

QinetiQ

Elicitation of British Army Commanders' Personal Constructs

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Section 1

Introduction

Introduction

- Research conducted under the UK MOD Corporate Research Programme (Human Sciences and CBD domain)
- Purpose was to inform the design of information systems to aid the attainment of Situational Awareness
- To be achieved through an understanding of the fabric of British Army commanders' mental models

Mental models and personal constructs

- Many theories of Situation Awareness (SA), but widely accepted that the attainment of good SA relies on forming a good mental model of the situation
- This research was concerned with the fabric of mental models rather than their form or construction
- A personal construct (Kelly 1955) is essentially an individual's mental abstraction and categorisation of some real-world phenomenon
- An individual's mental model comprises his or her system of personal constructs

Aim of the research

- To investigate the personal constructs that British Army commanders actually reference in their situation assessments
 - For a given scenario, what are these constructs?
 - How do individuals differ in their choice of constructs?
 - How do these constructs compare with doctrinal factors?

Section 2

Experimental Design

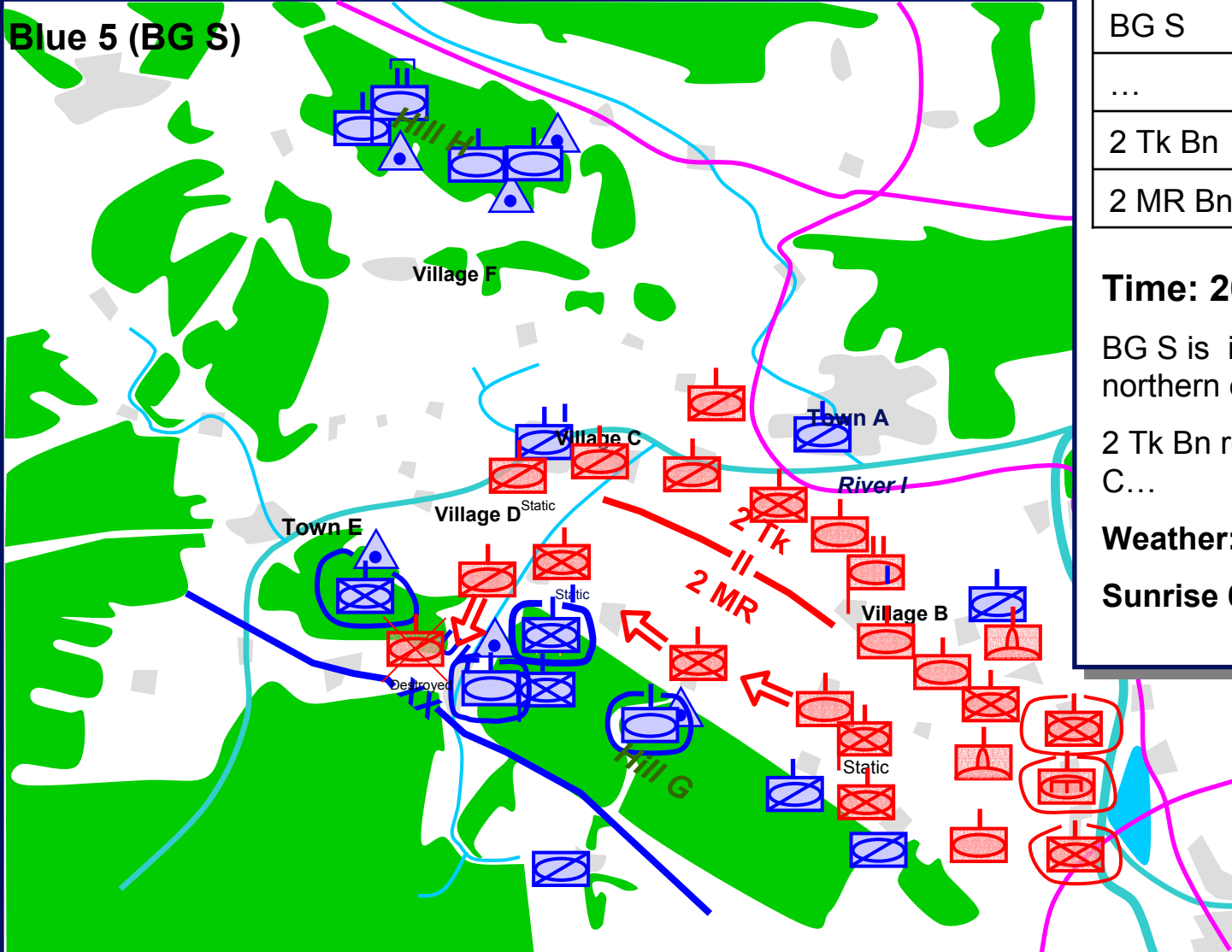
Kelly's Personal Construct Elicitation

- Based on the presentation of triads of elements (stimulus material) to participants
- Participants are asked, “How are two of the elements similar and thereby different to the third?”
- Underlying theory is that each similarity-difference pair is an exemplar of a construct for that participant
- Further, the identification of similarity-difference pairs factors out what is common to all three elements - focus on classification

Snapshot Elements

- 18 snapshots were developed, each depicting a possible situation from a single war-fighting scenario
 - 2 blue Battle Groups vs. red Bde 2nd echelon
- Each snapshot comprised a map, situation overlay and a written brief
- Credible means of presenting a situation

Example Snapshot (schematic)



BG S

Blue 5

Unit	Activity	CE
BG N	Holding	100
BG S	Withdrawing	85%
...
2 Tk Bn	Advancing	100
2 MR Bn	Advancing	95%

Time: 2030

BG S is in Sqn/ Coy hides along northern edge of Hill G...

2 Tk Bn recce reached the area of Village C...

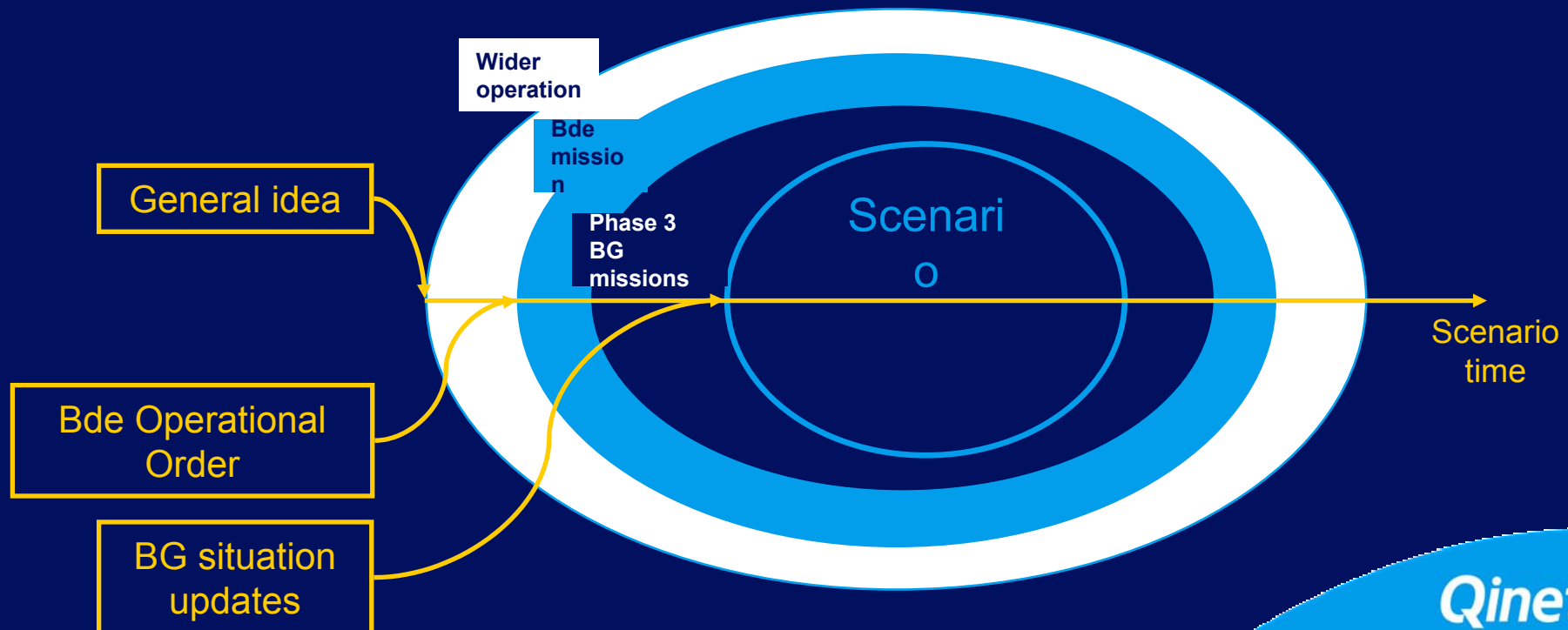
Weather: Dry and Calm...

Sunrise 6:47

Sunset: 16:55

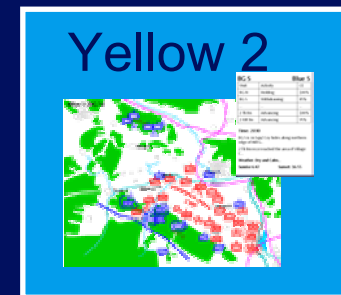
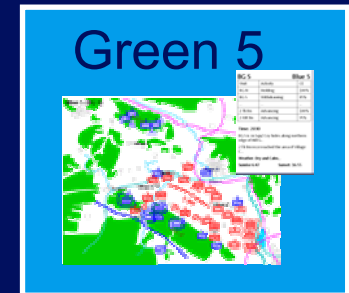
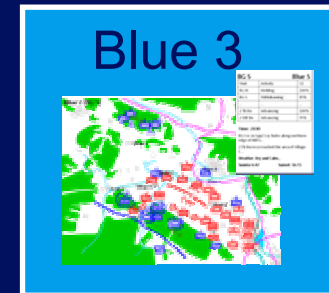
Scenario Immersion

- Participants were given a credible opportunity to immerse themselves in the scenario
 - Scenario briefs including situation updates
 - 2 hour map-based exercise



Experimental design

- 15 participants (current British Army Lt Cols and Majors)
- Experience questionnaire administered
- 18 snapshots allocated randomly to 6 triads
- Triads presented consecutively, 15 minutes each
- Participants instructed to conduct assessments of the situations presented and to answer the question:
 - “How are two of the snapshots similar and thereby different from the third?”
- No other guidance provided/ constraints imposed or limits set on number of similarities/ differences that were to be recorded

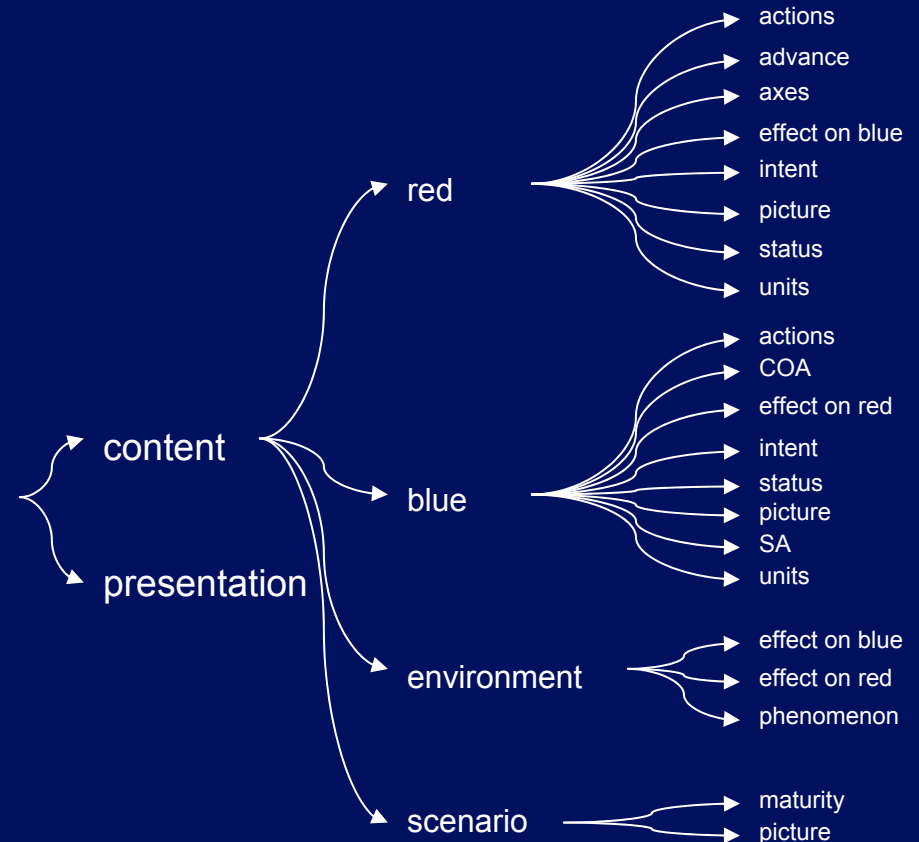


Section 3

Analysis of results

Content analysis

- Textual responses coded through content analysis
 - Coding scheme reflected doctrinal factors
 - 5 participants provided high proportion of responses that referred to presentation of snapshots rather than content – data removed
- 568 responses from remaining 10 participants taken forward to next stage of analysis
- 21 different constructs identified



Constructs and doctrinal factors

- Constructs map largely onto doctrinal factors with some notable exceptions

Doctrinal factors present	Doctrinal factors absent
Dispositions (Sequence of) tasks/ actions Strengths/ fighting power Routes COAs	Relative strengths Surprise Protection Deception

Constructs and SA levels

- Constructs also mapped onto Endsley's 3 levels of Situation Awareness

Endsley SA Level	Constructs
1. Perception	References to single situational elements within snapshots (e.g. units and their locations as reported on the overlay, unit combat effectiveness as reported on the brief)
2. Comprehension	Evidence of mental grouping of situational elements (e.g. effects of red on blue)
3. Projection	Assessments of future situations (e.g. red intent)

Construct frequencies

- 4 of the 21 constructs account for 55.3% of responses
 - red-axes, red-units, red-actions and blue-actions
- Only 3 of the 21 constructs were common to all 10 participants (accounting for 46.2% of responses)
 - red-axes, red-units and blue-actions
- There were two distinct patterns of constructs activated by the scenario
 - 5 of the 10 participants referenced one or two constructs far in excess of others
 - 5 of the 10 participants provided a fairly even spread of responses across the 21 constructs

SA constructs by experience level

- Results of experience questionnaire were mapped onto an experience scale, recoded to 2 levels
- Mean SA level calculated for each participant, weighted by frequency of responses mapped onto Endsley SA levels 1-3
- Correlation between mean SA level and experience level across group is given by
 - $r = 0.557$, $p = 0.094$ (significant at the 10% level)

Section 4

Novelty and Validity

Novelty of approach

- Elicitation of fabric of British Army commanders' mental models rather than their form or construction
- Application of Kelly's Personal Construct Elicitation techniques to the land tactical command decision-making domain

Validity - snapshots and immersion

- Scenario and snapshots generated by QinetiQ/ DSTL military team, led by a currently serving Lt Col
- Written briefs replaced detailed situation briefs that would be provided by Battle Group HQ staff
- Briefings and MAPEX both realistic and credible

Validity - experimental procedure

- Conduct of concurrent assessments across 3 situations not a militarily realistic process
 - May account for difficulty experienced by 5 participants
- Personal Construct Elicitation usually conducted during one-to-one interviews rather than by self-completion questionnaire
 - Possible problems with this approach include construct repetition
 - Necessary given availability of participants
- Experience questionnaire was designed for the experiment by the Lt Col from the supporting military team

Validity - analysis

- All responses coded by single researcher to maximise consistency in coding scheme
- Content analysis is necessarily subjective - doctrinal factors were not sought explicitly yet the responses were coded for 'factor-like' constructs
- Subjective mapping of constructs onto Endsley SA levels

Section 5

Interpretation of results

Interpretation of results (1)

- Constructs are a product of both the participants and the set of elements provided – care needed in generalisation
- Doctrinal factors missing from elicited constructs
 - Absence of relative strengths surprising
 - Moreover, low overall frequency of status constructs – also surprising
- Common set of constructs is small and accounts for almost half of all responses
 - If we accept that construct frequencies are associated with their relative contribution to SA then this is an important result

Interpretation of results (2)

- Variability across 10 participants in terms of the constructs activated by the scenario
 - Two variants – dominance of 1 or 2 constructs vs. even spread
 - This is not correlated with experience level

Interpretation of results (3)

- Significant correlation between mean SA level and experience suggests British Army commanders possess different construct systems dependent on experience
 - If we are prepared to accept validity of the SA level mapping it also suggests that more experienced commanders can attain better SA than less experienced commanders based on the same information

Section 6

Summary and Discussion

Summary

- Small number of common constructs and they account for almost half of the responses
- Degree of variability in the mental models elicited against the scenario (two variants)
- Mental models have been shown to differ according to experience level when grouped under Endsley SA levels

Discussion (1)

- What are the implications for the design of information systems to support British Army commanders in attaining good SA?
- A small set of constructs may be adequate for good SA across all commanders
 - Further research required to test this hypothesis with different commanders and scenario types
 - What is the effectiveness of reflecting/ complementing commanders' mental models through choice of information provided/ promoted?

Discussion (2)

- Variability in commanders' mental models should be recognised
 - A single information system solution may be unsuitable
 - Implications for balance of investment in information systems vs. commander selection and training?
- Experience influences mental models
 - Are information systems as important for commanders at all levels of experience?
 - If so should they reflect/ complement commanders' mental models through choice of information provided/ promoted?

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