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"Adapting C2 to the 21st Century"

A Sensemaking Experiment – Enhanced Reasoning Techniques to Achieve Cognitive Precision (Abstract Acceptance I-070)

Topics: Track 4 (Cognitive and Social Issues); Track 6 (C2 Metrics and Assessment); Track 5 (Organizational Issues)

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Abstract

The purpose of this research was to conduct a pilot study of techniques from Klein Associates and Cognitive Edge to improve military sensemaking, specifically in the area of Cognitive Precision – FSD defines it as the "collection and connection of the right dots", i.e. relevant data. Several obstacles to cognitive precision were identified in the areas of seeing information (info overload, pattern entrainment, bounded awareness), sharing information (groupthink, compartmentalized knowledge) and finally, acting on the interventions directly targeting these problems – abstraction of situation to a higher level, enforced alternative and hypothetical reasoning, greater diversity and externalization of insights for discussion or critique, etc. These interventions were tested with 7 groups of military and intelligence personnel in the context of two "garden-path" type scenarios – a military planning task and an intelligence assessment task, within which were embedded weak signals for detection. While the experiment successfully demonstrated many of the above-mentioned obstacles; more importantly, it was found that the interventions as a whole proved useful in amplifying and identifying weak signals which were otherwise seldom detected. The next step would be to systematically assess and select the most useful interventions to form an Anticipatory Thinking Model, as a means to improve cognitive precision for Sensemaking.

Sensemaking can be defined as "exploiting information under conditions of uncertainty, complexity and time pressure for awareness, understanding, planning and decision making." With superior sensemaking, it is expected that individuals and teams will be able to better handle situations despite uncertainty and information overload, make faster and better decisions with regard to the adversary, and finally, prevent fundamental surprise.

Under the umbrella of Sensemaking, Future Systems Directorate has identified six key desired outcomes to work towards in order to have superior sensemaking for the SAF. These are: Adaptivity, Cognitive Precision, As One, Reliable Instincts, Augmented Cognition and Rapid Cognition. Under each of these broad outcomes are several concept solutions in the form of processes, structures, technology tools and systems etc. that can be applied to achieve the desired outcome. This experiment focuses on the outcome of Cognitive Precision.

BACKGROUND

Cognitive Precision is essentially having teams and individuals well-aligned to reality - getting the most accurate, unbiased perspective of the problem by taking into account relevant weak signals before arriving at an unbiased hypothesis or solution to the problem. One main problem that hinders achievement of Cognitive Precision is insensitivity to weak signals. This historically well-documented phenomenon, most recently exemplified in events leading up to the 9/11 incident, is often colloquially

referred to as problems in both "collecting[1]" and "connecting the dots". The ability to identify relevant pieces of information within a sea of 'noise' is made harder by the effects of conditioning – with greater exposure to irrelevant, unimportant information, one's threshold of detection is raised, making it increasingly difficult to pick up the right signals. On the other end of the spectrum is the issue of hypersensitivity – being overly vigilant and cautious, hence falling prey to 'false alarms'.

What causes insensitivity to weak signals?

Looking to the field of social and cognitive psychology, there is also ample literature on *cognitive biases* and the instinctive use of heuristics in assessing situations and making decisions by individuals and teams. These include confirmation bias[2] - a study was previously done on this by FSD ("Countering Positive Confirmation Biases in Command Teams: An Experiment with Different Interventions", Oct 2004), groupthink, primacy and recency effect, availability heuristic, etc. These biases contribute to *inaccurate situation assessment and skewed decision making*, and when taken together, can often magnify a small error in judgment.

Also, there exists the problem of *compartmentalized knowledge* between individuals and teams, again exemplified by the events of 9/11, which saw the various US security agencies working separately and not sharing information to the nation's detriment.

The concept solution of Enhanced Reasoning comes in here – reasoning techniques introduced at both team and individual levels to mitigate inherent biases, encourage the application of useful heuristics and facilitate detection of weak signals towards achieving the best solution. Other solutions to Cognitive Precision are "Massive Sensemaking" – exploiting computing power to process and identify patterns within large amounts of data, a form of automated, large-scale data mining; and "Wisdom of the Rest" – extracting opinions and insights from large numbers of experts and non-experts alike.

EXPERIMENT OBJECTIVES

The objective of this experiment is to assess the effectiveness of various interventions in improving detection of weak signals at both team and individual levels. As mentioned earlier, this can be broken down further into several contributing problems, which the interventions are intended to solve. Esssentially, the issues underlying Cognitive Precision can be summarized into a **See-Attend-Act** model of Sensemaking (although this was only formalized post-experiment) - *Do we see the data? Do we pay attention to the data? Are we able to act on the data?* In a team setting, underlying all this is the notion of **Sharing** awareness, information or even opinions at any of the 3 levels.

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[1] Libicki, M. & Pfleeger, S.L. (2004). *Collecting the Dots: Problem Formulation and Solution Elements.* RAND Corporation Occasional Paper, OP-103-RC.

[2] Actively seeking only information that confirms one's hypothesis even in the face of disconfirming evidence…

To enable participants to better handle these questions, FSD, together with Klein Associates and Cognitive Edge, came up with several possible solution areas that are then implemented through various experimental interventions.

Developing new perspectives on the situation. Use of a high abstraction language would allow decision makers to gain new perspectives on a situation, which is presumed to facilitate assimilation of more data and provide more flexibility during re-planning.
Interventions: Attraction/Barrier description; Crystal Ball

Also, breaking the normal linear patterns of planning and decision making could increase the "after action" learning of a group and its ability to consider otherwise discounted events.
Intervention: Future Backward

Dissent. The problem of compartmentalized knowledge between teams and individuals can be avoided by either "forcing" or encouraging knowledge-bearers to share their information and views. This should be done at different points while parallel processing (planning and execution) is going on, as a checking mechanism to ensure common ground is maintained and information flows between all parties involved. Placing decision makers in a context where they confront failure without threat and separated from the formal decision process will reduce entrainment and increase the number of factors they take into account.

Inherent cognitive biases, particularly confirmation bias and groupthink, may also be mitigated by reducing inherent fixation and encouraging dissenting views between individuals. Through dissent, teams are less inclined to readily adopt the dominant view of the situation, as this allows consideration of minority opinions of the group. On the individual level, exposure to differing opinions reduces the tendency to be fixated (or pattern-entrained), as individuals are now more likely to question their assessments and decisions upon hearing the opinions of others.

Interventions: Ritualized Dissent, SA Calibration.

INTERVENTIONS

A range of methods from Cognitive Edge and Klein Associates that were chosen as possible ways of improving weak signal detection, and hence used as experimental interventions are described as follows.

1. Crystal Ball

The Crystal Ball exercise was developed by Marvin Cohen (see a description in Klein, 1998) to enable constructive criticism of assessments. When we critique our own assessments, we are hoping that we won't find any show-stoppers, any flaws that can't be fixed. In a team setting, people are often resistant to criticizing the ideas of others. The Crystal Ball provides a format that supports a productive critique of assessments, leveraging input from all team members. With a Crystal Ball technique, the group is told that while they have the right information, the assessment they have made is incorrect.

Then through mental simulation, the group attempts to come up with alternate assessments based on the given information. The intent is to prevent fixation and force team members to think differently in order to uncover critical flaws and areas of concern that are otherwise ignored. Once this is done, the group can look for more than one possible solution.

***2*. Ritualized Dissent**

This method was developed in the Cynefin Centre to overcome problems of group-think and pattern entrainment. It should not be confused with the more commonly known method of Devil's Advocacy in which dissenting opinions are introduced. In ritualized dissent, different groups of people engage in the same process and then send a spokesperson to another group to present their ideas. Following completion of the presentation the spokesperson ritually places his/her back to the audience and is not allowed to explain, argue or justify their position while the audience engage in an all out attack on their ideas. Unlike Devil's Advocate approaches, where the outsider's criticism can easily be rejected by the group, here the "devil's advocates" in each group have been through the same process. In effect, learning takes place in two ways: (i) in being forced to listen without response, the person subject to attack is not mentally preparing a rebuttal (as would happen in normal discourse) since no rebuttal is allowed, and (ii) the audience, in criticizing the other person's position, often realize flaws in their own arguments. The ritual turning of the back by the person on the hot seat helps to depersonalize the criticism and to increase the attention of the person on the hot seat who has no eye contact with the critics.

3. Attractors/Barriers (AB) Framing

The Attractors/Barriers method guides the decision maker to view the features of the situation in terms of ways to facilitate or interfere with desired outcomes. In a complex system it is not possible to predict outcomes with any degree of consistency. As multiple agents (individuals, ideas, decisions etc.) constantly interact one with another the number of possible patterns that can form from the various interactions makes it impossible to predict. However, agent interaction takes place within barriers and around attractors, perhaps better understood as "attractors attract and barriers repel". The AB method provides an analytic approach to a complex problem by getting the participants to describe the situation not in terms of causality leading to predictable outcome, but instead to describe the nature and type of attractors and barriers that are in play. In effect the situation is described at a level of abstraction from reality to allow the decision makers to focus on the evolutionary characteristics of an unpredictable space. Abstraction is a key aspect of human language and its evolution, and high levels of abstraction within shared context allow for a more efficient way of describing a situation then low abstraction techniques. AB additionally focuses on those abstractions of a decision space which can be changed and which are tangible.. The approach is normally to provide a metaphor (the children's party, sharks at a beach, fences round swimming pools) to allow people to take on board the concept and then have them describe the situation as a set of attractors and barriers, focusing on which they can control and which are out of control, which are stable which are volatile etc. Experience has shown that the approach only works where

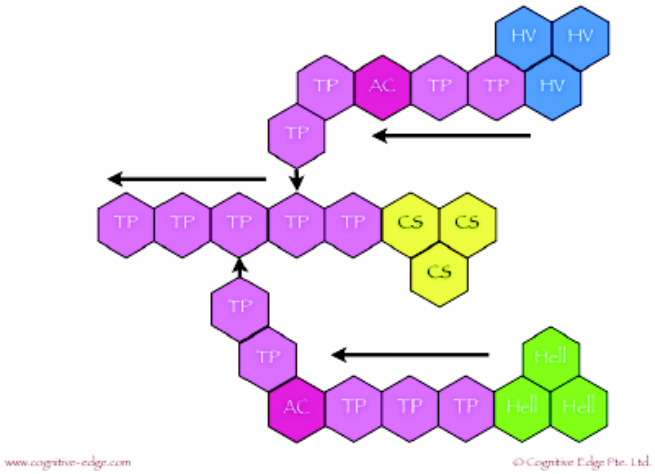
people are describing a position of (from their perspective) future uncertainty. It does not work where people attempt to explain the past as causality there is known.

4. <u>Future Backwards</u>

Originally developed as an alternative to scenario planning, this intervention aims to extend the range of possibilities that people will consider. The process is fairly simple and can be run over several hours or 10-15 minutes depending on the consequence. The intention is to gather the maximum possible number of decision or "turning" points in the past and possible futures, thus emphasizing interventions or decisions. The following sequence is recommended:

1. The group identifies the "current state" as a limited number of decisions or situations that they face.
2. They then step backwards (facilitators have to monitor closely for stepping forwards) to the last significant set of decisions (a turning point) that gave rise to the current state of affairs.
3. Following this, they continue to step backwards through turning points until from their perspective, there is no longer any significance. No guidance is given as to how long they should do this and the differences in time periods between different groups given the same task can be very useful.
4. The group then identifies 2 possible future states: Heaven and Hell i.e. impossibly good or bad future states. They are instructed to make these incredible, i.e. not a real best and worst future.
5. Having achieved that they are then instructed to make the impossible futures "happen" by stepping backwards through turning points to a point BEFORE the current state, including if desired one major accident or surprising event.

The goal of this method is to extend the scanning range of the decision making group. Cognitive Edge found that by having people engage in hypothetical reasoning around a highly certain event (e.g. a future state that is presented as a given), they work more diligently and creatively than when dealing with highly uncertain future states – this is a benefit of prospective hindsight.



5. <u>SA Calibration Exercise</u>

Situation Awareness (SA) refers to people's understanding of the environment (what they see and perceive around them) based on intelligence reports, threat, orders from HHQ, adjacent unit actions, etc. Good SA provides a basis for sound decision making. If people's view of the world is inaccurate, their decisions will likely result in a suboptimal outcome. The same is true for teams: if they fail to establish and maintain a common understanding of the dynamic battlefield, they will not be able to execute the Course of Action (COA) smoothly and accomplish the mission. The challenge in building SA in a team is that if everyone sees the world the same then the team loses a diversity of viewpoints. But if everyone sees the world differently then common ground breaks down and coordination becomes difficult.

The SA Calibration Exercise provides participants with insight into how others view the battlefield. It helps them understand the subtle cues and environmental factors that affect others' actions and decisions. The SA calibration exercise taps into key aspects of the mission – aspects where concordance is essential such as goals of the mission. In order to obtain data, the exercises were interrupted and the following questions asked (of individuals):

1. *What is the immediate goal of your squad/team?* This question examines how well the commander's intent was understood and remembered. Often, team members only report the big goal (e.g., win the war, take the city) and fail to report the immediate sub-goals (e.g., take the radio tower, suppress the sniper).
2. *What are you doing to support this goal?* Team members must understand both the goal and what they are supposed to be doing to support that goal.
3. *What are you concerned about?* This question could also be phrased, "What are some factors that could hinder your unit from achieving you goal?" This question helps uncover how participants are interpreting events on the battlefield or in a threat situation. Some participants are worried about their ability to achieve the immediate goal (e.g., "I'm worried the sniper will get me before I can get him.") while other team members may express a broader range of concerns (e.g., "there's another sniper in another building," "civilian causalities," "am I doing my job right?").
4. *What is the current threat location, size, and intention?* This question served as a reality check on how each person had assessed the battlefield/situation. This illustrates how participants understand the importance of maintaining a "big picture" view and avoiding tunnel vision
5. *What do you think the situation will look like in 24 hours (for the military scenario) or one month (for the homeland security scenario) and why?* The responses to this question can facilitate a discussion about how different pictures of the future battlefield are affecting current execution. This can lead to tweaking the plan or gathering lessons learned for the next exercise.

In addition to being an intervention, the SA calibration exercise is also a method of data collection, by providing experimenters with the ability to peer into an individual's cognitive sense-making processes and see how those individual processes were affecting the outcomes of the teams.

EXPERIMENT SETUP

Scenarios & Experiment Runs. Two scenarios were used in the experiment – one was a strategic/operational level military planning task, the second was to assess a homeland security situation for potential threat. Each scenario targeted the appropriate group of participants, i.e. military scenario for military participants, and likewise for homeland security. The experiment runs were conducted to best observe effects of the Enhanced Reasoning techniques (if any), by first running the scenario for a length of time and subsequently introducing the various techniques as experimental interventions at appropriate points in time. In this way, a reasonably objective comparison can be made between individuals' and teams' ability to detect weak signals, as well as associated behaviour, pre- and post-intervention. The expected effects of these various interventions were not made known to the participants prior to the runs in order to avoid the Hawthorne effect[3]. Previous work by Cognitive Edge (DARPA- Genoa II) had established that sense-making techniques work best when the subjects are dealing with conditions of uncertainty, i.e. they have to be tested and developed in as near a possible an environment to real-life rather than in any retrospective study or simulation.

i) Military Planning Scenario. This was designed to bring out the naturalistic biases one would bring to such a situation, specifically falling for the "Garden Path[4]" laid out within the scenario. It was tailored from a standard SCSC planning exercise that many participants would be familiar with, which adds to the probability of them making erroneous assumptions based on the most salient information available. In reality, the mode of enemy attack differed from what would be conventionally expected; this was suggested through pieces of information provided to the participants at the start, as well as injects administered in the course of the scenario. Participants had to develop a credible plan encompassing all levels (strategic, operational and tactical) of warfighting, within the allocated time of approximately 3 hours, including time for interventions.

ii) Homeland Security Scenario. This was also tailored from a full-scale terrorist attack scenario generated by Strategic Policy Office, with the timeline and number of elements compressed. In this case, participants did not have to formulate a response to the terrorist threat, but had to assess the rapidly evolving situation to best determine the nature, location, time etc. of the imminent threat. A large amount of information was pumped to the participants almost continuously throughout the approximately 3 hour runs, some of which were erroneous (conflicting) or irrelevant. Hence the biggest challenge was to piece together the relevant ones to arrive at an accurate situation assessment.

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[3] A phenomenon often quoted in organizational psychology first observed in the 1920s that refers to changes or improvements in behaviour resulting from the mere fact that subjects knew they were being studied or observed. Placebo type' effect…

[4] Being led down the Garden Path i.e. mistakenly following a path that seems right but is actually wrong.

Subjects. There were 7 groups of participants each with 4-5 members. They were from both military and homeland security agencies and represent a good spread in terms of background, job responsibilities and experience. It was important to get participants whose daily roles involved military planning and situational assessment, so that they would be familiar with what the experiment entailed, and also in the hope that the interventions could be subsequently implemented in their work.

Data Collection. Three types of measures were employed for "data collection" to validate the effectiveness of the various techniques towards cognitive precision.

i) Objective measures in the form of Future Backward and SA Calibration data provided "states of mind" of participants, in terms of situation understanding and decisions made at various points in time. AB framing of situation features.

ii) Subjective impressions of participants reflected in Narrative Captures and indexing of trust levels, team dynamics, expertise, dissent, information scanning range, etc. Also, Assessment Questions were asked on new insights and if anything could have been avoided.

Narrative Capture. Narrative capture was used to record the experiences of participants in story or anecdote form. At break points in the exercise, the participants simply typed incidents that they deemed noteworthy. This process allowed participants to capture their own thoughts and experiences from a uniquely individual perspective without mitigating, group conformity behaviours coming into play. The narratives were then indexed by participants according to factors and themes of interest to the experiment.

iii) Observations by personnel from Klein Associates and Cognitive Edge, both live and video capture.

Results & Discussion

This experiment addresses the issue of Cognitive Precision, specifically that of improving weak signal detection. The interventions introduced in the course of the experiment runs were designed to overcome the problems of compartmentalized knowledge, cognitive biases such as groupthink, confirmation bias etc. (described above) that contribute to insensitivity to weak signals. Based on the **See-Attend-Act (Share)** model described earlier, these interventions attempted to enable participants to perceive, pay attention to, share and lastly, act on weak signals present in the environment, and hence respond more quickly and alertly to early signs of trouble[5]. The results and discussion section is organized according to this model.

[5] Klein, G., Pliske, R., Crandall, B. & Woods, D. (2005). *Cognition, Technology and Work* Vol 7, Issue 1 (March 2005) Pgs 14-28. ISSN:1435-5558

Seeing the data – Did anyone notice the weak signals?

The Narrative Capture exercise elicited 77 anecdotes from 34 participants. Consistently across groups, certain individuals would notice weak signals early in the exercise. Typically, half the group detected the weak signals and in one experiment run, narrative capture showed that one individual had divined the enemy's intent (and the ultimate outcome of the scenario) by the end of the first run, even though very few signals were present. This was an unexpected finding, because as a group, they were not detecting or paying attention to those signals. This was corroborated by observational data where either discussion and dismissal of weak signals or no mention of weak signals was observed. That individuals noticed weak signals early was an encouraging sign given the (intentional) high levels of obscurity applied to those signals in the exercises; however, the failure to act on the weak signals was a concern. This will be dealt with in a later section.

The *Crystal Ball exercise* proved to be an effective intervention for forcing participants to think through alternative reasoning patterns and break free from pattern entrainment at the group level. When participants were asked to give a current assessment of their situation, their responses reflected a "garden path" thought process. When told their initial assessment was incorrect and they needed to provide alternative reasoning, it was found that people became much closer to the reality of what was happening, e.g. picking up key weak signals like the critical day for the homeland security scenario being National Day.

Likeiwse, after interventions such as *AB Framing (A/B)* and *Future Backwards (FB)* were introduced, there was an increase in individuals noticing weak signals early, as captured in narrative form. Additionally, the weak signals began to make a stronger appearance in whiteboard plans and in the calibration measures once interventions were in place. This was corroborated by an increase in the explicit discussion and consideration of possible alternative courses of action and likely events in the groups as noted in recorded observations.

Attending to the signals.

FB and A/B Framing were used as interventions to improve the detection of and attention paid to weak signals. Additionally, both these techniques sought to improve the range of possible outcomes and alternative actions contained in the scenario with a view to stimulating inclusion of that information in flexible action plans. When compared with the control group, it was evident that interventions stimulated awareness of the weak signals and alternatives to varying degrees. The main success of *A/B Framing* was in improving overall understanding of intent, whether behind a mission or for gathering information, with the creation of AB lists from various perspectives allowing groups to have more extensive discussion and a better understanding of the situation. This led them to consider more possibilities. *FB* improved scanning capability and understanding of

possible unconsidered scenarios to an even greater extent. It also served as an after-action review (learning process) for the teams when conducted at the end of the experiment run.

After the *Crystal Ball* exercise, participants continued their experiment run by evaluating the alternative explanations they had identified. It was observed that they paid more attention to conflicting information subsequently.

Sharing the Awareness - Differences between individual and team views.

At each of the 3 narrative captures, individual dissent from group opinion showed through clearly. As discussed above, there were early indications of weak signal detection. In addition, the individual narratives indicated that teams were not as well-calibrated as other measures (e.g. SA Calibration) and observations might indicate. Observations of team cohesion were somewhat moderated by observations of disparate views and dismissal of alternative points of view. One reason for this could be that SA calibration measures were direct and structured with "expected answers" relatively evident to participants, whereas the narrative capture process is indirect and perhaps better allows for expression of dissenting views. Narrative capture data indicated there were several opinions within groups as to assessment of the 'current situation', the 'proposed plan' and what might actually unfold. As interventions were introduced, the disparity between individual stories and the collective discussion (and group plan) appeared to diminish; this was particularly apparent when *Future Backwards* was conducted.

Level of debate increased. Perhaps the most significant observation arising from these interventions was that the level of debate, animation and dissenting voice increased during and after these interventions, particularly after Future Backward and Ritualized Dissent exercises. In some cases where participants had said nothing or very little in preceding interactions, they now took an active role and provided new insights and challenges for the group. While not all insights and points of view made it into plans, there was certainly a marked increase when compared to the group that did not use these interventions.

It was also observed that deference to rank appeared to lessen during these exercises, although this statement has no corroboration in other measures and is simply an observation. Interestingly, *Future Backwards* was rated the most popular of the methods, creating high levels of engagement and post event learning. While *Attractor-Barrier Framing* was judged as conceptually difficult, it was still rated 3rd among the interventions for usefulness and likelihood of being used.

Overall, SA Calibration data showed that the interventions resulted in a slight increase in calibration for 2 out of 3 teams that participated in the homeland scenario and 3 out of 4 teams that participated in the military scenario, and decreased calibration for the rest of the teams. Of the teams that benefited from the intervention, SA calibration improved an average of 10%. The challenge, therefore, is to find ways to improve these

scores without reducing the useful diversity of viewpoints essential to effective team sense-making. See **Annex A** for figures of SA Calibration levels.

Acting on the signals – Translating awareness to action.

Even though teams were generally more explicitly aware of weak signals and alternatives (as indicated by Assessment Questions), this awareness had significantly varied impact on the plans and behaviour of the teams i.e. the Acting stage of See-Attend-Act model. In 2 instances, following a Ritualized Dissent intervention, teams actively revised their plans to make provision for unexpected scenarios and built in more contingency. Additionally they began to question the state of the data received from superiors and consequently got relatively close in predicting the final outcome of the experiment.

An instance of groupthink. At the other end of the scale, one team refused to accept any of the additional insights, even though these were provided by a team of external, senior ranking experts, during a Ritualized Dissent/Crystal Ball exercise, and did not include any of the information in their plan. In fact, this group perceived that the expert panel had in fact corroborated their plan. This team proved an interesting example of group-think. As a group they appeared to be extremely confident and fixated in their approach. However, individual narrative capture and the use of assessment questions with this group *individually* (rather than as a group, as for all other teams), showed that the individual members varied significantly in their perspectives. One team member was relatively close in predicting the ultimate outcome and aware of the telling signals yet this did not translate into any impact on the group's plans.

RECOMMENDATIONS

On Interventions

1. The *Crystal Ball* and *Ritualised Dissent* techniques should be formalized and their use institutionalized into situational assessment and 2-sided type exercises. All of these are high impact, low-time requirement methods. Other similar techniques can also be included to ensure variety and consequently, novelty. If the same method is used consistently, it will become familiar and hence capable of being "gamed". Their formalization should include an awareness that they work best when a problem is not broken down into sub-components and the solutions assembled (i.e. reductionist approaches to assessment and decision making which are common), but when groups work in parallel on the same issue and compare results.

2. *AB Framing*, while shown to have considerable potential, requires additional development to reduce its conceptual nature (and the requirement for education). Though the different metaphors used to introduce the technique to participants helped considerably, ideally, a non-conceptual and intuitive front end should generate AB representation. Once this is achieved, futher experiments can be scheduled to test its efficacy. One possible way to facilitate creation of AB representation is through the use of narratives. Also, through the index structure of the narrative, such as in the RAHS

software, the ***see-attend-act*** aspects of the Sensemaking model described earlier could be tested. Preliminary work was done in the Snowden-Juarrero experiment (Sep 2006)[6] with success; the prototypes of the software created for this purpose will be available as part of RAHS by March 2007.

3. *Future Backwards* is ready to move into operations as a formal method for after action review and should be linked to narrative capture, and narrative based knowledge storage. As with the above, an experiment using the RAHS software to create a demonstrator could be set up and formal adoption considered thereafter.

CONCLUSION

An expected outcome of this collaboration with Klein Associates and Cognitive Edge on this Sensemaking Experiment is an **Anticipatory Thinking Model**[7] that can be applied by individuals and teams in operational settings of military, peacekeeping and homeland security etc. to achieve Cognitive Precision. The term anticipatory is used instead of the conventional "predictive", as the latter connotes a level of omniscience that does not usually exist in the inference of future events. In this experiment, we effectively started work on the creation and testing on such a model. The core of the model is Attractors and Barriers – i.e. what attracts effective anticipatory thinking, and what gets in the way? In this respect, it is important to note that attractors and barriers are not used as an alternative way of describing a decision space (as with the experimental intervention), but in a "meta-sense" for anticipatory thinking. By this token, some Barriers to anticipatory thinking would be the problems identified earlier (e.g. cognitive biases, compartmentalized knowledge) while Attractors could be based on the underlying principles of the interventive methods, such as alternative explanations of a situation, Ritualized Dissent etc.

The ***See-Attend-Act (Share) model*** of Sensemaking was an interesting and important discovery from this experiment. However, as this was only formalized post-hoc, this experiment was not designed to assess the different impact of the interventions on these three (or four) aspects of Sensemaking, leading to increased cognitive precision. A series of experiments should be set up to test this to greater detail, and FSD can consider the wider application of this distinction in our other Sensemaking experiments.

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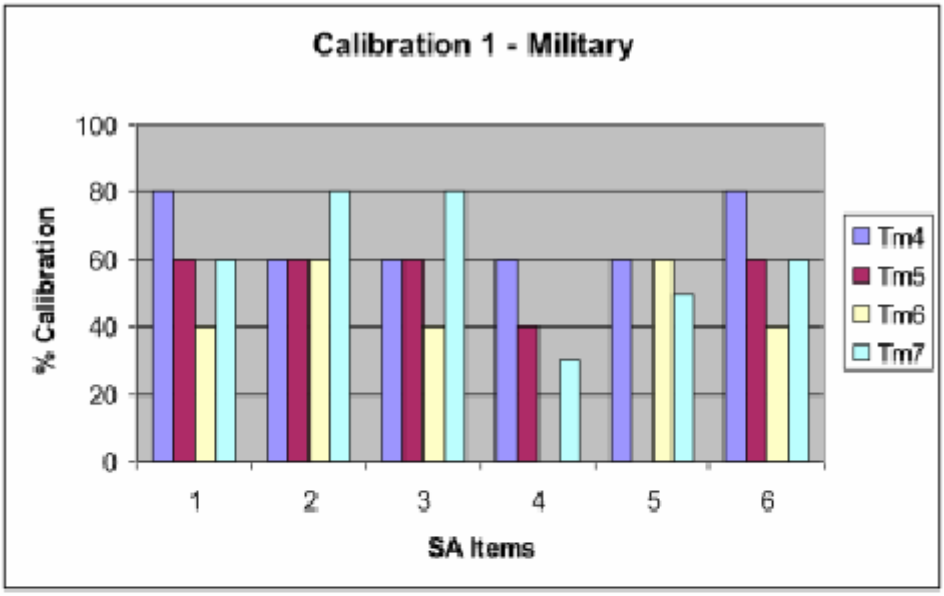
[6] Insert reference/ notes on experiment.

[7] Lazaroff, M. & Snowden, D. (2006). Anticipatory Models for Counter Terrorism. Chapter in Emergent Information Technologies and Enabling Policies for Counter-Terrorism, (Eds: R. Popp, J. Yen), Wiley-IEEE Press, June 2006.

Annex A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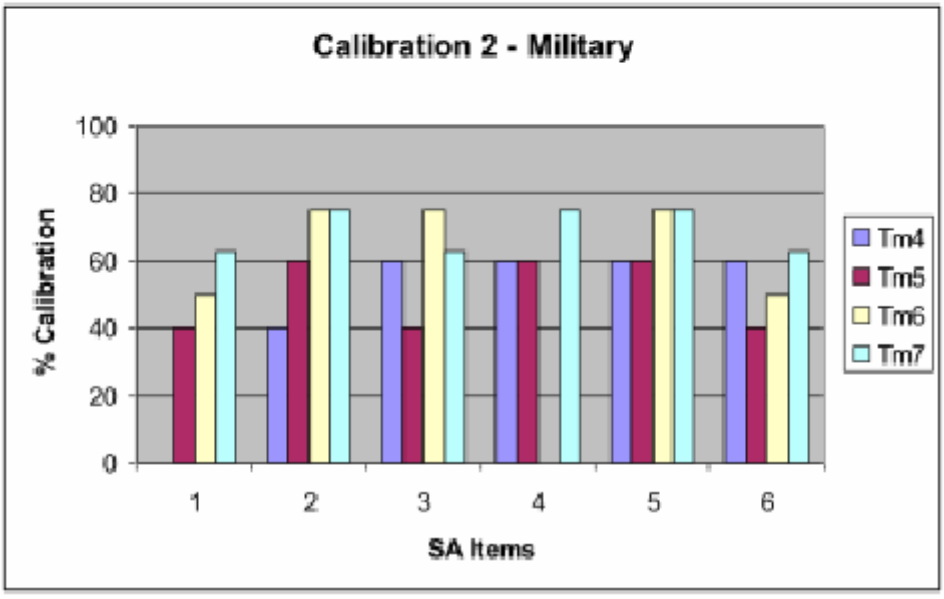
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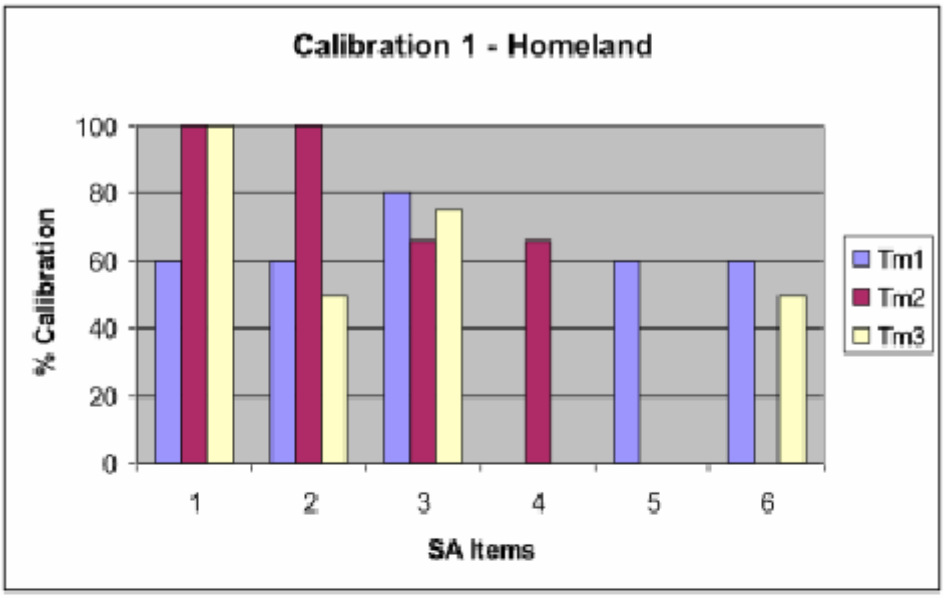
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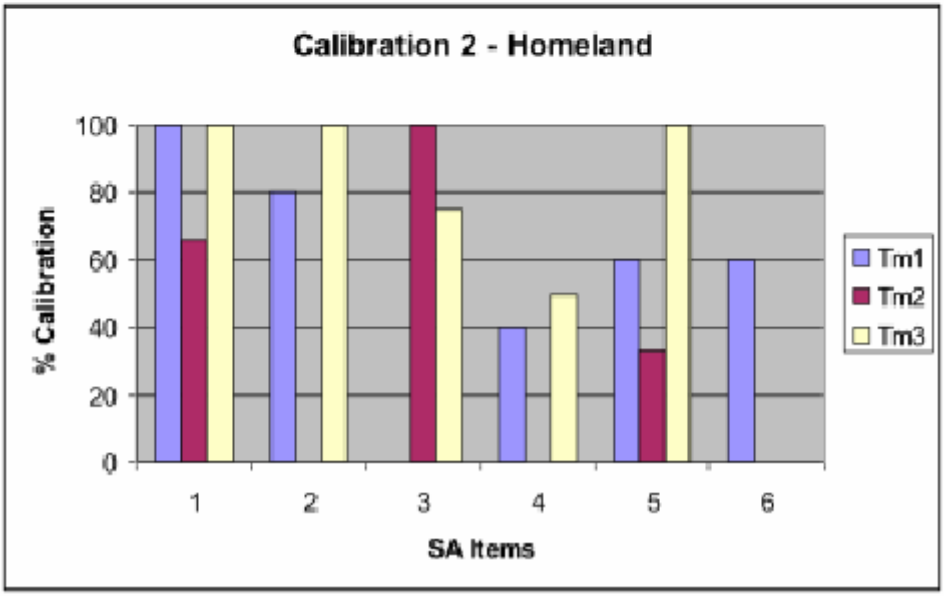
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