

Annex A

Statement of Work (Non Research & Development)

Behavioural Science Experiments on Reasoning in Intelligence Analysis

1 SCOPE

1.1. Purpose

Defence R&D Canada – Toronto (DRDC Toronto) is seeking contractor support for data collection and collation involving a series of behavioural science experiments with human subjects. The experiments described in this Statement of Work (SOW) are motivated by DRDC Toronto's Applied Research Program (ARP) project, entitled "Understanding and Augmenting Human Capabilities for Intelligence Production," which is under the project management of Dr. (will be named at Contract award) Group Leader of the Thinking, Risk, and Intelligence Group within DRDC Toronto's Adversarial Intent Section. The overarching objectives of the ARP project and the experiments described herein for which contractor support is sought are: (a) to identify systematic biases in human performance that may effect the quality of intelligence analysis; (b) to identify factors that may attenuate or amplify such biases or otherwise influence judgmental performance; and (c) to examine the viability of counter-measures aimed at reducing or eliminating them.

1.2. Background

The goal of this ARP project is to better understand the intelligence analysis process and examine ways of augmenting analytic performance. These goals are consistent with the mandate of the Adversarial Intent section, which aims, in part, to better understand the psychosocial factors that influence adversarial interactions and intelligence production.

Intelligence analysts perform in an environment where new information must be integrated with old information in order to achieve an accurate assessment of the particular issues under investigation. When successful, this information can be a valuable asset, whereas intelligence failures can lead to tactical, operational or strategic surprises, often with negative consequences. The ways in which people integrate information has been extensively studied and several heuristics have been identified that people employ as time saving measures. While efficient, these can lead to judgement biases or errors that are unacceptable in the context of intelligence analysis. The experiments to be conducted via this SOW will identify potential sources of error or bias in intelligence analysis and examine procedures for effectively integrating information. Given the relative lack of access to analysts as participants, these studies will largely employ non-expert undergraduate students as participants, employing experts where access to such samples is made available by the Scientific Authority (SA) or the ARP Project Manager (PM).

Undergraduates have a similar educational background to that of analysts and the psychological processes under investigation are expected to be common to both populations.

The precise nature of the experiments will be outlined by the SA, PM, or Principal Investigator (PI) in conjunction with the contractor. For the purpose of this contract, the research team (SA, PIs, and PM) have formulated general research areas that will be investigated, but the exact design and implementation of the experiments will unfold over the course of the contract period and will be provided in the form of detailed protocols. One sample protocol is provided to give an example of the work to be conducted. Three main areas will be addressed:

Hypothesis generation and hypothesis testing. Hypothesis generation and hypothesis testing (HGHT) are important parts of the analysis process. Failure to generate adequate hypotheses may leave key possibilities or conclusions unexamined. Failure to test hypotheses in a rigorous manner may produce judgements that are misleading. Accordingly, some analysts employ structured analytic techniques (e.g., Analysis of Competing Hypotheses (ACH), see Heuer, 1999) that are designed to improve HGHT.

Techniques like ACH represent recommendations that are based in part on a consideration of the analyst's tasks and in part on an assessment of the relevant behavioural science literature. There has been a paucity of research, however, that has directly assessed the effectiveness of such techniques on human judgement, particularly in analytic contexts. It is anticipated that part of the research conducted under this SOW would address this critical issue. One factor, for instance, concerns the order in which evidence is presented. ACH does not include an explicit process to deal with potential order effects on judgement, yet research in cognitive psychology has shown that the order of information acquisition can affect judgement (Hogarth & Einhorn, 1992). In addition to integrating new information, analysts also receive revisions to existing information that has already contributed to the current state of belief. When a piece of information requires revision, it is unclear whether the correction in belief is appropriate. It is anticipated that the issue of evidential revision will also be examined under this SOW.

The secrecy of information. When producing intelligence assessments, analysts must consider many sources of information and make judgements regarding relevance to the assessment task at hand. Part of the research addressed under this SOW will likely examine the degree to which the secrecy of information affects its use in judgement. Secrecy level refers to the accessibility of information depending on its level of classification (e.g., top secret, secret, or open source). For instance, would the secrecy of information influence information use independent of how diagnostic or reliable a piece of information is or how credible the source may be? Mock secret information will be used, so no special security clearance will be required.

Judgement under uncertainty. Analysts are often called upon to make assessments under conditions of uncertainty. These assessments, whether expressed in numeric terms (70% chance that X will occur in the next week) or verbal terms (quite likely that X will occur...) are often expressed as probabilities or propositions conveyed with a certain degree of confidence. The research conducted under this SOW will investigate factors that influence probability judgement. For example, recent psychological research has shown that the level with which a judge construes an event or event attribute can influence probability judgements about that event or even unrelated events (due to a priming effect). Such research has shown that events that are construed at a high level focus on the abstract features, whereas events that are construed at a low level focus on the concrete details of the event, and that construal level can

influence probability assessments (Wakslak, Trope, Liberman, & Alony, 2006). The present research will assess the causal influence of construal level on probability judgements in an intelligence assessment context.

Previous research has also shown that event experts (e.g., physicians) who are required to make judgements that require the integration of probability information have difficulty doing so correctly. A common error is to confuse diagnostic probability information (e.g., the probability of the data given the hypothesis) with the posterior (or Bayesian) probability assessment required (e.g., the probability of the hypothesis given the data; e.g., see Villejoubert & Mandel, 2002). As a consequence, part of the present research aims to examine methods for improving probability judgements through techniques for representing the information (e.g., natural sampling trees, concept maps, pie diagrams) and through techniques for teaching judges how to correctly integrate the information (e.g., explaining normative requirements for coherent probability judgements, such as the additivity property, to trainees). Building on previous research by project team members (e.g., Mandel, 2008), the experiments will also examine the factors that influence the accuracy and logical coherence of judgements.

2 REQUIREMENTS

2.1. Experimental specifications

Experiments will be administered with scripts programmed by the SA in MatLab (Mathworks) and ePrime (Psychology Software Tools), or via paper and pencil surveys. The relevant programs or electronic copies of the surveys will be provided by the SA. Recruitment of participants is the responsibility of the Contractor. Except where a special population is made available by the SA, **only undergraduate participants** are eligible to participate in the experiments to be conducted under this SOW, so it is critically important that the Contractor have access to this population. Experiments will require thirty (30) or sixty (60) minutes, and will be administered at individual computer work stations, but may be conducted in small group settings (preferably not more than 10 participants at a time). A total of 600 participant hours will be required for completion of work under this SOW. Participant payment is the responsibility of the contractor.

2.2. TASK 1: Meetings

2.2.1. Kick-off Meeting

The Contractor shall prepare for and attend a kick-off meeting with the SA. This kick-off meeting could be held in person at DRDC Toronto or by video-teleconference capacity (VTC). The Contractor shall maintain the minutes and action log documents for this meeting.

2.2.2. Experiment Setup Meeting

Prior to the beginning of data collection, a meeting with the SA will occur at DRDC Toronto during which each experiment will be piloted in order to ensure that each script is operating as intended, that the Contractor is administering the experiment in a satisfactory manner, and that all relevant data are being correctly logged (see 2.5.2.). Two to three such Setup Meetings are anticipated over the course of the contract. Where possible these meetings will be scheduled to coincide with kick off and progress review meetings (see 2.2.1 & 2.2.3.).

2.2.3. Progress Review Meetings

The Contractor shall prepare for and attend progress review meetings with the SA at the six and twelve month point of the contract. The review meetings will cover at least the following items:

- Technical progress report by Contractor (results, problems, documentation, etc.) focusing on adherence to the quality assurance standards of the contract
- Discussion of technical progress report
- Management report by Contractor (financial & manpower)
- Contractor's work plan for the next period (overview of the expected progress for the upcoming period)
- Status of contract documentation

Where necessary, the progress review meetings should be face-to-face. If geographic dispersion of the team members is encountered, VTC should be used as a complementary communications channel.

2.2.4. Final Presentation Meeting

The Contractor shall present the complete data file(s) from the experiments making up this SOW to the SA. The Contractor shall also present a Final Report, in the form of a document, of the experiments to the SA (see Section 2.5.2). This will constitute the end of this contract.

2.3. TASK 2: Background Literature

2.3.1. The Contractor shall read the ARP project summary to which these experiments contribute, as well as the associated human research ethics protocols, which will be provided by the SA. Each protocol contains specific guidelines for conducting each experiment. In addition, related background readings will also be provided by the SA where required. The purpose of this sub-task is to provide the Contractor with the rationale for each of the experiments to be conducted, as well as detailed guidelines for administering each experiment.

2.4. TASK 3: Guidelines on Software Use

2.4.1 The Contractor shall consult with the SA to receive guidelines on the specific procedures for administering the experiments to be conducted in this SOW.

2.5. TASK 4: Task Implementation and Data Collection

2.5.1. The Contractor shall only use the experimental platform (i.e., software) specified by the SA to administer each experiment.

2.5.2. Prior to each experiment the Contractor shall conduct pilot tests (at their own location) of the software in order to ensure that proper installation of the software, execution of experimental protocols, and accurate recording of the data have occurred.

2.5.3. For some experiments the Contractor must log, report, and export the results into a widely available and easy to use format (e.g., Excel or SPSS) for later analysis by the SA. However, most experiments will create individual subject data files after each run automatically. An appropriate software package for exporting the data can be provided by DRDC Toronto should the contractor not have this capability.

2.6. TASK 5: Reporting

2.6.1. The contractor will produce two technical progress reports (at the six and twelve month points of the contract). Each progress report will document any problems encountered, as well as measures taken in each case. The progress report will also document the number of participants run, along with demographic information (number of males/females, average age, age range) broken down by experiment.

2.6.2. The Contractor shall produce a Final Report of the experiments conducted to the SA by the end of the contract (18 months after the contract start date). The Final Report will include a complete and detailed description of the methodology used for recruitment of participants, implementation and administration of experiments including the setting used for each experimental session (e.g., number of computers in the room, etc.), and related information conveyed to the experimenters by participants.

3 DELIVERABLES

3.1. List of Deliverables

The Contractor is responsible for the following deliverables:

1. At monthly intervals the data collected during that month will be provided to the SA. Thus, on average, ***approximately 33.3 participant hours of data will be collected and provided to the SA each month.***
2. Technical progress reports will be provided at the six (6) and twelve (12) month points of the contract as documented in 2.5.1.
3. A final report as detailed in 2.5.2 will be provided at the end of the contract, 18 months after the contract start date.

4 EXPERTISE

At least one team member employed by the Contractor should have expertise in experimental design in social and cognitive psychology (at least a Master degree and preferably a Ph.D. in Psychology). The Contractor is responsible for ensuring that personnel in charge of administering the experiments that will be conducted under this SOW are trained in accordance with the guidelines developed by the SA.

5 CONDUCT OF WORK

5.1. Location of Work

The Contractor shall normally provide this service from the Contractor's own location. However, the location of the kick-off, progress review, experimental setup and final meetings will be at DRDC Toronto. In addition, travel may be required to collect data.

5.2. Duration of Work

Work is expected to start in September, 2009 and should be completed within 18 months of the actual start date (1.5 years).

5.3. Language of Work

English.

5.4. Equipment and Software

Up to ten (10) PC laptops installed with ePrime and ten (10) Mac minis installed with MatLab will be provided to the contractor by the SA. Any additional purchases should be authorized by the SA, using the portion of the funds allocated for possible equipment or software purchases as per Statement of Requirement. All authorized purchased equipment or software must be returned to DRDC Toronto upon completion of this contract.

5.5. Travel

Conditions for travel are described in the Conduct of Work, Section 5.1.

5.6. Security

This work is UNCLASSIFIED.

5.7. Value

The value of this Contract is not to exceed \$200,000.00 Cdn. funds excluding GST. Given the nature of the work, this contract will be based on a fixed price proposal with submissions of monthly progress payment, including 10% holdback.

6 APPLICABLE DOCUMENTS

6.1. Publishing and Standards

The language for all deliverables is English and all reports will be in Word format and will conform to DRDC publication standards for contractor reports. An Abstract and Executive Summary will be submitted with the Final Report. Final deliverables shall be provided on electronic media. Exceptions to these instructions require the approval of the SA. The Contractor shall also identify the PWGSC SOW number under which the work was conducted. The SA will provide the Contractor with publication standards.