WHEN WE CAN'T SEE WHAT'S THERE

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**Introduction**

Every day we use mental models effectively to help us resolve the challenges we face at work. But sometimes these mental models enable us to arrive at entirely the wrong decisions, decisions that can cause catastrophic failure and death. This paper aims to uncover how this occurs and what we can do to take the right decisions about the most critical of our challenges.

The notion of ‘mental model’ is widely discussed in several literatures, notably in the domains of human-computer interface, aeronautic education, cognitive psychology and, to a lesser extent, in management theory. Related terms include ‘cognitive dissonance’, ‘knowledge structure’¹ and ‘learning myopia’².

In the following paragraphs, the first section summarises three cases: two are from aeronautics (1988/1989) and the third is about the so-called Orkney satanic child abuse scandal of 1991. The second section analyses the decision-making process in each of the three cases. The third section explores the notion of mental models. The final section identifies ways in which decision-making in exceptional circumstances can be more effective.

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1. JP Walsh’s 1995 paper, Managerial and Organisational Cognition (University of Michigan, Ann Arbor) reviews the literature on knowledge structure.
I. The case summaries: two crises in the air and one on the ground

IRAN AIR FLIGHT 6553 -THE GULF, 1988

On the morning of July 3rd, 1988, Iran Air’s commercial Flight 655 took off from Bandar Abbas Airport, making the short local flight across the Straits of Hormuz to Dubai. It was flying in Iranian airspace over Iranian territorial waters in the Gulf. It kept to its flight plan, climbing steadily and consistently to its cruising altitude and gaining speed. Seven minutes later missiles fired by the USS Vincennes, a US naval missile cruiser, brought down Capt. Rezaian’s plane. 290 people lost their lives, including 66 children and 16 crew.

Vincennes had been operating in the Persian Gulf as part of the effort by Western powers to ensure the Gulf remained open to shipping. 1988 marked the approaching end of the Iraq-Iran war. The United States was not at war with either party.

Flight 655’s ‘squawks’ —transponder signals— were those used by all commercial aircraft. From the first alert that Flight 655 had taken off, various Vincennes personnel had ‘seen’ and reported a Mode II squawk —that of a military aircraft associated with Iranian Air Force F-14s (a much smaller aircraft than Capt. Rezaian’s plane).

USS Vincennes personnel in the command cockpit looked up the list of scheduled commercial flights for that day but saw no listing of Flight 655.

A few minutes before the missiles were fired, there were shouts of “Comair” (signifying a commercial aircraft) from the Vincennes crew members in the command centre (this is supported by the ship’s recorder). The commander acknowledged this message but did not act on it.

Petty Officers Anderson and Leach reported that the aircraft was descending and picking up speed — seen as a sign of an imminent attack. Anderson shouted that the speed of the ‘F-14’ was 455 knots and that it was travelling at 7800 feet. Rogers ordered the two anti-aircraft missiles to be fired, one or both of which hit the wing of the unaware Captain, crew and passengers of Flight 655, sending the Airbus A300 spinning into the Gulf.

SIOUX AIR CRASH:4 ON 19TH JULY 1989

Around an hour after take-off on the Denver to Chicago flight, there was a loud explosion at the back of the plane (a DC-10). Cockpit crew saw from their consoles that middle engine at the rear of the plane was no longer operating. Neither autopilot nor crew were in control of the plane because the hydraulic lines (including the fail-safe ones) had all been severed during the explosion in the rear engine. “We had no ailerons to bank the airplane, we had no rudder to turn it, no elevators to control the pitch, we had no leading-edge flaps for landing or slats to slow the airplane down, no trailing-edge flaps for landing” (Haynes, NASA transcript). The specialist United Airlines ground engineering team, whose job it is to deal with in-flight emergencies, were unable to offer any help. The situation was literally unprecedented.

There were two further critical problems. The first of these was that the damage to the rear of the plane was causing it to bank to the right and to fly at an angle of 38 degrees —just seven degrees from the point at which the plane would flip over. By a process of deduction, Capt. Haynes concluded that the only factor under his control was over the power to the engines under the wings, and he used these alternately to balance the plane’s flight.

Second, the plane began pitching, nose up then nose down in a violent, cyclic way known as a ‘phugoid pattern’ that would eventually have caused the plane to crash uncontrollably. Haynes’ intuitive response would have been to reduce thrust when the plane’s nose was down and accelerating and to increase thrust when the nose was up and approaching stall—which it is now known would have crashed the plane. After thinking about it, he took the opposite actions and thus reduced the extent of the phugoid cycle to manageable limits.

Between the explosion and the crash landing of the plane at Sioux Airport, some forty or so minutes elapsed. When the plane crash-landed at Sioux, 112 people died. But 184 survived. Widely seen as a heroic and successful attempt to save lives, the ‘success’ of Flight 232 provides an opportunity for looking at ‘what works’ when facing totally unknown conditions.

3 This case is one of a number used by MIT’s aeronautics course. See also www.iranchamber.com/history/articles/shootingdown_iranair_flight655.php.

4 NASA, Ames Research Centre, California published a 1991 transcript of Capt. Al Haynes’ account of the event (his 53rd speech on this accident). He is addressing an aviation audience, but readers who want a detailed first-hand account should persevere as the account is fresh and fascinating.
ORKNEY RITUAL ABUSE: ON 27 FEBRUARY 1991

Nine children belonging to four families were removed by social workers and police from their families in South Ronaldsay (Orkney Islands, UK) following an allegation of sexual abuse. The children were separated and dispersed to various ‘places of safety’; they were not allowed to take any personal belongings nor allowed direct contact with their parents. The alleged sexual abuse was posed in terms that included the words ‘ritual’, ‘organised’, ‘satanic’. The alleged abusers were said in the press to have involved a significant number of male and female adults, including the local Presbyterian minister. The case attracted a huge amount of press interest.

On 4th April, the Sheriff Court found the grounds for proof incompetent and the children were returned to their families. Following this, Lord Justice James Clyde was appointed in as chairman of the Inquiry in June 1991. After twelve months of enquiry proceedings, Lord Clyde in July 1992 presented his report to Secretary of State for Scotland. The facts as established by Clyde show that there was no ritual or organised abuse of the nine children from the four families. There was no sexual abuse. There was no abuse. These children never made any allegations and consistently denied them.

The key basis for evidence was the interviewing of the children, carried out by the Royal Scottish Society for the Prevention of Cruelty to Children on the request of the Orkney Social Work Department. Liz MacLean was the principal interviewer and interviews were conducted in the presence of another adult (often this was Police Constable Linda Williamson).

The Clyde Report shows that the purpose of the interviews was never spelled out. There was no detailed planning of the interviews by any of the three agency staff. The SWD and other agencies did not seek and made no use of people with deep expertise in the interviewing of children suspected of being victims of child abuse —Clyde is at pains to say how complex and specialised is the need. Audiotape record, where it existed, was highly variable in sound quality. Written notes were equally varied and sometimes obviously inaccurate. The absence of videotape was an especially important gap in understanding how drawings and other visual materials were introduced and by whom and at what point into the interview process. Clyde says "the interviewers tended to pursue matters of central concern to themselves...to pursue their own agenda when the material offered by the children did not immediately correspond to that agenda...the stress on the interviewer’s belief that allegations were true might easily have led the children to consider there was little point in saying anything at variance with what the interviewer said." (14.87)

2. How can we explain the decision-making processes?

IRAN AIR FLIGHT 655

What Capt. Rogers and the people in the command centre aboard USS Vincennes ‘saw’ diverged from the facts that emerged from the various black boxes (but not those of the Airbus, which were destroyed in the attack).

Principally these were:

- Flight 655 was a commercial not a military aircraft
- Flight 655’s transponder was continuously switched on from the take off point and ‘squawked’ the standard commercial signal
- Flight 655 was recorded in the list of commercial flights for that day command centre crew eventually correctly identified the flight by shouting ‘Comair’
- Flight 655 stayed within its proscribed flight parameters – which did not accord with the command centre’s view that its altitude, speed and trajectory signalled an attack.

How might one deduce an explanation of this striking divergence of the perceptions of the Capt. Rogers and crew in the CIC with the facts? The way these elements of the real world were filtered out of his perception—and that of others—is striking and indicates a powerful cognitive process that seemed consistently to lead to perceptual error.

Capt. Rogers was comparatively new to command and to battle conditions. Earlier on that day Rogers had sailed Vincennes towards a minor harassment activity by Iranian Revolutionary Guards in launches. The USS Vincennes helicopter had been despatched to find out what was going on and followed the Revolutionary Guard launches back to their base (that is, the launches were no longer posing a threat) in their own waters. Rogers said that his helicopter had been fired on and followed the Revolutionary Guard launches back to their base (that is, the launches were no longer posing a threat) in their own waters. Rogers said that his helicopter had been fired on and he was giving chase, opening fire on the launches. The USS Vincennes is striking and indicates a powerful cognitive process that seemed consistently to lead to perceptual error.

According to Shapour Ghasemi’s account (2004)7, “the record shows that the decision to fire was taken more or less calmly and deliberately on the basis of personal advice passed from junior officers to the senior AAWC, and from the AAWC to the CO -in the face of a stream of contrary evidence from the electronics aboard”. The mental model that filtered the information for Rogers seems to have similarly affected the perceptions of others in the team in the CIC. It cannot be said then that it was exclusively Rogers’ perception that seemed to screen out apparently dissonant facts.

UNITED AIRLINE FLIGHT 232

How did Capt. Haynes manage to retrieve 184 lives out of what seemed to be a lost situation?

According to Haynes’ own account, the social system in the aircraft was team based. United Airlines had let go of the earlier protocol “that the captain was THE authority on the aircraft” (Haynes) and in the 1980s had switched to a system of distributed leadership. This meant that there was constant communication in the cockpit as individuals carried out their assigned roles as well as roles that emerged during the crisis. “Everybody was throwing out a suggestion...if we had not let everybody put their input in [sic], it’s a cinch we wouldn’t have made it” (Haynes). The cabin crew likewise intentionally helped provide some insulation of the cockpit crew from the passenger anxieties. The volume of data (in the form of ideas and technical information) being produced and discussed in the cockpit and the effective distribution of prior and emerging roles seems to have balanced in a way that enabled Haynes to find ‘cognitive’ space to consider his options.

Another key factor is Haynes’ tendency under these pressures to double-check his intuitive responses before acting on them, for example, in dealing with the phugoid problem. “The hardest thing to do though was, as the nose started up, and [the airplane] started to slow down, and you’re approaching a stall, you’d have to close the throttles—that’s very difficult to do”. Haynes seemed to have a way of understanding his intuitions but creating a time and/or cognitive delay that enabled him to evaluate these. It was the counter-intuitive approach that enabled him to avoid catastrophe. 8

It is striking too how, under the immense pressure of the crisis, Haynes sticks with his routines. He went through the DC-10 manual in detail. He evaluated and eliminated potential solutions. Reviewing these sources of information, together with the constant flow of discussion among the four people in the cockpit meant that a large amount of data was being processed by the cockpit team and, in particular, by Capt. Haynes. An example of this seems to have been the insight that “while the plane was already at a 38° angle- increasing thrust to one engine while reducing power to the other would get the plan to pull out of the flip-over trajectory. This was in effect how Haynes controlled —after a fashion- the inability of the plane to fly straight.

ORKNEY RITUAL ABUSE

What is clear from the Clyde Report is that the key players from each of the three agencies in this story, and principally the SWD, had ‘fastened’, to use Clyde’s strikingly apposite term, on the belief that ritual or organised child sexual abuse had taken place. What is not clear is how this paradigm became formed.

6 John Barry (Newsweek, 13th July 1992)
7 Shapour Ghasemi, Shooting down IranAir Flight 655, 2004 www.iranchamber.com/history/articles/shootingdown_iranair_flight655.php
8 Paradoxically, Haynes found some intuitive/emotional habits difficult to eliminate. For example, it was taking two of the cockpit crew to physically move the yoke (‘the steering wheel’). “We were reasonably sure that we weren’t accomplishing anything with the yoke, [yet it took] all four hands, now we had to let go of the throttle, move a throttle, let go of the yoke…” (Haynes)
Clyde thought that the social workers and others were well intentioned and genuinely believed that they were acting in the best interest of the children. Yet the unintended effect of their decisions appears with hindsight to be cruel and, perhaps even, abusive to the children. How was the paradigm that shaped the perception and behaviours of the staff concerned formed? First, it seems clear that there was a pre-disposition to believe that abuse had taken place and that it was organised and ritual.

We cannot be certain but it is likely that this pre-disposition emerged from a mid-1980s and early 1990s narrative (also referred to as a mass-hysteria) in social work and psychology circles. David Lotto9 wrote in 1994 “allegations of ritual cult abuse (RCA) and Satanic Ritual Abuse (SRA) have reached near epidemic proportions”. He referred to a 1991 survey of American Psychological Association members that found that over 800 therapists had reported treating cases of ritual or religion related abuse, alongside many publications on the subject in the clinical literature. Lotto quotes a ‘Cult Crime Impact Network’ estimate that as many as 50,000 human sacrifices a year were carried out by satanic ritual sexual abusers.

Liz Maclean, the lead interviewer, had spent a sabbatical training period in 1990 in the Minneapolis Centre that specialised in the treating of sexual offences. It is highly likely that Maclean will have had considerable exposure to the US discourse. More to the point, the American discourse had already made it across the Atlantic and was becoming current in British social work and child protection circles. It is known, for example, that British agents for the American group, Believe the Children, circulated information about ritual child abuse to British social work departments and to police services10.

Second, this predisposition was critical in shaping the initial perception of facts and thus the choice of interview methodology (the adoption of a ‘supportive and development’ interview model rather than an investigatory evidential model). Once the notion was established in the minds of the members of the team of social workers, police and RSSPCC staff, that there was a conspiracy to abuse children involving all of the adults of all of the families and other local adults in the community, including the Presbyterian Minister, then it became impossible to trust any one person on the island. All material things could then become significant – toys, play clothing (for example, turtle outfits), other clothing etc. No evidence from the local community could then be acceptable. The agency workers, it follows, then had to depend on what the children could tell them. Hence everything had to turn on the interviews of the children. Even the foster carers, to their own frustration, were excluded from the work of the agencies for fear of “contamination”, a term frequently used by the agency workers. However, as the case summary shows, the interview model and process were inappropriate and deeply flawed. In any event, Maclean herself kept no notes of the interviews and therefore deprived any potential professional supervision of any material on which to reflect.

Third, there was a strong sense of urgency, probably derived from fear of further abuse and damage to the children, in removing the children from their families. Clyde said of the

10 Lotto, op.cit.
3. Mental Models

Mental models are representations of the real world that are mainly unconsciously formed and retained by the mind. They are formed as a consequence of the mind learning from repeated patterns of action that successfully achieve their objectives—they therefore emerge from past experiences. However, we use mental models predictively, that is, looking toward a predictable unfolding future.

The mental model is a good-enough simplification of the real world object. This is because "limitations in memory and processing capabilities mean that humans cannot handle the totality of the information displayed in their environment". Mental models operate by selecting from the totality of data that experience presents. Thus, they screen in and screen out data.

Neuroscience shows that the brain’s models of how the real world can be expected to operate are formed principally by experience. The brain’s regions for generating emotions carry out a great deal of analysis of experience in order to reach an emotional pre-disposition to do something. These emotions in most cases play the most decisive role in the routine decisions that we make. Where the predictive outcome is not achieved, the ‘thinking brain’ detects the error through negative feedback and quickly corrects the predictive model.

This benign system only fails when it is faced with new situations in which there is an insufficient or non-existent volume of experience on which to base the emotional brain’s pattern recognition analysis. Faced with such a situation, the emotional brain—used to rapid reaction times—may react with a response that is ‘intuitive’ but fundamentally wrong.

In such circumstances, effective challenge of the mental model depends on rational brain over-riding the impulses of the emotional brain, which is, under normal circumstances, the major determinant of human decision-making. The amount of 'clean' thinking time available to find a solution is a key issue too as the rational brain has to work at a considerably slower rate than the emotional brain. Lieberman reminds us that our minds have a preference to use heuristics to simplify decision-making (p127) and that the use of the mentalising system requires intentionality and effort, something we may have a preference to avoid.

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12 One of the earliest insights in this area was in Descartes’ Error, 1994, in which Antonio Damasio shows the necessity, in decision-making, of the brain areas that produce emotion.
13 Lieberman, M.D. Social: why our brains are wired to connect, OUP, 2013.
14 He quotes a laboratory study by Demontheil & Blakemore that shows that using a heuristic approach and avoiding the use of the mentalising system led to a 45% error rate in effective task completion.
The case studies described and analysed in this paper indicate some factors that may make mental models deeply embedded and difficult to recognise.

The first of these factors is **predisposition**. Both in the case of IranAir Flight 655 and the Orkney cases, there appear to be pre-existing factors that led to the main players finding it difficult to absorb contrary evidence.

Second, the **social nexus** in which people facing complex and critical situations operate can make it difficult for contrary evidence to be considered. 'Cognitive overload' can be caused by panic or extreme fear of role failure or by trying to carry out too many roles simultaneously. When these roles become difficult to achieve, fear of critical role failure can then become a major psychological obstacle to problem-solving capability. Writing about another air disaster (the Kegworth crash when 47 people died near East Midlands Airport, UK, 1989), Besnard and Greathead explain: “Saving cognitive resources biases mental models in such a way that partial confirmation is easily accepted. Instead of looking for contradictory pieces of evidence, mental models tend to “wait” for consistent data.” They argue that the co-occurrence –two unrelated effects occurring in the same space/time frame- reinforces the belief in partial evidence, thus maintaining “as valid, representations that have already departed from a reasonable picture of the reality”.

Third, when mental models become shared in a team, **team dynamics** are hard to manage when facing contrary evidence. This was apparent in the command centre below decks on USS Vincennes. It was also the case in the Orkney Social Work Department in which there were reservations about the direction of the investigation but these were unable to make sufficient headway in the face of the now hegemonic paradigm.

Finally, **mental model revision is cognitively costly**. In each of the case studies it is clear how the sense of diminishing time within which to find a solution, together with the other cognitive-overload factors described above, provides a strong drive to confirmation bias and certainty bias, even where these may prove fatal.

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4. Managing in crises – four lessons

While few of us will be called upon to fly a plane out of a crisis, several of us will face situations in which the mental models through which we routinely work may prove harmful for our clients or our businesses.

The lessons that emerge from this paper suggest four things that we can do.

Resist the impulse to implement the obvious ‘right thing to do’ by slowing down the considerative process so that ‘the right thing to do’ is subject to questioning. Achieving this degree of mental discipline can be difficult because of another innate feature of our brain – the bias for certainty. Edward de Bono’s white hat and black hat come to mind here as helpful tools.16

Second, be systematic and go through one’s normal routines, checking the facts, what has worked before, opening up the matter for others’ ideas. If the situation being faced is truly new, then this process is unlikely to yield a solution but it might rule out other potential inaccurate diagnostics. More importantly, going over all available data could help build the volume of data that needs to be considered. The sudden, ‘Aha moment’ that can often occur and that creatively finds a way through the crisis, comes from the processing that takes place in the rational brain (the so-called working memory) and it may well use these data as the raw material from which to build the creative insight.17 Similarly, Weick (referring to Eisenhardt18) advises that “non-stop talk, both verbal and non-verbal, is a crucial source of co-ordination in complex systems that are susceptible to catastrophic disasters”.

A third action should be to insulate oneself from cognitive stress – find ‘cognitive space’ - in much the same way as Capt. Haynes trusted the cabin crew to carry out their roles in the passenger compartment and asked his cockpit crew to do other tasks relating to the diagnosis of the aircraft’s problems while he focused on thinking about a few critical issues.

Fourth, leaders and managers can shape the dynamics of their key teams by getting a diversity of people and styles in the team. Arguments about political correctness are irrelevant here. The key issue is not about gender or ethnic equality but about the likely capacity of top teams to be able to create and sustain the group equivalent of ‘cortical dissonance’. Diversity does not guarantee this – it is essential that the group’s process is open and challenging – but not having such diversity may be a reason to start being concerned about the potentially self-limiting capability within top teams.

We should be cautious about trusting our intuition in critical situations. Well-known OD practitioners and writers like Margaret Wheatley (Leadership and the New Sciences) and the leading thinkers at Hertfordshire Business School (such as Ralph Stacey and Patricia Shaw (Managing the Unknowable, Changing Conversations in Organisations, respectively) were deeply influenced by the ways of thinking emerging from the so-called ‘new science’. They are struck, for example, by the way apparently chaotic behaviour at a sub-atomic level creates, over hundreds of interactions, clear patterns that express an underlying order. The expectation of an underlying order leads them to be skeptical of structure and to privilege non-linearity in thought. Other thinkers19, also influenced by quantum physics, critique the linear thinking of the Cartesian intellectual tradition and point out the non-linearity of organic systems. These thinkers all privilege the notion of ‘emergence’ which is often seen as the product of non-linear processes. Yet the evidence in this paper is that perhaps we need both forms of thinking and that in critical circumstances they may be co-dependent. It is through the linear consideration of many types of data out of which the creative solution will emerge.

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16 Edward de Bono, Six Thinking Hats, 1985.
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