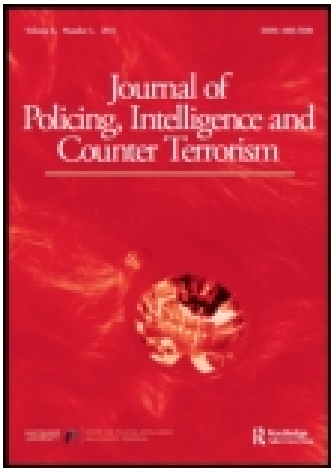

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SINTELLA: Simulation of INTELLigence Analysis

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Forum

SINTELLA: Simulation of INTELLigence Analysis[1]

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ABSTRACT

The development and testing of a simulation program for investigating the work of intelligence analysts is presented. The SINTELLA program is designed to create a structured information resource that represents the essential elements of intelligence analysis environments. Participants are required to produce documents and estimates of risk appropriate to the work context. The program captures a range of analyst information processing behaviour, including selecting, combining and evaluating information. Two versions of SINTELLA have been developed to date. Testing of these has shown promise from a number of perspectives. Experimental participants find the simulations easy to use. Performance data generated shows variability and sensitivity to both characteristics of the task and the psychological predispositions of the participants. Ongoing work with the program is involving national and international policing and security organisations.

Introduction

Intelligence analysts work in a complex, dynamic and time sensitive information environment. The recent reports commissioned by Western governments into intelligence failures accepted that the task of analysts is difficult. What is often not

1 The project was funded by the Department of Prime Minister and Cabinet's National Security Science and Technology (NSST) initiative and Macquarie University's Centre for Policing, Intelligence and Counter Terrorism.

acknowledged however is that the task of effective intelligence analysis is made even more problematic by the cognitive predispositions and biases that are part and parcel of the human mind. A great deal of research (Kahneman & Tversky, 2000; Gilovich, Griffin, & Kahneman, 2002) has demonstrated time and again that human information processing as seen in decision-making and judgment is distorted in ways that hamper rigorous analysis. The findings of this research indicate that human reasoning is constrained by cognitive limitations and predispositions and that these limitations are not easily remedied. For example, when individuals feel pressured to reach a decision, under time constraints or information overload, they are more likely to seize on the first or most salient conclusion and resist updating this belief by conducting limited and selective searches (Kruglanski, 2004). Individual variations in a range of psychological traits can also have substantial effects on analysis and advice. One important trait is closed mindedness which has been associated with poorer outcomes in political forecasting (Tetlock, 2005) and intelligence failures in war (Bar-Joseph and Kruglanski, 2003). Finally, the way a problem is described or framed, including the context and wording, can dramatically alter how a problem is approached as demonstrated by research on anchoring, framing and mindsets (Levin, Schneider & Gaeth, 1998). Studies by Wastell *et al* (in press) have shown that cognitive predisposition can have substantial effects on decision making and reasoning in high stakes industries such as minerals exploration. There exists a large body of research which indicates that human information processing in general is vulnerable to the biasing and distorting effects of human cognitive predispositions (see Hastie & Dawes, 2001; Stanovich, 2004). Intelligence analysis is no exception. Richards Heuer, an experienced and respected CIA analyst, made this very clear in his monograph *The Psychology of Intelligence Analysis* (1999). The challenge is how to investigate the process as specifically applied to the world of intelligence analysis?

Investigating the limitations and distortions that human information predispositions produce within the intelligence analysis environment is not easy. The environment has a number of inherent difficulties. These include the variety of information sources (unclassified and classified) as well as the use of deception by adversary targets. What is needed is a method of investigation that both maintains sufficient fidelity to the processes within the environment and allows for rigorous conditions to be set up in order to establish the impact of the predispositions in human information processing.

A.S.P: Analysis Simulation Project

This program of research is based on the premise that all human information analysis involves processes that can be generalised across a very wide range of information environments. These include policing, military applications, finance decision making and health care contexts. All these information environments require analysts to gather, interpret and distill information which is applied to decisions involving substantial ongoing uncertainty. Figure 1 shows the generalised model of human information processing that informs the *A.S.P* research program.

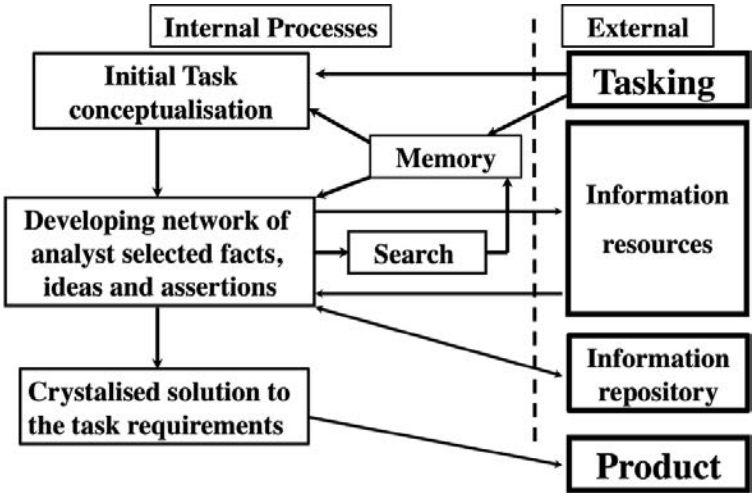

Figure 1 – Simplified information processing schema. Elements in heavy lined boxes are the aspects of the process instantiated and tracked by *A.S.P* computer programs.

The SINTELLA computer program

SINTELLA is a specific application of the *A.S.P* research methodology designed to be applied to the intelligence analysis environment. The project was funded to investigate the tasks and requirements associated with military, security and policing contexts. The SINTELLA program as initially developed required participants to complete a typical analytic task (e.g. a threat assessment) by accessing a standardised information database in order to write a report and make a judgment about the perceived level of threat based on the information supplied. The database of information is in the form of an 8 by 8 matrix, where each column represents a category of information and each cell is labeled with a description of the information contained in the cell. When selected each cell reveals a block of information of between 50 and 130 words. The program records information search behaviour such as cells viewed, cell search sequence, time spent in individual cells as well as content of working notes and copied content, the decision made, and the final report. The program represents several elements of the generic information processing model presented in figure 1 above. The program has a standardised information database, an information repository for analyst notes and relevant information copied from the database, an output box where the final report is generated.

The SINTELLA database can be populated to suit a wide range of law enforcement, security and military contexts. The system is designed to be very flexible in terms of categories and content. The type of information that can be inserted into the matrix includes text, maps and photographs. The program can also be customised to

include information evaluation markers such as those of the Admiralty system that is commonly used in Western military organisations.

Versions of SINTELLA

To date two versions of SINTELLA have been developed and tested.

VERSION ONE: SINTELLA: PARETTE

The Parette version was designed to simulate the intelligence analysis environment where analysts are required to gather information on a particular country in order to prepare a report for senior officers. The categories were designed to cover those topics which are of interest to security and military agencies in the preparation of intelligence products, for example infrastructure, economy and politics. The task requires participants to generate a risk assessment and compile a visit threat assessment report on the fictitious country, Parette. There is no correct answer to the task but analysts must use their judgment to estimate a risk and produce a report that both informs the senior officer and justifies the risk estimate. This task measures the depth, breadth and type of information participants focus on, what information was selected to be particularly relevant (as indicated by text copied to the workspace and report), as well as the final report and other behavioural variables. Figure 2 shows the Parette screen with information categories and workspaces.

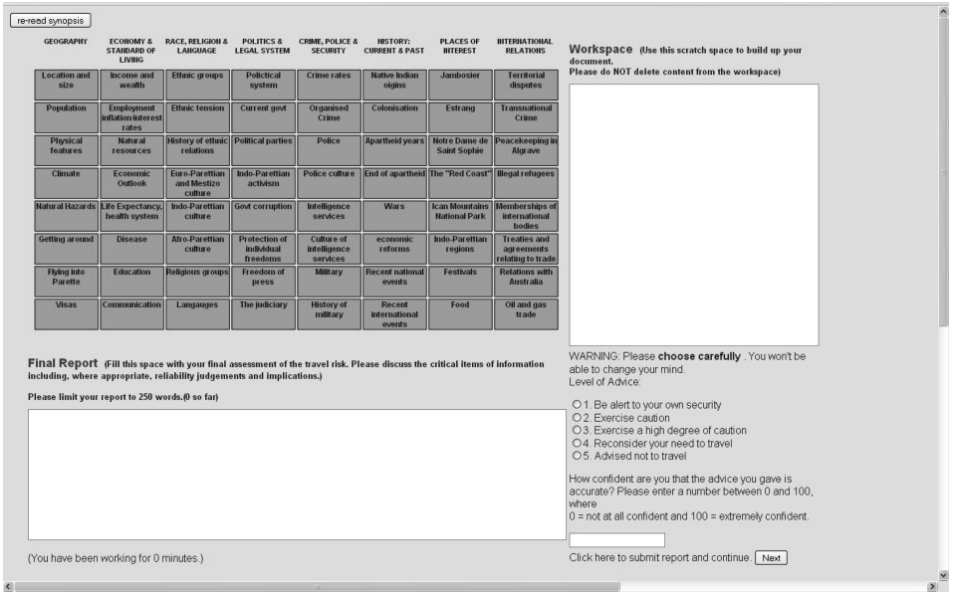

Figure 2 – Parette version of SINTELLA

Initial testing was conducted on 59 university students recruited at Macquarie University. Participants were randomly allocated to one of two conditions and given 20 or 40 minutes to complete the task.

Task Engagement

Participants appeared to engage well with the task. They took the report and word length seriously as evidenced by the minimum word count of 74.

The functionality of the program was well utilised. Content analysis revealed good use of the copy and paste function and the workspace was used by 88% of participants.

Simulation Effectiveness

Although some participants opened all 64 cells, the majority didn't, which indicates that the simulation effectively replicated an environment where there is more information than could be practically processed in the time given.

Content Effectiveness

The content produced various interpretations as evidenced by the wide range of risk assessment values and confidence in these assessments.

Variability in Behaviour

As shown in Table 1, participants showed a good degree of variability in their behaviour.

However, contrary to expectations none of the variables differed significantly across different durations, suggesting that 20 minutes may not have been experienced as a restrictive time limit.

	20 minutes (n = 33)			40 minutes (n = 26)		
Variables/ Measures	Mean	SD	Range	Mean	SD	Range
Distinct cells opened (of 64)	33.88	15.68	10 – 64	35.12	16.29	4 – 64
Repeat cell openings	22.91	14.04	1 – 56	25.58	16.37	7 – 59
Total cell openings	56.79	26.85	17 – 107	60.69	30.69	12 – 112
Time per cell (seconds)	7.55	2.85	3.42 – 15.51	8.75	3.93	1.97 – 19.00
Words in workspace	212.42	457.43	0 – 2652	303.73	397.19	0 – 1815
Words in report	196.55	53.50	74 – 266	231.77	30.00	134 – 272
Proportion of evidence*	58.84	33.81	0 – 100	53.88	28.82	0 – 100
Confidence**	76.88	17.11	30 – 100	78.42	14.07	40 – 100
Risk Assessment***	59.00	22.11	10 – 100	58.27	21.82	15 – 90
Attitude to Australia	54.57	19.93	20 – 100	57.58	22.81	20 – 100
Age	21.07	3.16	18 – 35	50.60	14.85	20 – 85

N = 59

*Percentage of the report content that was taken from the matrix.		
**Confidence:	0 = Extremely unconfident,	100 = Extremely confident
***Risk Assessment	0 = No risk,	100 = Extreme risk
Gender:	Male 50%	Female 50%
Majors:	Psychology 41%	Others (Economics, Politics etc) 59%

Table 1 – Participant behaviour on the Parette task

VERSION TWO: THE MURDER MYSTERY SCENARIO

The second version of SINTELLA was developed to simulate an investigative task where there was a single most likely solution to the task, in this case the identification of a murderer. The task involves analysts gathering information to identify a specific person. The data was created in such a way as to make the task inherently imprecise. So that participants had to decide on the most probable perpetrator and produce a report accounting for their decision. Information provided includes categories such as: Persons of interest (POI), POI statements and Police documentation. This task measures the same variables as the Parette task, as well as how often participants seek corroboration for unreliable information and their reactions to evidence that disconfirms their preferred suspect. The layout of the program screen is shown below in Figure 3.

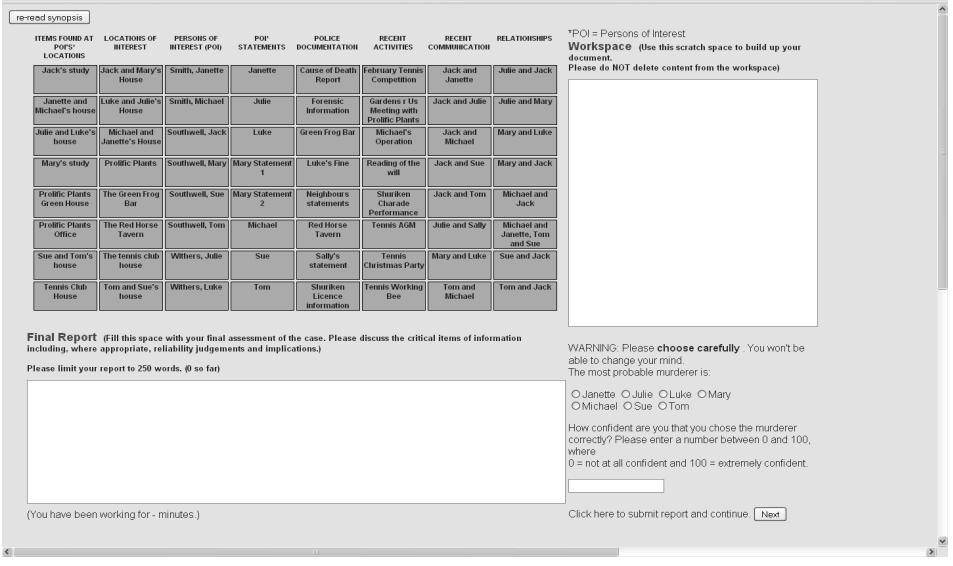

Figure 3 – Murder Mystery of SINTELLA

Initial testing was conducted on 50 native English speakers recruited for payment at Macquarie University. Participants came from a range of disciplines with a balance of participants from Business and Economics, Arts, and Human Science faculties. Only 26% of participants were in their first year of university and 14% were completing postgraduate studies.

Task Engagement

Participants appeared to engage well with the task. The majority of participants (66%) used all the time available (40 minutes) and only 14% finished in under 30 minutes or less. Those who finished early were no less confident in their conclusion, suggesting that they felt they had chosen adequately.

The functionality of the program was well utilised. Content analysis revealed good use of the copy and paste function, all participants opened at least 17 cells, the workspace was used by 92% of participants and only one person neglected to use the report space. Participants who wrote few or no words in the report tended to show high cell and workspace activity suggesting that the investigation and decision was prioritised over the report. The program received good usability feedback with 75% of participants stating that it was easy to use.

Simulation Effectiveness

The simulation was effective in representing the ambiguity and time pressure associated with analysis problems. This was indicated by the relatively low confidence (mean 58.40, max 90) in the decision and high proportion (74%) of participants that stated that they would have liked more time. Information overload was also apparent because most participants didn't open all 64 cells and those who did were no more likely to make the correct decision.

Content Effectiveness

The content produced a range of suspect choices, indicating that the choice was not clear cut, but the most probable murderer (one of seven possible suspects) was chosen more often than chance, by 42% of participants. Confidence did not differ by decision accuracy, suggesting a good degree of ambiguity.

Variability in Behaviour

The range of responses displayed in Table 2 suggest that individual differences in approach to the task were captured. For example, the proportion of matrix content versus interpretative statements included in the reports ranges from 0 to 100 percent.

Variables/ Measures	**Mean**	**SD**	**Range**
Distinct cells opened (of 64)	50.24	12.84	17 – 64
Repeat cell openings	38.42	23.57	6 – 129
Total cell openings	88.66	31.88	25 – 188
Time taken (minutes)	38.27	7.59	15.06 – 47.82
Time per cell (seconds)	16.40	6.60	8.00 – 46.10
Words in workspace	213.48	170.24	0 – 737
Words in report	128.27	58.03	0 – 273

Proportion of evidence*	39.12	25.17	0 – 100
Confidence**	58.40	21.15	0 – 90
Age	22.82	6.44	17 – 61

N = 50

*Percentage of the report content that was taken from the matrix.		
**Confidence:	0 = Not at all confident,	100 = Extremely confident
Gender:	Male 40%	Female 60%
Majors:	Psychology 16%	Other (Economics, Politics etc) 84%

Table 2 – Participant behaviour on the Murder Mystery task

Comparison of the two versions

The two versions of SINTELLA are designed to tap different problem spaces, and this was reflected in the results. The main output for the Parette version was a travel advisory report which is subjective, in contrast the Murder Mystery version asked participants to come to a decision which could be right or wrong, and produce a report. It appears that the need for a decision in the Murder Mystery task switched the focus from the report to the cells, resulting in a greater number of cells opened and repeat cell openings (see Figure 4 below).

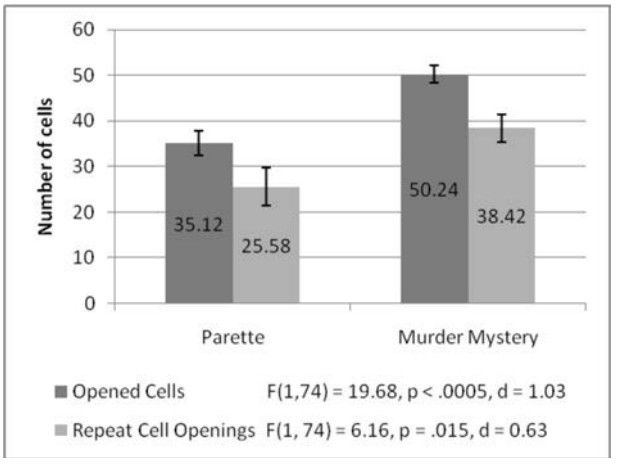

Figure 4 – Information cell openings by SINTELLA versions

Shorter reports were completed in the Murder Mystery version when compared to the Parette task (as shown in Figure 5).

The confidence that participants experienced in their respective judgments differed between the two versions. Parette participants had greater confidence than Murder Mystery participants and they also cited more evidence in their reports.

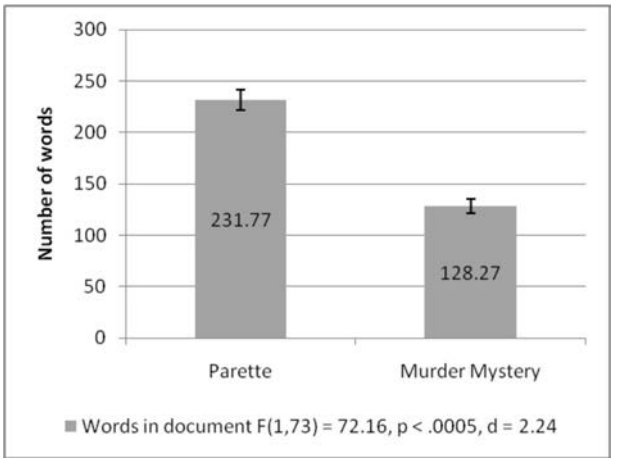

Figure 5 – Report length by SINTELLA versions

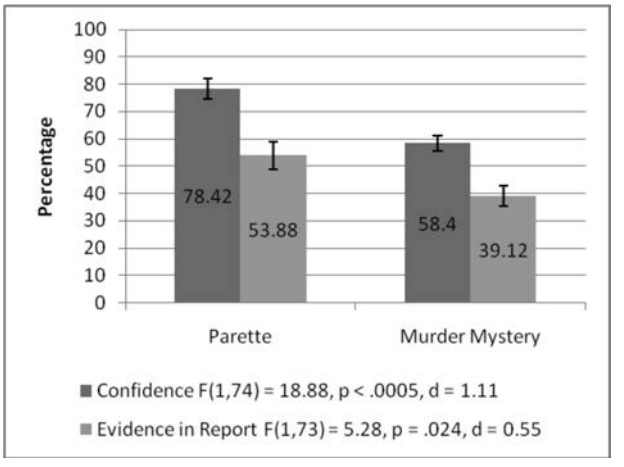

Figure 6 – Judgment confidence and cited evidence in reports by SINTELLA versions

Applications and future developments

ONE: RESEARCH INTO HUMAN INFORMATION PROCESSING PRE-DISPOSITIONS

SINTELLA is an effective tool for researching analysts' reasoning and decision making behaviour in complex and ambiguous situations and can reveal patterns in search behaviour, information selection and reporting. Experimentation using SINTELLA has begun and some of the results are reported below.

Individual differences were predictive of search, decision making and report writing behaviour. For example, people who disliked ambiguity more ('Need for

Closure' subscale) tended to be more susceptible to the primacy bias. That is they were more likely to choose a suspect seen in the first five cells $F(1,48) = 4.38$, $p = .042$, $d = 0.62$ or choose the suspect first sighted $F(1,48) = 4.64$, $p = .036$, $d = 0.77$. Participants who tended to rely on their intuition in decision making were less likely to make the correct decision on the Murder Mystery task (experiential engagement $F(1,48) = 6.45$, $p = .014$, $d = 0.71$ and ability $F(1,48) = 4.44$, $p = .040$, $d = 0.59$, REI subscales) and participants who were more inclined to consciously enjoy thinking about decisions, tended to include a greater proportion of evidence from the matrix in their report (rational orientation $r = .33$, $p = .022$ and ability $r = .30$, $p = .036$).

TWO: COMPARISON OF ANALYTIC SOFTWARE TOOLS

Within the intelligence, security and military fields there are number of commercial computer program as well as analytical methodologies being promoted as solutions to the problems associated with intelligence analysis. SINTELLA could be utilised to evaluate the effectiveness of various analytic tools and associated commercial products such as Analysis of Competing Hypotheses (PARC & Heuer, 2005), bCisive® and Analyst Notebook®, with a view to demonstrating empirical gains in analytic rigor and accuracy afforded by different tools.

THREE: TRAINING

SINTELLA also has the potential to become an analysis training tool. The more realistic the training task, the more likely the skills are to be transferred to the work environment (Kozlowski, 1998). SINTELLA provides a simulated environment where information search and analysis skills could be taught, demonstrated and practiced.

Decision making is very context dependent. It is important not to remove the context, nor to overtrain in one context. SINTELLA's training advantage is that it can provide feedback on all stages of the information search, decision making, and reporting processes, in a realistic but controlled environment, where content and task can be varied. For example SINTELLA can structure and track search behaviour, allowing for the inclusion of timely prompts to encourage questioning of information reliability, and appropriate belief updating or hypothesis testing behaviour. SINTELLA can also highlight important items of information that were missed and encourage consideration of the kind of hypothesis testing questions that would have led to a more complete understanding. The report space also allows for feedback and examination of core assumptions and potential biases, use of evidence and appropriate portrayal of evidence reliability.

Conclusion

The *A.S.P/SINTELLA* research program offers to intelligence, security and police agencies a methodology to evaluate, develop and train their intelligence analysts. Work

is proceeding along these lines. A number of Australian and international organisations have shown interest in participating in the development and customisation of the programs and we look forward to the contribution of agencies to the refinement and improvement of SINTELLA programs. This methodology promises to assist with the development of intelligence analysts in their critically important contribution to the security environment.

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