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Impact of Uncertain Cues on Combat Identification Judgments

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Abstract

This report describes an experiment examining combat identification (CID) decision making and the impact of cue uncertainty on subjects decision accuracy. Subjects played the role of a dismounted infantry soldier in a first-person perspective environment and engaged a series of simulated targets. Subjects attempted to engage (i.e., shoot) only those figures that were enemies. Friendly and enemy forces were distinguishable by differences in uniforms, equipment, and whether or not they were identified as friendly in the CID system. Variability in the characteristics of friend and enemy trials was introduced across blocks. Two factors were considered: 1) whether the uncertain characteristic was visual or behavioural, and 2) whether the uncertain feature was salient or not salient. Subjects hit rates but not false alarm rates were affected by uncertainty associated with visual and behavioural characteristics of targets in the environment. Subjects sensitivity was also not affected by cue uncertainty, indicating that they remained equally good at distinguishing friend and foe despite variations in the characteristics of friends and foes. Subjects did, however, exhibit differences in response bias across blocks. This result suggests that subjects shifted their decision criterion in response to cue uncertainty associated with targets. Subjects appear to have slightly lowered their criterion when enemies appeared with uncertain cues but more dramatically raised their criterion when friendly contacts appeared with uncertain cues.

Résumé

Le présent rapport décrit une expérience qui porte sur la prise de décision dans l identification au combat (IDCbt), et qui examine l impact des « indices incertains » sur la justesse des décisions prises par les participants. Dans cette expérience, chacun des participants joue le rôle d un soldat d infanterie à pied dans une perspective de premier intervenant, et des objectifs simulés (figures humaines) lui sont présentés. Il essaie de ne tirer que sur les figures représentant un ennemi. Les forces amies et ennemies se distinguent par leurs uniformes et leurs équipements, et par leur code d identification (ami ou ennemi) dans le système d IDCbt. Des caractéristiques variables associées aux amis et aux ennemis sont introduites dans les différents blocs d essais. Deux facteurs sont pris en considération : 1) Les indices incertains sont-ils visuels ou comportementaux? 2) Les indices incertains sont-ils saillants ou non saillants? Le taux de succès des participants, mais pas le taux de fausse alarme, est influencé par l incertitude associée aux caractéristiques visuelles et comportementales des objectifs dans l environnement opérationnel. La réactivité des participants n est pas affectée non plus par cette incertitude : leur capacité de distinguer un ami d un ennemi se maintient au même niveau quelles que soient les variations dans les caractéristiques des amis et des ennemis. Cependant, dans les différents blocs d essais, les participants présentent des différences dans le taux de réponse erronée. Ce résultat semble indiquer que les participants ont modifié leurs critères de décision en réponse aux indices incertains associés aux objectifs. Les participants, semble-t-il, ont abaissé légèrement leurs critères lorsque des soldats ennemis présentaient des indices incertains, mais les ont augmenté considérablement lorsque des soldats amis présentaient des indices incertains.

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Executive summary

Impact of Uncertain Cues on Combat Identification Judgments

Bryant, D.J., & Smith, D.J.; DRDC Toronto TR 2009-127; Defence R&D Canada – Toronto; November 2009.

Combat Identification (CID) is the capability to identify friendly, enemy and neutral forces rapidly and accurately, manage and control the battlespace, and optimally employ weapons and forces. When CID fails, however, the result can be fratricide or neutricide, which have significant negative impact on operational effectiveness.

CID is a complex cognitive as well as technological process. Although improvements in decision support can enhance the effectiveness of CID, it is nevertheless necessary to understand the human decision making processes involved in identification. As a first step toward building a more detailed cognitive model of CID decision making, we investigated the target identification aspect of CID and attempted to determine how human decision makers deal with uncertainty.

The experiment described in this report, subjects played the role of a dismounted infantry soldier in a first-person perspective environment. Subjects were presented with a series of trials, in which each trial comprised a human figure moving into view. The subject s task was to engage (i.e., shoot) only those figures that were enemies. Friendly and enemy forces were distinguishable by differences in uniforms, equipment, and behaviour. Trials were grouped into blocks. In each block, the subject remained at a specific fixed location in the simulated environment. His or her accuracy and speed in engaging enemies were the primary experimental measures. To investigate the impact of cue uncertainty on engagement decision making accuracy, variability in the characteristics of friends and enemies was introduced across blocks. Two factors were manipulated: 1) the type of characteristic that was uncertain (visual or behavioural), and 2) the salience of the uncertain feature (salient or not salient).

Subjects hit rates but not false alarm rates were affected by uncertainty associated with visual and behavioural characteristics of targets in the environment. Subjects sensitivity was also not affected by cue uncertainty, indicating that they remained equally good at distinguishing friend and foe despite variations in the characteristics of friends and foes. Subjects did, however, exhibit differences in response bias across blocks, suggesting that subjects shifted their decision criterion in response to cue uncertainty associated with targets. Subjects appear to have slightly lowered their criterion when enemies appeared with uncertain cues but more dramatically raised their criterion when friendly contacts appeared with uncertain cues.

The nature of modern warfare makes uncertainty a pressing issue. Soldiers can expect to find themselves operating in environments in which friendly, enemy, and neutral factions employ similar or identical equipment, wear similar or identical clothing, and potentially employ similar tactics. Hostile factions in asymmetric conflicts can be expected to purposely mimic civilians in order to confuse soldiers. In addition, the Canadian Forces (CF) often works in coalitions, which can undermine soldiers familiarity with the appearance of friendly units. The risk posed by cue uncertainty may be mitigated through changes to tactics and procedures, training and education, and development of decision support systems.

Sommaire

Impact des indices incertains sur les jugements humains d'identification au combat

Bryant, D.J., & Smith, D.J.; DRDC Toronto TR 2009-127; Defence R&D Canada – Toronto; novembre 2009.

L identification au combat (IDCbt) est la capacité d identifier les forces amies, ennemies et neutres de façon rapide et précise, de gérer et contrôler l espace de bataille, et d employer les armes et les forces de façon optimale. Cependant, lorsque l IDCbt échoue, cela peut donner lieu à un incident fratricide ou neutricide qui a un impact négatif considérable sur l efficacité opérationnelle.

L IDCbt est un processus cognitif et technologique complexe. Les améliorations apportées aux outils d aide à la décision peuvent améliorer l efficacité de l IDCbt, mais il demeure nécessaire de comprendre les processus de prise de décision qui entrent en jeu dans l identification. Comme première étape dans l élaboration d un modèle cognitif plus détaillé de la prise de décision dans l IDCbt, nous avons examiné l aspect « identification des objectifs » de l IDCbt, et nous avons essayé de déterminer comment les décideurs humains font face à l incertitude.

Dans l expérience que décrit le présent rapport, chacun des participants joue le rôle d un soldat d infanterie à pied dans une perspective de premier intervenant. L expérience consiste en une série d essais dans lesquels une figure humaine est exposée soudainement à la vue du participant. Celui-ci ne doit tirer que sur les figures représentant un ennemi. Les forces amies et ennemies se distinguent par leurs uniformes, leurs équipements et leur comportement. Les essais sont groupés en blocs. Dans chaque bloc, le participant demeure à un endroit fixe dans l environnement simulé. La précision et la vitesse avec laquelle il tire sur l ennemi sont les principaux critères de mesure expérimentale. Pour mesurer l impact des « indices incertains » sur la justesse des décisions prises par les participants, des caractéristiques variables associées aux amis et aux ennemis sont introduites dans les différents blocs d essais. Deux facteurs sont pris en considération : 1) Les indices incertains sont-ils visuels ou comportementaux? 2) Les indices incertains sont-ils saillants ou non saillants?

Le taux de succès des participants, mais pas le taux de fausse alarme, est influencé par l incertitude associée aux caractéristiques visuelles et comportementales des objectifs dans l environnement opérationnel. La réactivité des participants n est pas affectée non plus par cette incertitude : leur capacité de distinguer un ami d un ennemi se maintient au même niveau quelles que soient les variations dans les caractéristiques des amis et des ennemis. Cependant, dans les différents blocs d essais, les participants présentent des différences dans le taux de réponse erronée. Ce résultat semble indiquer que les participants ont modifié leurs critères de décision en réponse aux indices incertains associés aux objectifs. Les participants, semble-t-il, ont abaissé légèrement leurs critères lorsque des soldats ennemis présentaient des indices incertains, mais les ont augmenté considérablement lorsque des soldats amis présentaient des indices incertains.

Dans la guerre moderne, l incertitude un problème très préoccupant. Les soldats peuvent se retrouver dans un environnement où les factions amies, ennemies et neutres utilisent des équipements similaires ou identiques, portent des uniformes similaires ou identiques, et emploient des tactiques similaires. Dans les conflits asymétriques, il faut s attendre à ce que

les ennemis imitent le comportement des civils pour jeter la confusion parmi les soldats. De plus, les Forces canadiennes (FC) interviennent souvent dans le cadre d une coalition, ce qui peut nuire à la capacité de nos soldats à reconnaître les unités amies. Le risque lié aux indices incertains peut être atténué par la modification des tactiques, des procédures et des programmes d instruction et d éducation, et par le développement de systèmes d aide à la décision.

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Acknowledgements

The experiment reported here was completed with the invaluable assistance of Matthew Lamb and Elaine Maceda.

Introduction

Combat Identification (CID) is the capability to identify friendly, enemy and neutral forces rapidly and accurately, manage and control the battlespace, and optimally employ weapons and forces [1]. The goal of the decision maker in CID is to ensure that when a weapon is fired, it is fired at an appropriate target. Therefore, CID involves rapidly and accurately identifying the allegiance (e.g., friend, enemy, neutral) of contacts detected in the battlespace, based on all available sources of data. Ultimately, the purpose of CID is to gain the maximum combat effectiveness possible, which involves minimizing losses caused by both enemy and friendly fire [2].

In most operational settings, numerous sources of data are available and must be considered to correctly identify targets. These data sources include surveillance, navigation, and networking. CID is generally considered to entail three elements: situation awareness (SA), target identification, and Tactics, Techniques, and Procedures (TTPs) (e.g., Dean & Handley [2]). SA refers to the perception and understanding of the operational environment needed to act effectively in that environment. CID clearly requires SA as a precursor to the classification of entities as friendly, hostile, or neutral. Target identification is the process of making that classification judgment based on the characteristics of the entity in question in relation to the TTPs that govern how one interprets objects in the operational environment. One can think of SA as providing the data about objects in the environment and TTPs providing the knowledge needed to interpret that data. Target identification is thus the process by which SA and TTPs are employed [2].

Another view of CID focuses on the decision making steps required. Dean et al. [3] propose a four-stage model of CID comprised of:

- Detection: Determining that a target of potential interest is present;
- Classification: Assigning the target to a general class of object or entity, such as an armoured vehicle, tank, etc.;
- Identification: Determining the allegiance of the target (friend, enemy, neutral); and
- Action: Determining the appropriate action to take with respect to the target, based on Rules of Engagement (ROE) and Standard Operating Procedures (SOP).

Why is CID Important?

CID is the process by which enemies are identified and targeted for destruction and is a key element of combat effectiveness. It is generally the failures of CID that cause the most concern both operationally and nationally. Failure of a CID system can lead to fratricide (the inappropriate engagement of a friendly soldier or unit), neutricide[1] (identifying a neutral contact as hostile), or injury or death to oneself caused by failure to identify an enemy contact[2] (see Harris & Syms [4]).

[1] Neutricide is the term used by Dean et al. [3] to describe incidents when civilians and civilian infrastructure are accidentally targeted or misidentified and deliberately targeted.

[2] Referred to as a mistake akin to 'suicide' on the battlefield by Karsh, Walrath, Swoboda and Pillalamarri [5].

Causing accidental death or injury is only one of the negative effects of fratricide and neutricide. Other negative effects are listed in Table 1. Some affect the combat effectiveness of one s own forces, as fratricide can lead to loss of morale as well as a reluctance to take risk and seize the initiative. Other effects are more systemic, changing the nature of command and control or causing political or legal issues. Neutricide can likewise create political and legal issues and undermine efforts to win over local civilian populations.

Table 1: Negative Effects of Fratricide and Neutricide

Source: Dean et al. (2005) [3]	**Source: U.S. Congress, Office of Technology Assessment**
Casualties & damage to equipment	Hesitation to conduct limited visibility operations
Wasted time, effort, and ammunition	Loss of confidence in leadership
Drop in morale and levels of trust	Increase of leader self-doubt
Drop in unit effectiveness and excessive caution	Hesitation to use supporting combat systems
Strain on coalitions if casualties inflicted on allies	Oversupervision of units
Political repercussions	Loss of initiative
Loss of “hearts and minds” of civilian population	Loss of aggressiveness during fire and maneuver
Unnecessary risk to own forces	Disrupted operations
Disruption of tempo	Needless loss of combat power
	General degradation of cohesion and morale

How prevalent are failures of CID?

Estimating the frequency of fratricide has historically been a difficult task. Generally, little reliable evidence is available and the tempo of warfare works against the preservation of sites where fratricide may have occurred [6]. Estimates from the First and Second World Wars put the percentage of all Allied casualties caused by friendly fire between 10 and 15% [3]. Harris and Syms [4] conducted a thorough review of historical reports and documents that indicated similar fratricide rates for those conflicts but suggested higher rates for more recent conflicts. In line with this, nearly 80% of casualties suffered by the United Kingdom in Operation Granby (1st Iraq war) were attributed to friendly fire [3]. The United States estimated a much lower fratricide rate in that conflict but one still higher than those estimated in earlier wars.

Several factors potentially contribute to a greater risk of fratricide in the modern battlespace. Weapons have much longer ranges than in past conflicts, and targets can be engaged before it is possible to acquire positive identification [7]. This creates a dangerous situation in which forces must be concerned that a target is a potential enemy who could fire upon them but are unable to gather the data necessary for CID. The greater range of weapon systems also means that remote sensors, which may provide only partial cues to identity, must be relied on to a greater extent. Greater mobility of forces has led to operational environments in which forces are more dispersed, making it more difficult to maintain good SA [1].

In addition to the greater risk of fratricide and neutricide, the use of modern weapons and surveillance allows fratricides and neutricides to be more easily detected [1]. Hence accidental deaths and injuries that may have gone unexplained in past conflicts may now be more accurately detected.

Perhaps the most significant factor working against CID in today s environment is the increasingly asymmetric nature of conflict. Canada and its coalition partners find themselves participating in high tempo, non-linear operations with enemies who eschew traditional uniforms and employ diverse equipment. The presence of civilians further complicates the environment.

What causes CID failures?

There is no single cause for incidents of fratricide and neutricide. Major risk factors are the loss of SA and misidentification of the target [4] [7] [8]. Each of these factors, however, is a confluence of more proximal factors that break down further into human, physical, and organizational factors [2].

Human factors are characteristics or traits of human beings, related to their physiology, cognitive capabilities, and development (e.g., through training), that can negatively affect CID performance. For example, people have natural limits to information processing capacity [9] which makes it difficult for soldiers to maintain SA in complex environments [7]. CID is made especially difficult for soldiers in environments such as Afghanistan by the asymmetric nature of that conflict, characterized by a difficulty in knowing who and where one s enemies are and how and when they will attack. Human beings are also subject to stress and emotions that can impair performance, leading to misidentifications, lack of fire discipline, etc. Training and education can be positive factors but poor training can impair both SA and identification [2].

Physical factors include environmental conditions and the state of equipment, especially sensors. Environmental conditions that reduce visibility or hinder the functioning of sensors are key factors in many fratricide incidents [10]. Equipment failures can also make CID more difficult and error-prone. Increasingly, operational zones feature the presence of similar or even identical equipment being used by friendly, neutral, and enemy forces and this can cause tremendous confusion in the identification process [7].

Operational factors pertain to the unique geographical, cultural, and historic features of the operational setting, as well as the organizational structure in which soldiers function. Operating afield in unfamiliar nations can leave soldiers with limited knowledge about data sources needed to distinguish neutral from potentially hostile factions [11]. It is often the case that such knowledge is difficult and time-consuming to acquire. Constraints imposed from higher command in the form of SOPs and ROE can further hinder the CID process. Failures of command and control (C2) and communication frequently contribute to fratricide and neutricide incidents [10]. All of these issues are exacerbated in high-tempo operations that decrease margins of error [4].

How can CID be Improved?

CID performance can be improved by addressing each of its elements: a) target identification, b) SA, and c) TTPs [2]. The US Armed Forces, for example, has developed concepts for decision support to both SA and target identification (see [1] for a review). In the former case, it has considered so-called blue-force tracking systems that track the positions of all friendly vehicles and transmits this information. Significant work in this area has been done by the U.S. Joint Force Command s (USJFCOM) Coalition Combat Identification (CCID) team through its Advanced Concept Technology Demonstrations (ACTDs). In addition, the US Armed Forces has employed visual markings, radio emission intercept, and IFF (Identify Friend/Foe) systems to assist in target identification [5] [7].

Although Canada is participating in efforts to develop SA and target identification decision support tools, the Canadian Forces (CF) has also worked on refining TTPs to enhance CID [12]. This work includes the development of enhanced training as well as new SOPs.

Understanding Human Judgment in CID

CID is a complex cognitive as well as technological process. Although improvements in sensors and development of Blue Force Tracking (BFT) devices[3] can enhance the effectiveness of CID, it is nevertheless necessary to understand the human decision making processes involved in identification. The nature of the decision making process determines how human factors affect CID and can also help us better understand the kinds of physical and operational conditions that will challenge soldiers.

One such CID model is the INtegrative Combat IDentification Entity Relationship (INCIDER) model [2] [3]. This model integrates the effects of physical, operational, and human factors in a description of the steps required to identify a target. In brief, the model assumes that the human decision maker fuses multiple sensory inputs and SA, as interpreted with respect to his/her knowledge base, to produce a classification of the target. The decision maker assesses his/her confidence in that classification based on various parameters and expectations and generates a decision on what action to take. Although the INCIDER model offers a framework in which to understand CID, it is not very specific concerning the nature of the cognitive process by which the decision maker fuses data, classifies the target, and determines the appropriate response. Dean et al. [3] assume that people employ a recognition-based process along the lines of Klein s [13] Recognition-Primed Decision (RPD) model to recognize targets. The RPD model does emphasize the role of SA in decision making and, as such, seems consistent with what is known about CID. However, like the INCIDER model, the RPD model also does not provide a detailed process-oriented model with which to predict the effects of human factors on CID judgments and decision support.

In this report, we focus on the target identification aspect of CID and attempt to determine how human decision makers deal with uncertainty. The modern battlespace presents instances in which the physical characteristics of friend, neutral, and enemy may be similar or identical [7]. Soldiers are therefore faced with the difficult task of determining identity based on cues that are only imperfectly associated with a target class. As a first step in building a more detailed cognitive model of CID decision making, we investigated the process by which people aggregate and fuse multiple data sources, or cues, to identify targets.

The experiment described in this report explores elements of human CID decision making. In particular, the experiment provides insight into the way people deal with the uncertainty associated with various kinds of cues (visual and behavioural) to indicate whether a target is friendly or hostile. This will help us determine plausible models of human information aggregation for CID (see Famewo, Matthews, & Lamoureux [14]). By identifying plausible models of human behaviour, we will be able to support development of procedures, training, and technology to enhance combat ID decision making.

[3] A BFT is a system that collects positional information from friendly units carrying appropriate transmitters, collates this information, and distributes a composite map of friendly unit positions.

Experiment

This experiment was conducted using the IMMERSIVE (Instrumented Military Modeling Engine for Research using SImulation and Virtual Environments) software platform developed at Defence Research & Development Canada (DRDC) Valcartier. IMMERSIVE is based on a modified gaming environment called Unreal Tournament that creates a first-person perspective environment in which the subject assumes the role of a dismounted infantry soldier. This platform was used to present subjects with a series of blocks of trials, in which each trial comprised a human figure moving into view. The subject s task was to engage (i.e., shoot) only those figures that were enemies. Friendly and enemy forces were distinguishable by differences in uniforms, equipment, and behaviour. In each block, subjects remained at a specific fixed location in the simulated environment. Their accuracy in engaging enemies was the primary experimental measure.

The initial objective of the experiment was to investigate the impact of cue uncertainty on engagement decision making performance. To examine this objective, variability in the characteristics of friend and enemy trials was introduced across blocks. Two factors were considered: 1) the type of characteristic that was uncertain (visual or behavioural), and 2) the salience of the uncertain feature (salient or not salient). These factors were systematically varied across blocks. Visual characteristics are perhaps of primary importance to dismounted soldiers, but the behaviour of individuals provides valuable information as well [15].

Method

Subjects

Subjects were 30 male and female employees of DRDC Toronto, students conducting research at DRDC Toronto, or individuals recruited from local universities. All subjects were aged 18 and older, had normal or corrected-to-normal vision, and were unfamiliar with the specific hypotheses and stimulus configurations of the experiments. All received stress pay remuneration for participating.

This study, approved by the DRDC Toronto Human Research Ethics Committee (HREC) and was conducted in conformity with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.

Materials

The experiment was conducted with Personal Computers (PCs), which presented stimuli, collected subject responses, and recorded data. The IMMERSIVE platform was used as a test bed simulating combat activities.

The experimentation process comprised the set up, deployment, and management of the following components:

- Terrain: The simulated environment in which a scenario takes place;
- Scenario: A sequence of events representing a portion of battlefield action;

- roBOTic computer controlled entities (BOTs): Play scenario characters (see Figure 1);
- Subject: Plays the role of a Canadian soldier and controls a rifle that can be used to engage (shoot at) hostile entities; and
- Rules of engagement: Rules that govern how the subject responds to different kinds of BOTs.

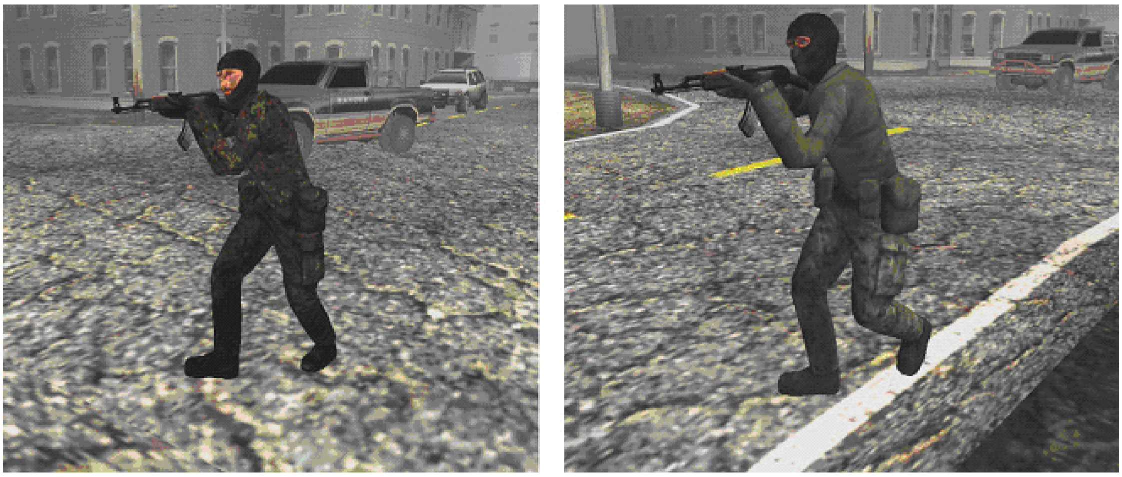

Figure 1. Examples of BOTs to be used in scenarios (pictures presented here are not as sharp as actual computer images).

Subjects were provided with ROE at the beginning of the experimental session. The ROE distinguished friendly from potentially hostile BOTs and governed when the subject was to engage hostile BOTs with the rifle.

Each subject performed 10 blocks of trials as a dismounted infantry soldier in a three-dimensional urban environment. Subjects interacted with this environment from a fixed location (indicated by the white box in Figure 2), giving them a viewpoint within the environment. Note, subjects never saw a top-down view as illustrated in Figure 2. In a block, a number of computer-controlled BOTs were in motion, following pre-specified paths at pre-specified times. Two such paths are marked in blue and red in Figure 2. The BOTs traveled into and out of view sequentially, so that no two BOTs were visible to the subject at the same time.

The Combat ID Virtual Simulation software logged subject actions pertinent to subjects firing decisions. The software logged each instance in which the subject fired the rifle, the identity of the BOT fired upon, and the subject s accuracy (whether or not the shot hit the BOT). The primary experimental measure was decision accuracy (i.e., whether or not the subject engaged a hostile or friendly BOT). A subject could fire one or more shots at a BOT without hitting it. To capture such events as intended engagements, the software logged for each shot fired whether it hit a BOT and, if not, how close the shot was to a BOT (i.e. minimum distance between shot and BOT). Shots fired within a certain distance of a BOT (approximately one meter in the simulated environment) were counted as engagements.[4]

[4] Because the criterion for engagement was a fixed distance with respect to a BOT, the angular displacement from rifle to BOT varied somewhat with the distance of the BOT to the subject s firing position. However, angular displacements were not computed for each shot because the range of firing angles associated with engagements was fairly small.

Design

The initial objective of the experiment was to investigate the impact of cue uncertainty on engagement decision making (accuracy, speed). Two factors were manipulated: 1) the BOT characteristic that was uncertain (visual or behavioural), and 2) the salience of the uncertain feature (salient or not salient). These factors were manipulated within-subjects, across blocks.

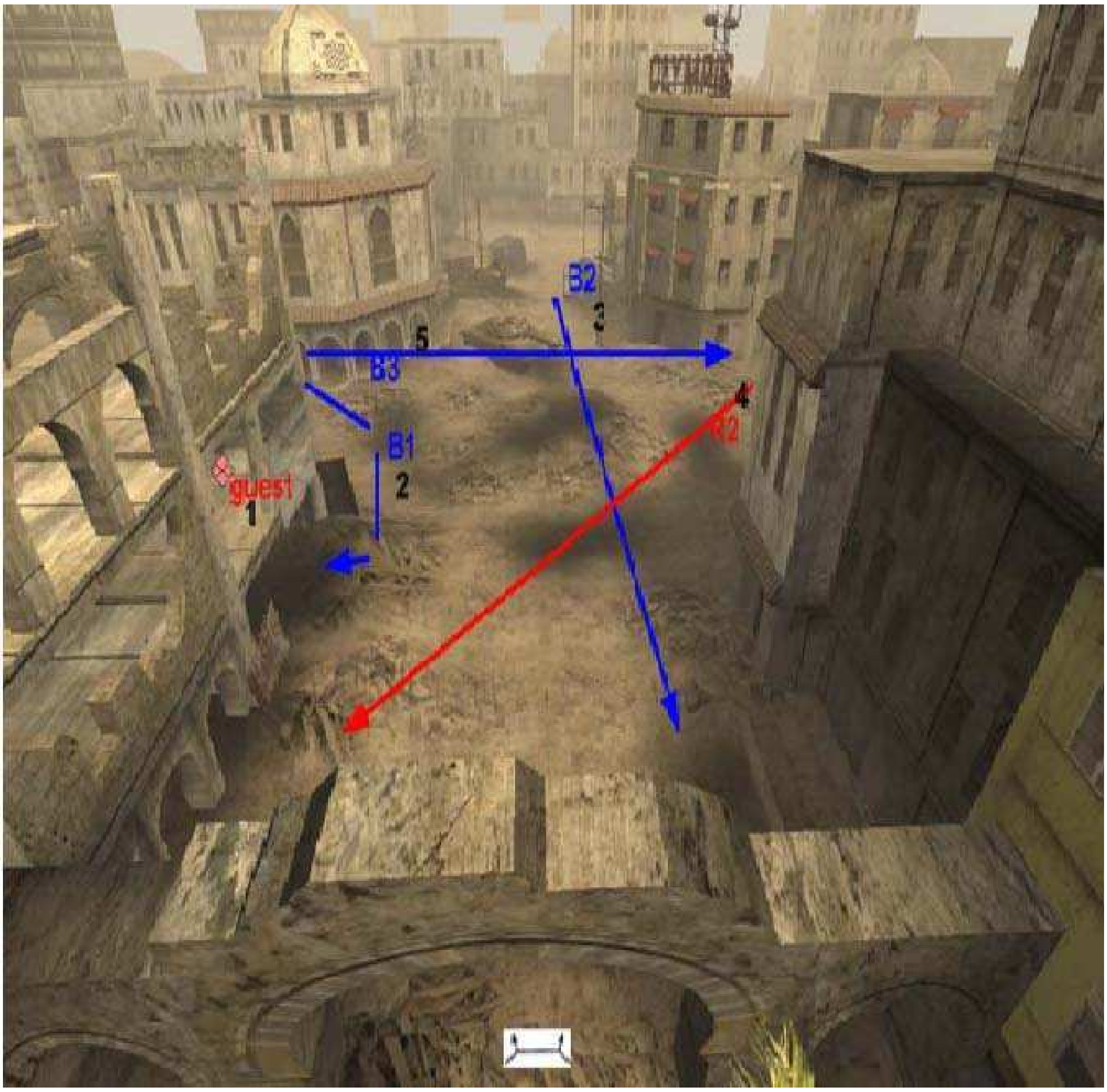

Figure 2. Example BOT paths in a simulated environment.

Friendly and hostile BOTs were designed on the basis of a common model that could be varied according to two visual and two behavioural features (see Table 2). For both visual and behavioural characteristics, one feature was relatively salient and the other less so. BOTs designated friendly or hostile differed only along these four characteristics.

The salient visual characteristic was the color of the BOT s uniform. The standard friendly value was the green Canadian Distinctive Pattern (CADPAT) used by the CF, whereas the enemy value was a distinct olive colour. The less salient visual characteristic was the rifle carried by a BOT, which was either a C7 rifle (friend) or AK-47 (enemy). Salience of visual cues was based on the relative size of the uniform and rifle, with the larger uniform being judged more salient than the rifle. The salience of behavioural characteristics was based on the ease with which a subject could notice that characteristic. The salient behavioural characteristic was the direction in which a BOT moved when it appeared in the subject s field of view. Friendly BOTs moved away from the subject s position, whereas enemy BOTs moved toward the subject s position. The low-salience behavioural characteristic was the presence or absence of a pause in the BOT s motion. Friendly BOTs paused for 1 - 2 seconds during movement, whereas enemy BOTs did not pause at any point.

Table 2. Critical BOT Cues

Bot Class	Feature Type	Saliency	Feature	Standard Value
Friend	Visual	High	Color	CADPAT
		Low	Rifle	C7
	Behavioural	High	Movement	Away
		Low	Pause	Pause
Enemy	Visual	High	Color	Olive
		Low	Rifle	AK-47
	Behavioural	High	Movement	Toward
		Low	Pause	No pause

Procedure

Subjects were first briefed on the general purpose of the experiment and their role. They were told that they would be engaging in simulated combat using a first-person-shooter computer game which has been modified for data collection purposes.

In the experiment session, subjects played the role of a dismounted soldier, which was represented in the simulated environment by an avatar (a controllable character in the simulated environment). The avatar could only remain at its fixed location and the subject controlled the angular direction of the avatar, which could face any direction in a 180° arc. The subject s task was to monitor the area in front of the avatar s position and engage any and all enemy soldiers that moved into view. Subjects controlled the movement of the rifle with the computer mouse and fired by pressing the left mouse button. Subjects were told that roughly equal numbers of friendly and enemy soldiers would move through their area of responsibility, but that friends and enemies could be distinguished by observing four characteristics of the soldier.

Subjects were guided through a practice session in which they were told how to control the avatar, shoot the rifle, etc. During the practice session, subjects saw examples of friendly and enemy soldiers and practiced firing the rifle.

In the main session, subjects performed a series of 10 blocks. Each block consisted of 20 BOTs (10 friend and 10 enemy) moving through the environment. The starting points and timings of

Table 3. Schedule of Blocks and BOT Features

Block	Name	BOTs	Friend Features		Enemy Features	
			Uniform	Rifle	Movement	Pause
1	Baseline	10 Friend	CADPAT	C7	Away	No
		10 Enemy	Olive	AK-47	Toward	Yes
2	Friend Salient Visual Variable	8 Friend	CADPAT	C7	Away	No
		2 Friend	Olive*	C7	Away	No
		10 Enemy	Olive	AK-47	Toward	Yes
3	Friend Non-Salient Visual Variable	8 Friend	CADPAT	C7	Away	No
		2 Friend	CADPAT	AK-47*	Away	No
		10 Enemy	Olive	AK-47	Toward	Yes
4	Enemy Salient Visual Variable	10 Friend	CADPAT	C7	Away	No
		8 Enemy	Olive	AK-47	Toward	Yes
		2 Enemy	CADPAT*	AK-47	Toward	Yes
5	Enemy Non-Salient Visual Variable	10 Friend	CADPAT	C7	Away	No
		8 Enemy	Olive	AK-47	Toward	Yes
		2 Enemy	Olive	C7*	Toward	Yes
6	Friend Salient Behavioural Variable	8 Friend	CADPAT	C7	Away	No
		2 Friend	CADPAT	C7	Toward*	No
		10 Enemy	Olive	AK-47	Toward	Yes
7	Friend Non-Salient Behavioural Variable	8 Friend	CADPAT	C7	Away	No
		2 Friend	CADPAT	C7	Away	Pause*
		10 Enemy	Olive	AK-47	Toward	Yes
8	Enemy Salient Behavioural Variable	10 Friend	CADPAT	C7	Away	No
		8 Enemy	Olive	AK-47	Toward	Yes
		2 Enemy	Olive	AK-47	Away*	Yes
9	Enemy Non-Salient Behavioural Variable	10 Friend	CADPAT	C7	Away	No
		8 Enemy	Olive	AK-47	Toward	Yes
		2 Enemy	Olive	AK-47	Toward	No*
10	End Baseline	10 Friend	CADPAT	C7	Away	No
		10 Enemy	Olive	AK-47	Toward	Yes

* Non-standard features are highlighted; except in baseline conditions, two friend or enemy BOTs possessed a single non-standard feature and all other BOTs possessed exclusively standard features.

the BOTs was varied systematically, so as to be unpredictable to subjects, but no two BOTs appeared within the subject s field of view at the same time. To ensure that starting position did not affect overall performance, one friend and one enemy shared the same starting point (at different times) in each block.

Table 3 indicates for each block the features associated with friend and enemy BOTs. The first block served to measure subjects baseline performance and contained 10 friends and 10 enemies comprised of the standard features associated with each type of BOT (see Table 2). In subsequent blocks, one cue of either friend or enemy BOTs was varied such that two of the 10 instances contained non-standard features (i.e., features associated with the other class of BOT). For example, in Block 2, eight friendly BOTs possessed all four features standard to the definition of friend in the ROE but for two friendly BOTs the salient visual feature associated with friend was replaced with the feature normally associated with enemy BOTs. All 10 enemy BOTs in Block 2 possessed all the features standard to the definition of enemy. As shown in Table 3, subsequent blocks involved the switching of one visual or behavioural feature at a time across friendly and enemy BOTs to systematically introduce uncertainty as to what features a friend or enemy could possess. This was done according to the schedule shown in Table 3. All subjects followed the same order of blocks as indicated in Table 3. Each row in Table 3 indicates a block and the number of friends and enemies presented with the visual and behavioural features indicated. The final block was the same as the first and served as a comparison to the baseline for assessing learning effects over the course of the experiment.

The trial block is a key factor for analysis of the data. To facilitate description of the results, the acronyms listed in Table 4 were used to refer to each block. A brief description of each condition is also provided in Table 4 for use as a reference.

Table 4: Description of Experiment Blocks

Block	Acronym	Description
Baseline	Baseline	Assessment of initial performance level with all standard Friends and Enemies
Friend Salient Visual Variable	FSVV	Two Friends possess a salient non-standard visual characteristic
Friend Non-Salient Visual Variable	FNSVV	Two Friends possess a non-salient non-standard visual characteristic
Enemy Salient Visual Variable	ESVV	Two Enemies possess a salient non-standard visual characteristic
Enemy Non-Salient Visual Variable	ENSVV	Two Enemies possess a non-salient non-standard visual characteristic
Friend Salient Behavioural Variable	FSBV	Two Friends exhibit a salient non-standard behavioural characteristic
Friend Non-Salient Behavioural Variable	FNSBV	Two Friends exhibit a non-salient non-standard behavioural characteristic
Enemy Salient Behavioural Variable	ESBV	Two Enemies exhibit a salient non-standard behavioural characteristic
Enemy Non-Salient Behavioural Variable	ENSBV	Two Enemies exhibit a non-salient non-standard behavioural characteristic
End Baseline	End Baseline	Final assessment of performance level with all standard Friends and Enemies (to ascertain learning effects)

Results

Subjects decisions to shoot, as indicated by firing a shot that hit or came within a critical distance (see Materials section, p. 16) of the BOT, or to not shoot, as indicated by no shot or a shot outside the vicinity of the BOT, were recorded for each BOT in each block. Decisions to shoot an enemy

BOT were termed *hits* and indicated correct recognition of an enemy, whereas decisions to not shoot an enemy BOT were termed *misses* and indicated failures to recognize an enemy leading to reduced mission effectiveness. Decisions to not shoot friendly BOTs were termed *correct rejections* and comprised the correct recognition of a friend, whereas decisions to shoot a friendly BOT were termed *false alarms* (FA) and indicated the incorrect determination of an enemy, leading to an instance of fratricide. Hit and false alarm rates were of greatest interest in this experiment.

Hit Data

Figure 3 shows the hit rates calculated for each block. Overall, hit rates were relatively high, exceeding 80% in all blocks. A single factor repeated-measures Analysis of Variance (ANOVA) indicated that the trial Block had a significant effect on subjects mean hit rate [$F(9,207) = 4.38$, $MSe = 0.011$, $p < .01$]. To better understand how hit rate varied across blocks, a series of post-hoc comparisons were performed to contrast each block with every other block. These post-hoc comparisons were performed using Fisher s Least Significant Difference (LSD) method, which computes an LSD value for each pair-wise comparison of means and determines the probability that the difference was the result of random chance. The results of the comparisons are summarized in Table 5.

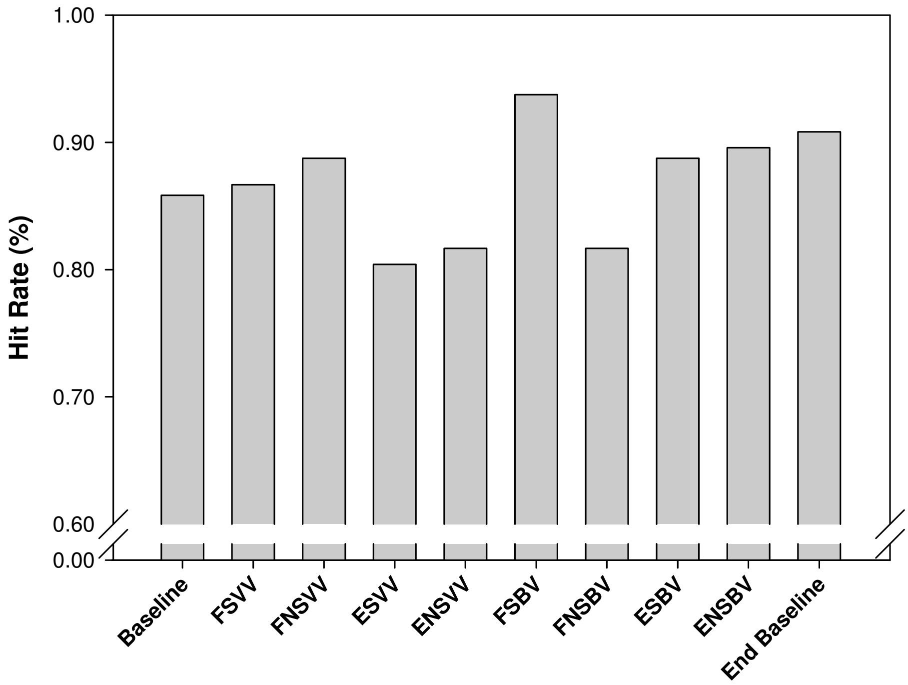

Figure 3. Hit rates (correct engagement of enemy) across all blocks of trials.

The baseline and end baseline hit rates did not differ significantly, indicating that there was no learning effect across the course of the experimental session. Because there was no variability in the features of friend and enemy BOTs in the baseline conditions, they indicated the expected level of performance when subjects are certain of the distinguishing features of friends and enemies. By comparing the hit rates of the baselines to the hit rates of all other conditions (in

Table 5. Fisher's Least Significant Difference (LSD) Test Results (Hit Rate)

		Uncertain Visual Cue				Uncertain Behavioural Cue				
		Uncertain Friend		Uncertain Enemy		Uncertain Friend		Uncertain Enemy		
	Baseline	**FSVV**	**FNSVV**	**ESVV**	**ENSVV**	**FSBV**	**FNSBV**	**ESBV**	**ENSBV**	**End Baseline**
Baseline	N/A	0.780	0.328	0.070	0.163	***0.008***	0.163	0.328	0.210	0.094
FSVV	-	N/A	0.484	***0.037***	0.094	***0.018***	0.094	0.484	0.328	0.163
FNSVV	-	-	N/A	***0.006***	***0.018***	0.094	***0.018***	1.000	0.780	0.484
ESVV	-	-	-	N/A	0.675	***<0.001***	0.674	***0.006***	***0.002***	***0.001***
ENSVV	-	-	-	-	N/A	***<0.001***	1.000	***0.018***	***0.008***	***0.002***
FSBV	-	-	-	-	-	N/A	***<0.001***	0.094	0.163	0.328
FNSBV	-	-	-	-	-	-	N/A	***0.018***	***0.008***	***0.002***
ESBV	-	-	-	-	-	-	-	N/A	0.780	0.484
ENSBV	-	-	-	-	-	-	-	-	N/A	0.675
End Baseline	-	-	-	-	-	-	-	-	-	N/A

Within MSe = 0.011; df = 207
Contrasts which are significant to p<.05 are shown in ***bold italic***

which uncertainty was associated with a feature of the friend or enemy BOTs), we can determine whether or not, and to what extent, uncertainty concerning the distinguishing features of friend and enemy BOTs affected subjects performance.

The mean hit rate was lower in several blocks than that of the baseline (ESVV, ENSVV FNSBV) but these differences were not statistically significant. Only the FSBV block exhibited a significantly higher hit rate than the baseline. Hit rates in the ESVV, ENSVV, and FNSBV blocks were significantly lower than that of the end baseline. This finding, in conjunction with the non-significant differences of these blocks from the baseline (no uncertainty), suggests that hit rate was reduced by variability of the enemy BOTs salient and non-salient visual features and the friendly BOTs non-salient behavioural feature.

Uncertainty of the characteristics of friends (i.e., cases in which friends may possess characteristics associated with enemies) did not reduce hit rate, except in one block, even though one might have expected subjects to be less willing to engage enemies because of the increased risk of misclassifying a friend as an enemy. Subjects either had no difficulty recognizing friends despite cue uncertainty or were applying strict decision criteria that discouraged engaging any target perceived to have a friendly characteristic.

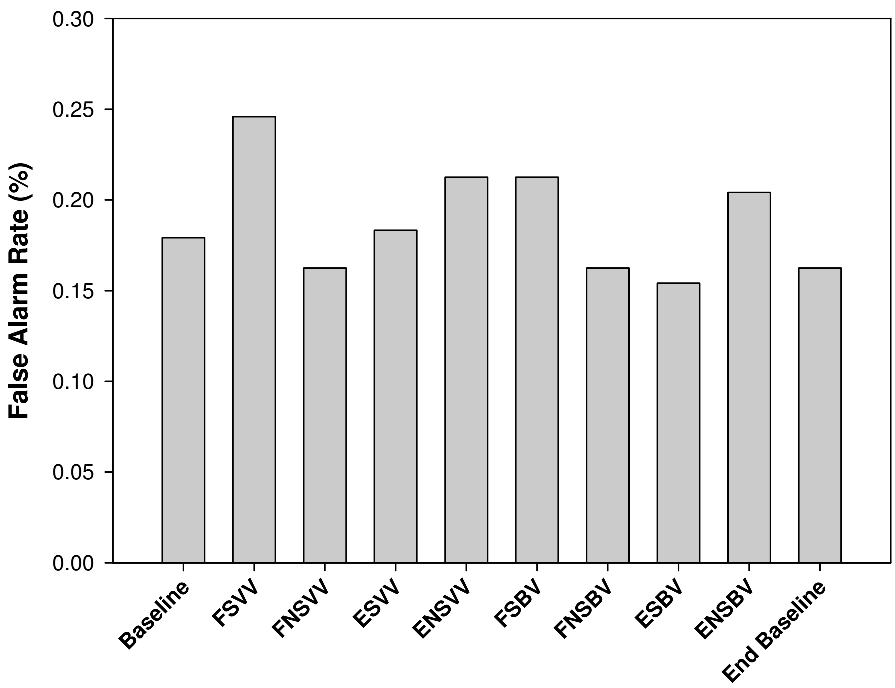

Figure 4. False Alarm rates (incorrect engagement of friend) across all blocks of trials.

False Alarm (FA) Rate

Mean FA rates (see Figure 4) ranged between 15-25%, which is much higher than any commander would wish to observe in an operational environment. For the purpose of this experiment, however, it was essential that subjects made FAs at a suitably high rate to allow statistical discrimination of differences between blocks.

Although FA rates were somewhat higher in the FSVV, ENSVV, FSBV, and ENSBV blocks than the baseline block, a single factor repeated-measures ANOVA revealed no significant overall effect of trial Block on subjects mean FA rate [$F(9,207) = 1.39$, $MSe = 0.015$, *n.s.*]. Thus, these differences are not statistically reliable and no post hoc comparisons were made.

Sensitivity

Signal Detection Theory (SDT) [16] is a way to examine subjects sensitivity to stimuli. In the context of the CID task, sensitivity refers to subjects psychological discrimination between friends and foes, or their ability to correctly classify a friend as a friend, and a foe as a foe. As a statistical measure, sensitivity (d') is defined in terms of z, the inverse of the normal function and the observed hit (H) and FA rates [17] by the formula:

$$d' = z(H) - z(FA) \qquad (1)$$

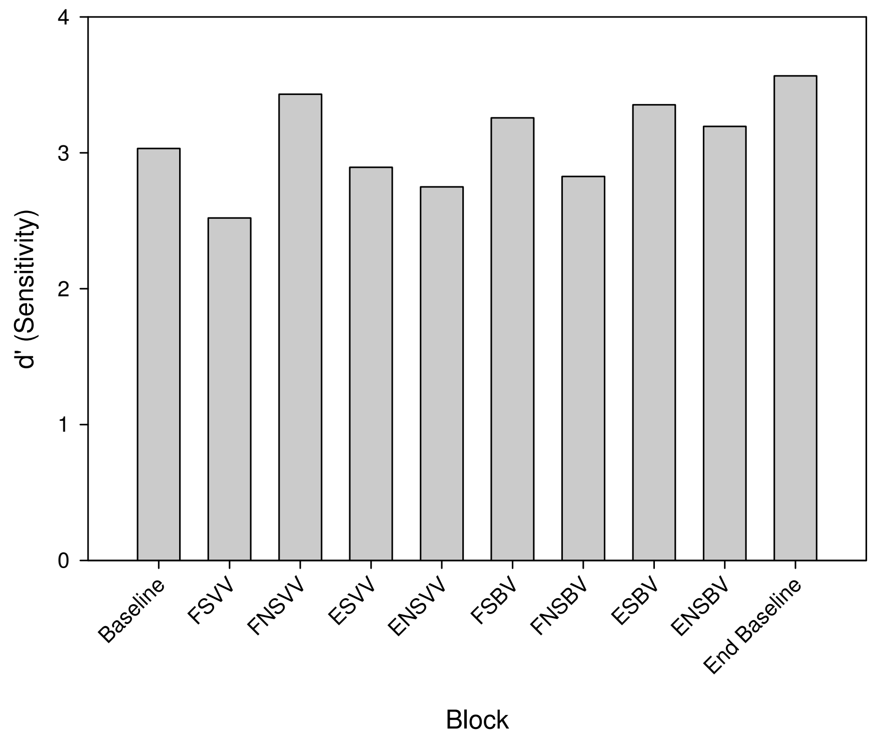

Figure 5. Mean d' Values (Sensitivity) across all blocks of trials.

The z-transformation converts the H and FA rates to standard deviation units such that a d' value of zero corresponds to a complete inability to distinguish friend from foe. Increasingly positive values of d' indicate progressively greater ability to discriminate friend from foe. Sensitivity takes into account correct engagements of enemy BOTs and correct non-engagements of friendly BOTs and is thus a more complete measure of performance than H rate or FA rate alone.

Figure 5 shows mean *d′* scores for each block. A single factor repeated-measures ANOVA revealed no significant overall effect of trial block on *d′* [F(9,207) = 1.39, *MSe* = 0.015, *n.s.*]. Thus, no post hoc comparisons were made.

Response Bias

Derived from SDT, response bias is a measure of a subject s general tendency to respond positively to a target. In the case of the current experiment, it measures the general tendency to report a foe regardless of the actual identity of the target.

Like sensitivity (*d′*), response bias (*c*) is defined in terms of *z* and the observed H and FA rates [17]:

$$c = -0.5 \bullet [z(H) + z(FA)] \qquad (2)$$

Positive values of *c* indicate a tendency to classify a target as foe regardless of its true identity, whereas negative values indicate a tendency to classify a target as a friend. The larger the value in either direction, the greater the tendency.

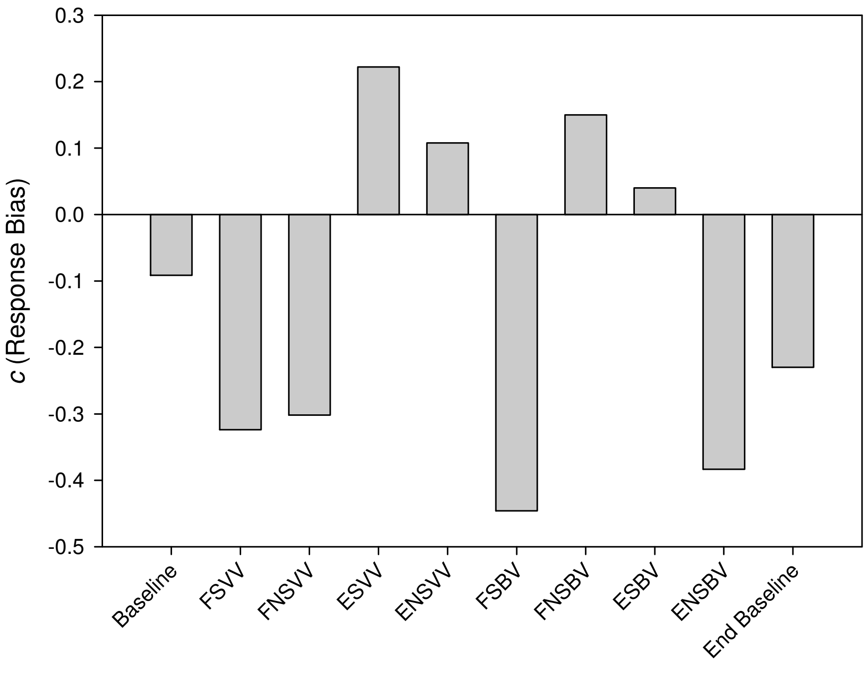

Figure 6. Mean c Values (Response Bias) across all blocks of trials.

Figure 6 shows the mean *c* scores calculated for each block. A single factor repeated-measures ANOVA revealed a significant effect of trial block [$F(9,207) = 3.27$, $MSe = 0.432$, $p < .01$]. To better understand how response bias varied across blocks, a series of post-hoc

Table 6. Fisher's Least Significant Difference (LSD) Test Results (Response Bias)										
		Uncertain Visual Cue				**Uncertain Behavioural Cue**				
		Uncertain Friend		**Uncertain Enemy**		**Uncertain Friend**		**Uncertain Enemy**		
	Baseline	**FSVV**	**FNSVV**	**ESVV**	**ENSVV**	**FSBV**	**FNSBV**	**ESBV**	**ENSBV**	**End Baseline**
Baseline	N/A	0.222	0.269	0.100	0.295	0.063	0.205	0.490	0.126	0.466
FSVV	-	N/A	0.908	***0.004***	***0.024***	0.521	***0.013***	0.057	0.754	0.622
FNSVV	-	-	N/A	***0.006***	***0.032***	0.449	***0.018***	0.073	0.668	0.705
ESVV	-	-	-	N/A	0.547	***<0.001***	0.704	0.338	***0.002***	***0.018***
ENSVV	-	-	-	-	N/A	***0.004***	0.824	0.722	***0.010***	0.077
FSBV	-	-	-	-	-	N/A	***0.002***	***0.011***	0.742	0.256
FNSBV	-	-	-	-	-	-	N/A	0.563	***0.005***	***0.047***
ESBV	-	-	-	-	-	-	-	N/A	***0.027***	0.156
ENSBV	-	-	-	-	-	-	-	-	N/A	0.420
End Baseline	-	-	-	-	-	-	-	-	-	N/A
Within MSe = 0.432; df = 207 Contrasts which are significant to p<.05 are shown in ***bold italic***										

comparisons was performed using Fisher s LSD method. The results of the comparisons are summarized in Table 6.

As shown in Figure 6, subjects exhibited small negative biases in the Baseline and End Baseline blocks, indicating a general tendency to not engage targets. Biases in all other blocks did not differ significantly from the Baseline value. Only the biases in the ESVV and FNSBV blocks differed significantly from the End Baseline. Thus, the overall differences among blocks do not seem to constitute very large shifts in response bias.

Nevertheless, we see that subjects exhibited positive bias in the ESVV, ENSVV, FNSBV, and ESBV blocks. This suggests that when enemy BOTs possessed uncertain characteristics, subjects exhibited a slight bias to engage, although the *c* values are small. Positive bias, however, is not seen in the ENSBV block, perhaps because the variable behavioural characteristic was non-salient. Conversely, subjects exhibited negative bias in the FSVV, FNSVV, FSBV, and ENSBV blocks, suggesting subjects exhibited a general tendency to not engage targets when friendly BOTs possessed uncertain characteristics. Negative bias, however, was not observed in the FNSBV block, perhaps because the variable behavioural characteristic was non-salient.

Discussion

Both hit rate and FA rate are important indicators of performance in this experimental task and, indeed, real-world combat where soldiers must successfully but safely engage enemy forces. Reductions in hit rates correspond to decreased combat effectiveness, which opens possibilities for the enemy to survive and cause harm to one s own forces. However, increased FA rates correspond to instances of fratricide and direct harm to own forces being caused by own forces. Although the results of this experiment showed only very small effects on hit rate and response bias, it remains important to consider how the variability of perceptual and behavioural cues might affect CID in the field.

Subjects hit rates were affected by uncertainty associated with visual and behavioural characteristics of targets in the environment. This effect depended on the salience of the characteristics that were uncertain. Presumably because less salient characteristics are less likely to be considered in the CID decision [16], subjects hit rates were not affected in the FNSBV block. Although hit rates in the FSVV and FNSVV blocks were very similar to those of both the baseline and end baseline, the hit rate of the FSBV block significantly exceeded those of both baseline blocks. In contrast, the hit rate of the FNSBV block was lower than those of both baseline blocks. Although we had expected that hit rate could decrease as a result of characteristic uncertainty, it is unclear why such an effect would appear only when non-salient behavioural characteristics were uncertain.

Subjects FA rates were not affected by cue uncertainty, although FA rates were somewhat higher than baseline in the FSVV, ENSVV, FSBV, and ENSBV blocks. It may be that stronger manipulations of cue uncertainty could produce increased FA rates.

Subjects sensitivity was also not affected by cue uncertainty, indicating that they remained equally good at distinguishing friend and foe despite variations in the characteristics of friends and foes. Subjects did, however, exhibit small differences in response bias across blocks. This result suggests that subjects shifted their decision criterion in response to cue uncertainty associated with targets. Subjects appear to have slightly lowered their criterion when enemies appeared with uncertain cues but more dramatically raised their criterion when friendly BOTs appeared with uncertain cues. These shifts in criteria indicate that subjects were sensitive to changes in the certainty with which cues predicted a target s classification. Thus, when some enemy BOTs appeared with a feature associated with friendly BOTs, subjects lowered their criterion to be able to correctly engage enemies. This shift in criterion, however, did not have an appreciable effect on hit rate or sensitivity. In contrast, when friendly BOTs appeared with a feature associated with enemies, subjects raised the criterion to avoid the error of engaging a friend. This change in criterion presumably contributed to the lower hit rates seen in those blocks in which friendly BOTs possessed uncertain cues.

The nature of modern warfare makes uncertainty a pressing issue. Soldiers can expect to find themselves operating in environments in which friendly, enemy, and neutral factions employ similar or identical equipment, wear similar or identical clothing, and potentially employ similar tactics (e.g., [7]). Hostile factions in asymmetric conflicts can be expected to purposely mimic civilians in order to confuse soldiers. An enemy, by adopting characteristics of friendly forces or characteristics that are readily mistakable for those of friendly forces, can decrease own force effectiveness. The art of disguise has of course been known from the advent of warfare but it takes on much greater significance in today s asymmetric conflicts with the addition of large numbers of neutral/civilian entities likely to be in close proximity.

In addition, the CF often works in coalitions, which can undermine soldiers familiarity with the appearance of friendly units. Friendly forces will not intentionally take on characteristics of the enemy. Nevertheless, it is possible to unintentionally take on those characteristics or, more likely, characteristics that can be misperceived as those of the enemy. This is especially true in coalition environments where own forces will be comprised of soldiers using different equipment and trained in different procedures. Of course, when enemies attempt to blend into neutral/civilian populations they are attempting to create confusion concerning what characteristics reliably signal enemy presence.

The risk posed by cue uncertainty can be mitigated in several ways. TTPs can be revised to help soldiers recognize the potential for the visual and behavioural characteristics of targets to be imperfect predictors of identity. Training and education can prepare soldiers to anticipate and recognize that equipment and clothing can be similar among factions. A related approach is to develop SOPs based on operational experience to eliminate the use of cues that have proved unreliable.

Decision support systems can also help. Although SA support systems, such as Battlefield Target Identification Device (BTID), do not directly aid in target identification, improved spatial awareness of friendly units can reduce confusion caused by visual and behavioural uncertainty in targets. More direct measures to support identification, such as the use of Radio Frequency (RF) tags, provide soldiers with a tool to reliably identify friendly units.

Finally, the findings of this experiment will contribute to the ongoing effort to develop a cognitive model of CID decision making and information aggregation [18]. A cognitive model is needed to complement procedural models such as INCIDER [3] and provide a means to predict the impact of operational factors on target identification performance. This model will also be useful in assessing the impact of decision support concepts before expensive technology development begins.

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List of symbols/abbreviations/acronyms/initialisms

RF	Radio Frequency
ANOVA	Analysis of Variance
BFT	Blue Force Tracking
BOTs	roBOTic computer controlled entities
BTID	Battlefield Target Identification Device
c	Response bias
C2	Command and Control
CCID	Coalition Combat Identification
CF	Canadian Forces
CID	Combat Identification
d'	Response sensitivity
DRDC	Defence Research & Development Canada
FA	False Alarm
HREC	Human Research Ethics Committee
IFF	Identify-Friend-or-Foe
INCIDER	INtegrative Combat IDentification Entity Relationship
LSD	Least Significant Difference
MSe	Mean Square Error
IMMERSIVE	Instrumented Military Modeling Engine for Research using SImulation and Virtual Environments
ROE	Rules of Engagement
RPD	Recognition-Primed Decision
SA	Situation Awareness
SOP	Standard Operating Procedures
TTPs	Tactics, Techniques, and Procedures
USJFCOM	U.S. Joint Force Command
CADPAT	Canadian Distinctive Pattern
FSVV	Friend Salient Visual Variable

FNSVV	Friend Non-Salient Visual Variable
ESVV	Enemy Salient Visual Variable
ENSVV	Enemy Non-Salient Visual Variable
FSBV	Friend Salient Behavioural Variable
FNSBV	Friend Non-Salient Behavioural Variable
ESBV	Enemy Salient Behavioural Variable
ENSBV	Enemy Non-Salient Behavioural Variable
SDT	Signal Detection Theory
H	Hit

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(U) This report describes an experiment examining combat identification (CID) decision making and the impact of cue uncertainty on subjects' decision accuracy. Subjects played the role of a dismounted infantry soldier in a first–person perspective environment and engaged a series of simulated targets. Subjects attempted to engage (i.e. shoot) only those figures that were enemies. Friendly and enemy forces were distinguishable by differences in uniforms, equipment, and whether they are identified as friendly in the combat ID system. Variability in the characteristics of friend and enemy trials was introduced across blocks. Two factors were considered, 1) the type of characteristic that is uncertain (visual or behavioural), and 2) the salience of the uncertain feature (salient or not salient). Results indicated that both hit rate and FA rate can be affected by uncertainty associated with visual and, to a lesser extent, behavioural characteristics of targets in the environment. When uncertainty is associated with friends, the FA rate can increase, whereas hit rate is primarily affected by uncertainty associated with potential enemies. In both cases, effects depend on the salience of the characteristics that are uncertain. Because less salient characteristic are less likely to be considered in the CID decision, they will be less likely to confuse CID decision makers.

(U) Le présent rapport décrit une expérience qui porte sur la prise de décision dans l'identification au combat (IDCbt), et qui examine l'impact des « indices incertains » sur la justesse des décisions prises par les participants. Dans cette expérience, chacun des participants joue le rôle d'un soldat d'infanterie à pied dans une perspective de premier intervenant, et des objectifs simulés (figures humaines) lui sont présentés. Il essaie de ne tirer que sur les figures représentant un ennemi. Les forces amies et ennemies se distinguent par leurs uniformes et leurs équipements, et par leur code d'identification (ami ou ennemi) dans le système d'IDCbt. Des caractéristiques variables associées aux amis et aux ennemis sont introduites dans les différents blocs d'essais. Deux facteurs sont pris en considération : 1) Les indices incertains sont ils visuels ou comportementaux? 2) Les indices incertains sont ils saillants ou non saillants? Le taux de succès des participants, mais pas le taux de fausse alarme, est influencé par l'incertitude associée aux caractéristiques visuelles et comportementales des objectifs dans l'environnement opérationnel. La réactivité des participants n'est pas affectée non plus par cette incertitude : leur capacité de distinguer un ami d'un ennemi se maintient au même niveau quelles que soient les variations dans les caractéristiques des amis et des ennemis. Cependant, dans les différents blocs d'essais, les participants présentent des différences dans le taux de réponse erronée. Ce résultat semble indiquer que les participants ont modifié leurs critères de décision en réponse aux indices incertains associés aux objectifs. Les participants, semble t il, ont abaissé légèrement leurs critères lorsque des soldats ennemis présentaient des indices incertains, mais les ont augmenté considérablement lorsque des soldats amis présentaient des indices incertains.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (Technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

(U) combat identification; decision making; fratricide

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