Applied Cyberpsychology: Military and Defence Applications

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Dando, C.J. and Tranter, C., Dando, C.J. and Tranter, C. 2016. Applied Cyberpsychology: Military and Defence Applications. in: Attrill, A. and Fullwood, C. (eds.) Applied Cyberpsychology. Practical Applications of Cyberpsychological Theory and Research, pp. 197-216, 2016, Palgrave Macmillan. Reproduced with permission of Palgrave Macmillan.

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http://link.springer.com/book/10.1057%2F9781137517036

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Military and Defence Applications

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12.1 Introduction

Virtual environments are synthetic computer simulations that represent activities at a high degree of realism, and which are presented to a user in such a way that s/he temporarily suspends belief and accepts them as real environments (see Witmer & Singer, 1998). Virtual Environments (VEs) allow people to communicate as *avatars*, which are digital visual projections that represent a synthetic reality (Fox & Ahn, 2013), so that individuals can change aspects of their identity, or even create a novel, entirely fictitious, and unrepresentative online identity. Virtual environments have numerous applications for military and defence purposes, ranging from allowing personnel to experience realistic high-pressure situations with a sense of presence but in the absence of real world risk, to modelling threats to national and international infrastructure to improve resilience. Additional and emerging opportunities also exist for communication and intelligence gathering purposes, exploring online social cognition and group behaviour, and for understanding how to mitigate the negative effects of combat-related stress disorders, for example.

In this chapter we introduce psychological theory and contemporary cyberpsychology research, and offer an albeit very brief introduction to the rapidly developing application of technology for understanding human behaviour and facilitating performance to support and advance military and defence capability. For the purposes of this text we make a distinction between military and defence, and have split the chapter into two distinct sections, accordingly. The nature of defence has changed considerably in the past two decades to encompass the police and intelligence agencies far more than has previously been the case. Broadly speaking, we use the term military to refer to non-civilian armed forces (e.g., Navy, Army & Air Force) that are authorised to use force to support the interests of the state and its citizens. We use the term defence to refer to civilian, non-military law enforcers and investigators who are tasked with proactively and reactively investigating crime and defending national and international infrastructure (e.g., police, security services, and national crime agencies), and who are not typically members of the armed forces. We make this distinction because, while there is clearly commonality, in that both military and defence personnel/organisations are concerned with national (and increasingly international) defence and security (e.g., Defence Reform Act, 2014; Intelligence Services Act, 1994; Ministry of Defence Police Act, 1984), remits and operational environments can differ markedly. Hence, the demands and challenges faced by each are often disparate, and so psychologically-guided cyber research tends to be bespoke, problem-specific, and end-user driven, particularly given that traditional face-to-face (FtF) psychological theories and explanations cannot simply be applied to online behaviours (e.g., Dando & Bull, 2011; Dando et al., 2015; Dando & Tranter, in press; Kolasinski, 1995; Manojlovich et al., 2003; Taylor et al., 2014).

12.2 Military applications

12.2.1 Training

Perhaps one of the most obvious areas of interest in terms of practical applications of cyberpsychology research is for military training purposes. The military face numerous challenges in meeting the high levels of training necessary to respond effecitvely and efficiently to existing and emerging threats, often at short notice. Operational excellence and mission success rely on personnel becoming combat proficient, and remaining so despite a low base rate of real life occurences, and limited access to traditional, live, large-scale training environments. Virtual environments offer large numbers of personnel the chance to interact in realistic, simulated face-to-face environments with other distant military units through the Internet (or through the classified network known as SIPRNET), with first-responder units, civilians, and even medical personnel providing a training experience that is increasingly effective, but at a much lower cost than would be required for a real-life training exercise (CRS Report for Congress: Wilson, 2008). Empirical research investigating the effectiveness of large-scale virtual military training is scant because measuring efficacy is challenging, largely due to the fact that defining quantitative outcomes is complex. That said, the military have not developed virtual training in a vacuum; rather, it has exploited positive research findings from other domains, for example, serious gaming technology, which has been adapted by the military for security, healthcare, and communication training (Djaouti et al., 2011).

Using technology to simulate real world action is not new. World War II (WWII) pilots were trained, in part, for example, using flight simulators, which offered opportunities to practice manoeuvres and procedures (Macedonia, 2002). Flight simulator technology has evolved considerably since WWII, and while pilots still rehearse basic procedural tasks without having to worry about actually flying aircraft, current virtual flight simulation technology provides a truly immersive and realistic experience.

The practical, procedural benefits remain, but significant additional benefits arise from, among other things, increased awareness and understanding of the psychological impact of “real world” combat. Virtual flight simulators allow pilots (be they military or civilian) to safely and repeatedly experience adverse, life-threatening occurrences. Understanding how human sensory and perceptual systems react (visual, auditory, and other components) and interact in such circumstances allows both pilots and trainers to experience the types of physiological and psychological reactions that can occur under such circumstances, and, importantly, how to manage these reactions to best effect. For example, desensitising pilots to what might otherwise be psychologically and physiologically debilitating occurances when first experienced.

There is considerable merit in allowing military personnel to compare performance in the real world with performance in a virtual environment, particularly if the virtual environment is mimicking the real world. This means that metrics developed for the real world can be deployed in the virtual environment, and vice versa. However, this presumes humans perform similarly in real and virtual environments, which is an important consideration for training applications where a virtual environment is used to train a particular skill that is to be transferred into the real world. Research investigating whether and how skills learned in a VE are transferred to the real world typically reveals equivalent levels of post-training performance (e.g., Lee, 2006; Rose et al., 2000). Virtual- and real-trained real world performance has not been found to result in differences in susceptibility to cognitive and motor interference tasks in terms of spare attention capacity to respond to additional stimuli not directly related to the task demands. In fact, real task performance after training in a VE has been found to be less affected by concurrently performed interference tasks than real task performance after training on the real task, indicating that virtual training can result in equivalent or even better real-world performance than real training (also see Lathan et al., 2002).

The use of virtual environments for training is also being integrated into military medical and surgical training, whereby doctors are able to practice working with limited resources in armed conflict situations before moving from civilian practice to front line field hospitals. This allows learning agendas to be deconstructed and directed toward task-/situation-specific objectives, such as those associated with complex multiple battle injuries, rather than the availability of patients, allowing skill-development to progress prior to real-world military application (Teteris et al., 2012). Some consider that the absence of practice using virtual environments and simulation training to be unethical (Ziv et al., 2003), and for certain high-risk, time-critical medical procedures, simulator training is compulsory (Gallagher & Cates, 2004), in an attempt to protect military patients from unnecessary risk.

The initial introduction of military personnel to a new environment under combat situations is estimated to result in a 40% mortality rate within the first three months of deployment (Eshel, 2011). To reduce the number of fatalities and appropriately equip foot soldiers, immersive simulations for training purposes have been rapidly evolving. Immersive military training simulators initially focused on vehicle operations using physical devices (such as a cockpit or cabin), whereas virtual training for dismounted foot soldiers has only been widely employed in the last decade. This is due, in part, to the increased availability of high quality, affordable interactive technology, comprising highly-defined graphics, often fixed on a head-mounted display (HMD), to create a truly immersive experience (Cruz-Neira et al., 2011). This type of technology allows personnel to prepare better for potentially dangerous situations, because immersive interactions can be made unpredictable and highly realistic. For example, modelling a busy checkpoint in Baghdad, where avatars simulate civilians, portraying facial expressions and emotions, thereby supporting trainees in interpreting and reacting accordingly (here to prevent a roadside bomb from being ignited: Wilson, 2008).

The US Army has recently created the Dismounted Soldier Training System (DSTS; Wang et al., 2012), allowing the simultaneous and interactive training of dismounted squad teams. Each team soldier is equipped with a head-mounted display (HMD), tracking sensor, stereo speakers, microphone headset, 3D display processer, and an instrumented weapon (*see* Figures 12.1 and 12.2). Each trainee controls and is represented by an avatar and all can see and interact with each other (Intelligent Decisions, 2011). This allows commanders and trainers to deliver collective tasks in challenging terrains, comprising multiple concurrent objectives for maximum skill acquisition. The technology permits soldiers to move and interact within the VE in a natural and ordinary way, enabling them to signal to others and lean/jump around obstacles, ensuring generalisability to real-world combat situations. Military virtual realism is considered much more advanced than civilian comparisons, with enhanced levels of detail, such as complex facial expressions and even disturbed soil, which could indicate a hidden device (Intelligent Decisions, 2011). VEs allow highly detailed levels of interaction, which support effective interpretation of motivations and reactions of other avatars, which can be used to enhance the efficacy of military training. For example, Gehlbach et al. (2012) found that interactive feedback improved the accuracy of social perspective-taking, which in turn improved the accuracy of detecting biases, generating initial hypotheses, and adapting these hypotheses in light of new evidence; all of which can affect the success, or otherwise, of a deployment.

Figure 12.1 US Army Soldiers conduct training using the Dismounted Soldier Training System (DSTS) at the 7th Army Joint Multinational Training Command (JMTC) at Grafenwoehr, Germany, 2013

Figure 12.2 Paratroopers conduct simulated missions in 2012, using the DSTS, a virtual reality environment with unlimited mission possibilities

Five primary themes are evidenced in the training – major combat operations, irregular warfare, peace operations, limited intervention and peacetime military engagement – as well as the four elements of Unified Land Operations – offence, defence, stability, and civil support. Inclusive operational themes allow wide-ranging levels of complex motor and cognitive training, maximum skill acquisition and increased validity for real world experiences. This technology is very much in the experimental stage and is currently being trialled at various Army bases across the US, but initial signs indicate the utility of the training. However, less than 43% of soldiers play videogames at least once a week (compared to 69% of civilians), which suggests there may be a need for "training for training," to enhance and speed up the benefits of virtual reality technology for military personnel (Orvis et al., 2010): if military personnel are not comfortable using this type of technology on a regular basis then the task demands associated with learning to use virtual reality equipment may offset the expected utility, and could result in training in incorrect habits and behaviours (Knerr, 2007).

Unfortunately, VEs can bring about severe motion sickness, resulting in nausea, headaches, dizziness, and severe disorientation. The primary cause is thought to be inconsistent body orientation, clashing with the motion received from the immersive headset (see cue conflict theory; Kolasinski, 1995). Between 20 and 40% of military pilots have been found to experience motion sickness following VE exposure (Kennedy et al., 1989), which is suprising because military pilots are typically less susceptible to motion sickness than the general population, as a direct result of their training. A Simulator Sickness Questionnaire, developed to measure adverse effects of VE training (SSQ; Kennedy et al., 1993) allows the quantification of adverse sickness effects on emerging technologies, but pre-exposure results also need to be compared for this to be an effective indication of adverse effects (Kolasinski, 1995). One concern with using this measure is that symptoms are not unique to motion sickness (they may also result from, for example, excessive alcohol, sleep deprivation, or the flu). However, the risks associated with motion sickness are thought to reduce with gradual exposure to the synthetic envionments over time (Knerr, 2007), and so controlled exposure in a safe (virtual) environment, irrespective of cause, is akin to exposure therapy, the benefits of which are likely to carry over to real world environments.

12.2.2 Treatment

Virtual imaging and immersive reality have begun to assist military patients with psychological illness and physical injuries that result from combat experiences. For example, burn-care patients revealed a 50% reduction in pain and anxiety ratings when immersed in a VE, compared to a video game distraction task (Hoffman et al., 2000a), with increased immersion being negatively correlated with pain reduction (Hoffman et al., 2000b). Immersion appears to decrease attention to painful stimuli, resulting in a reduced need for analgesia, and an overall improvement in the patient's tolerance to painful medical procedures (Shahrbanian et al., 2009).

Post-traumatic stress disorder (PTSD) is caused by traumatic events outside of typical human experience and is not uncommon in soldiers returning from combat and war zones. Graduated and prolonged exposure therapy, which is based on the assumption that repeated reliving and recounting of the traumatic event within a therapeutic setting will allow patients to manage their fears and memories, has well documented therapeutic outcomes for the treatment of PTSD (Rizzo et al., 2014). However, it relies on imagination and sensory memory, which can be problematic when individuals do not want to/cannot recount and verbalise experienced events (Rizzo et al., 2014). To overcome these problems, researchers have turned to VEs as an alternative means of therapy. Virtual Reality Exposure Therapy (VRET) provides a multisensory experience, enabling context-relevant cues to be produced using a VE to aid confrontation without effortful memory retrieval.

Therapists control the VRET to manipulate visual, olfactory, and audio cues presented, allowing for the presentation of specific and variable scenes relevant to each individual (Rizzo et al., 2008). McLay et al. (2012) found that of the 20 patients who completed VRET treatment, 75% no longer met the diagnostic criteria for PTSD, and that this improvement was still evident three months later for 76% of patients (also see Groves & Thompson, 1970; Thompson & Spencer, 1966). However, this research is in its early stages, typically has low sample sizes and high drop-out rates, and fails to pinpoint the locus of the reduction in PTSD symptoms.

The University of Southern California's Institute of Creative Technologies has started to create stress resilience training (STRIVE: STress Resilience in Virtual Environments; Rizzo et al., 2013), which is given to soldiers prior to deployment. This VE training aims to reduce PTSD symptoms and diagnoses for active military personnel by educating individuals to develop psychological coping skills for a variety of combat situations (for example, seeing fellow comrades injured from a roadside bomb, or watching innocent civilians dying). Throughout the training individuals get to know and interact with fellow military avatars, allowing immersive engagement to occur, akin to real-life relationships. Within each training episode, an emotionally challenging event occurs, developed from the feedback of service members diagnosed with PTSD. A virtual mentor then appears, guiding the individual through stress-reduction and management strategies, whilst additionally providing restructuring exercises to facilitate the process and appraisal of the event in a rational way, which is likened to a "digital emotional obstacle course.” Allostatic load (AL) is the body’s response to stress, which can be measured using physiological instruments such as pupil dilation and EEG (McEwen & Seeman, 1999). STRIVE is currently being used to investigate whether AL can predict individual resilience, and psychological and cognitive capability to experience traumatic events, often unavoidable within combat situations. Possibly in addition to pre-deployment training, this tool could be used as a psychological assessment pre-recruitment into the military?

There is stigma associated with seeking military psychiatric healthcare, possibly due to the assumption that mental illness may prevent personnel from progressing. SimCoach is a revolutionary approach to seeking advice on healthcare issues, designed especially for military personnel and their families by the US Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury (DCoE). Consisting of customisable avatars, the virtual programme allows individuals to seek healthcare information anonymously, by interacting with embodied virtual interactive humans (avatars). Speech and even emotions are introduced via avatars whilst interacting with the “patient,” providing confidential and anonymous feedback about the individual’s history or clinical concerns (Rizzo et al., 2013; see https://www.youtube.com/watch?v=2bsMESwBeyg). Users interact with the avatar by typing text, to which they respond by speaking, providing subtitles, sending links and tips specific to each individual’s needs, and creating surveys and questionnaires to allows the correct and unique advice to be given to each patient. Created by doctors, technicians, psychologists, and the experiences of military personnel, they emphasise that this system does not replace human experts or live care; instead it is a gateway to advice and support, and in certain cases, signposts users to relevant therapeutic real-life services.

12.3 Defence applications

12.3.1 Information gathering and investigation

Gathering information is a fundamental goal for those concerned with protecting national and international security. One central challenge is understanding how to *move* people from withholding to imparting information. Additional challenges arise from the increasing use of synthetic/virtual reality environments as communication channels, and how to gather information when interacting in such environments. In recent years there has been a move away from coercive, interrogative interview methods towards intelligence interviewing (e.g. Intelligence Science Board, 2009; Janofsky, 2006; Wahlquist, 2010, which is information gathering in context. Here, context includes physical, interpersonal, and informational environments, which intelligence interviewers should be cognisant of in order to develop a bespoke operational accord to maximise the possibility of information gain (see Boon et al., 2010; Intelligence Science Board, 2009).

Fundamental to developing an operational accord is “information power” – that is, *possessing* information about an interviewee (physical, interpersonal, and environmental) and *understanding how* to use that information to increase information gain. One example being the, a tactical approach to disclosing of information (Dando & Bull, 2011; Dando et al., 2015), or using information gained to influence the interviewees’ perceptions and behaviour. Intelligence interviewing is grounded in social cognitive theory, which in brief argues that human cognition, that is the way in which humans “think,” is a product of a reciprocal interplay between intrapersonal, behavioural, and environmental determinants (Bandura, 1991). Accordingly, understanding the reciprocity between intrapersonal (internal to the communicator) aspects, and external environments offers exciting opportunities for understanding how to move to a position of information power.

To date, social cognitive theory and intelligence interviewing approaches have largely been FtF-centric, and so the question that arises is how might an operational accord be developed across different contexts? VEs offer exciting possibilities because they can be manipulated, and so can the way in which communicators represent themselves as avatars. Accordingly, they offer opportunities to discreetly collect information that can be used to “get to know” a receiver, to move to a position of “soft power” (Nye, 2004), whereby positive outcomes are possible without commanding them, and without having tangible power, but rather by affecting behaviour and shaping preferences. VEs may allow intelligence interviewers opportunities to do just that.

It is timely that consideration be given to VEs as interviewing spaces on several counts. First, there has been an exponential increase in our dependence on VEs: over 40% of the world’s population currently have an Internet connection (compared to just 1% in 1995; www.internetlivestats.com), and cyberspace underpins national and international infrastructures (e.g., water, fuel, and banking). Access to VEs has resulted in increased crime and antisocial behaviours (identity theft, fraud, inciting hatred, sexual offending, harassment). Extremism and radicalisation has and is increasing in synthetic communication spaces (Cornish et al., 2009), with terrorist groups regularly using VEs to spread propaganda, raise funds, communicate, and plan attacks.

Currently, VEs are being developed and utilised for forensic and investigative training purposes, typically to simulate events and interactions to allow investigators to develop and practice skill sets more efficiently than might otherwise be that case, and to do so in a safe environment. For example, using an avatar-based interview simulator (ABIS) to allow free-flowing conversation, thus creating a realistic interactive training experience (Kuykendall, 2010). VEs could also be useful for harvesting information on a receiver's cognitive style, information that could then be used to support the development of an operational accord, and so affect information-gathering during an initial investigation and during more formal follow-up interviews (see Dando & Tranter, 2015).

Cognitive style is variously described, but in the main is a preferred method of managing specific cognitive tasks (Kozhevnikov et al., 2014; Zhang & Sternberg, 2006, 2009), and is believed to be "*stable attitudes, preferences, or habitual strategies that determine individuals' modes of perception, memory, thought and problem solving*" (Kozhevnikov et al., 2014, p. 4), which are environmentally sensitive (Buss & Greling, 1999). Hence, understanding cognitive styles may be the basis for developing a bespoke person-interaction fit. Cognitive styles have received much attention in the domains of education, business, and management, but as yet, despite the obvious application of models of cognitive style to investigative interviewing, there appears to be little empirical research in this domain.

VEs may countenance information power because human cognition and behaviour differs when communicating in SEs, compared to traditional FtF environments, and synthetic communication environments can be easily managed/manipulated to encourage the revelation/collection of information. The psychological literature offers several hypotheses as to why behaviour in VEs differs compared to FtF. The online disinhibition hypothesis (Suler, 2004) suggests that individuals are increasingly willing to disclose more personal information online because the fantasy and invisibility elements of VEs allow communicators to remain anonymous. However, more recent research suggests that people do not always divulge more information. Rather, people are selective in the information that they share, typically offering extensive basic information in the first instance; only following some level of interaction do they divulge their innermost feelings and thoughts. Equally, other factors are believed to be as important as perceived disinhibition or perceived anonymity, such as knowing who one is talking to (e.g., the stranger on a train versus the known other effects), the content of self-revelations, and the mode of communication (people are more likely to divulge in 1:1 synchronous communications), for example (see Attrill, 2015).

Furthermore, there is a perception that the rules and regulations that govern in reality do not actually exist in VEs, because meaningful reprisal is extinguished from the conscious. The Equalisation hypothesis (Dubrovsky et al., 1991) supports this, arguing that VEs allow freedom from physical attributes such as race, gender, age, and physical disabilities, and so stereotypical behaviours that arise in traditional FtF interactions are not available in VEs. A key example of this comes from an early study by Matheson (1991), who used a negotiation task to manipulate the availability of gender cues. Social perceptions of gender were directly affected by the availability of this information. Gender stereotypical perceptions were absent until gender cues were revealed and became salient to participants, at which point women were perceived as more cooperative, and men as more exploitative, indicating that anonymity alters people's cognition, which in turn affects behaviour.

Positive affect is the instinctual reaction to positive, emotionally-provoking stimuli which can systematically influence performance on varying cognitive tasks without conscious awareness. One example is the International Affective Picture System (IAPS: Lang et al., 1999), which provides a set of normative, emotionally-evocative pictures across a wide range of semantic categories. Implementing emotionally evocative backdrops within a synthetic environment offers possibilities for managing an environment to improve communication, and enhance cognition. Indeed, research does indicate that positive affect enhances problem-solving and decision-making as a result of more flexible, innovative, and efficient cognition (Isen, 2001). Positive affect has also been found to facilitate the bargaining process, improving outcomes when negotiating to buy and sell (Carnevale & Isen, 1986), apparently facilitating more systematic and careful processing of additional task information, and reducing distractibility and impulsivity. One avenue for future research is to consider integrating the IAPS into VEs to investigate cognition and positive effects for information gathering.

The role of haptic feedback in collaborative tasks, that is whether haptic communication through forced feedback can facilitate a sense of being and collaboration with a remote partner, also speaks to intelligence gathering in VEs. Using multimodal shared virtual environments across gender and personality, simulating touch was found to have a powerful impact on task performance and sense of togetherness, which in turn affected cognitive processes, such as decision-making (e.g., Hafich et al., 2007). Making one subject "strong" and the other "weak" by way of a haptic device might offer environmental opportunities for information gathering and criminal investigation.

One significant advantage of VEs for information gathering is that they allow people to communicate as avatars. Avatars allow individuals to change aspects of their social identity to become less identifiable, or even create a novel, entirely fictitious and unrepresentative online identity – customising features such as eye colour, hair colour, height, gender, race, etc. It is believed that many people who use avatars online wish to be unique, different, and creative when immersed, allowing them to explore things they could not do in reality (Lin & Wang, 2014). However, others use avatars as an extension of their offline self, to explore aspects of their self that they are not overly confident with offline. Building confidence online allows them to then transfer those features of self offline. Others want to portray their actual self through avatars because they can obtain reinforcement and positive feedback for that self online that they might otherwise not receive offline – a form of acceptance (as one of the fundamental underlying needs of humans: social acceptance and belongingness).

Avatars have been found to influence cognition. For example, Yee and Bailenson (2007) found that when individuals were assigned an avatar, their cognition merged to this digital representation, changing their behaviour in accordance with the representation. This is referred to as the *Proteus Effect*, whereby people conform to the expectations and stereotypes of their given avatars altered self-representation, which has a direct effect on behaviour in VEs. For example, those assigned attractive avatars were found to display increased self-disclosure and were more willing to approach the opposite sex; and the taller the avatar, the more confident participants became when verbally communicating in the VE.

12.4 Linguistic behaviour

It has been suggested that a lack of media richness in VEs is a challenge for investigators that without being able to consider physical behaviour (often referred to as body language), alongside spoken and written verbal communication, senders may be less effective information gatherers, and are unlikely to make appropriate veracity judgments (Marett & George, 2004). However, recent research has suggested that trained investigators can be more effective in determining veracity FtF when considering only the informational content offered in reply to a sender’s questions, rather than the paralinguistic and non-verbal cues commonly associated with deception (Dando & Bull, 2011; Dando et al., 2015; Jenkins & Dando, 2012). When communicating online, indicators of deceit are discernable in the complete absence of any physical behavioural cues simply by analysing language use (Tausczik & Pennebaker, 2010; Taylor et al., 2013). For example, use of words that denote distinctions and connections (e.g., but, also) can offer insights into the nature of people’s reasoning, and interviewer initiated language matching between interviewer and interviewee has been associated with increased confessions (Richardson et al., 2014).

US law enforcement agencies are currently using a virtual reality simulation for training on interaction and communication styles within an interview setting (Kuykendall, 2010). The technology (known as SIMmersion) creates an avatar that allows trainees to practise their skills, thus reducing the need for costly classroom teaching. Police officers displayed much improved interviewing reaction time, response time, critical decision processes, and safety skills after completing training using this technology, findings that indicate the utility of SEs for allowing officers able to make mistakes, rewind, and practise their skills and techniques within a safe and secure environment.

12.5 Modelling threats

Researchers have just begun to investigate the utility of immersive gaming as a method for modelling and investigating threats. For example, modelling insider incidents (Dando et al., 2013) following the realisation that what is needed is a method for understanding insider behaviours, and the need to develop rapid investigative methods both to filter potential insider persons of interest, and to provide information relevant to planning an effective investigative strategy. Deceivers are known to attempt to control their verbal and physical behaviour when being interviewed about suspected wrongdoing, making veracity decisions difficult. Yet, computer mediated VE communication by way of a triage interview has recently resulted in a high degree of success: veracity detection was more accurate (for truth-tellers and deceivers) because verbal and physical behaviour differences emerged online that were not apparent face-to-face (also see Dando & Bull, 2011; Dando et al., 2015).

Organisations concerned with serious and organised economic crime and counter-terrorism are increasingly turning to VEs to model occurrences associated with organised crime and terrorism. Projects include the development of pan-European VEs for data sharing, monitoring, and cooperative analysis, and understanding how best to use electronic movement data collected from simulation VEs to detect and predict terrorist occurrences in real life (e.g., Andrews et al., 2015; Sandham et al., 2015). Typically the literature reporting this type of modelling research is not openly available, for obvious reasons, and in any case this type of research is in its infancy (but see Stedmon & Lawson, 2015).

12.6 Conclusion and food for thought

Psychological research investigating the potential of VEs for military and defence innovation is timely in that it offers numerous interesting, and promising lines of enquiry, but as yet is not widely available. For example, group polarisation, which is the tendency for like-minded people to become extreme in their thinking following a group discussion, also occurs in virtual communities (McKenna & Green, 2002). Understanding the cognitive processes that support this phenomenon in VEs may prove beneficial for military and defence purposes. Knowing how judgements are formed and modified in VEs may allow the development of predictive models. Knowledge of mode of information processing style, namely intuitive-experiential or analytical-rational, might predict the likelihood of irrational behaviour in given certain circumstances (Denes-Raj & Epstein, 1994; Epstein & Pacini, 1999), which may offer methods for overriding rational cognitive systems to best effect. Understanding individual need for cognitive closure and how this affects behaviour in VEs would indicate whether individuals are more likely to "seize and freeze" upon initially presented information, and so close their minds to further knowledge, resulting in impulsive decision-making (Webster & Kruglanski, 1994). This style implies that individuals may be less likely to move from opposing to converging viewpoints, suggesting that intelligence gatherers need to be particularly cautious about how to manage initial approaches, at least in terms of the informational content of verbal interactions, perhaps?

Using virtual reality headsets to immerse participants in virtual worlds, manipulating environments, collecting information on immersed cognitive styles, and then measuring VE cognition compared to traditional face-to-face contexts, would further our understanding of ways to gather information in SEs (e.g., see Dando & Tranter, 2015; Tranter et al., 2014). The increasing number of individuals using online environments to communicate dictates that military and criminal investigators, and information gatherers *must* give serious consideration to the multiple contexts in which communication can occur – being proactive, rather than reactive, may reap significant rewards.

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