisions in the cockpit and PCM is a suitable approach to analyse CDM data
- Further data collection required to validate claims made here

¹Dekker, S. *The Field Guide to Understanding Human Error*. Ashgate: Aldershot, 2006.

²Klein, G.A., Calderwood, R., & Macgregor, D. "Critical Decision Method for Eliciting Knowledge". *IEEE Transactions on Systems, Man and Cybernetics*, Vol. 19, No. 3, 1989, pp. 462-472.

³Leximancer. "Leximancer user Manual: From words to meaning to insight, v3.5". Retrieved September 5, 2011, from www.leximancer.com