# The Threat of Violent Extremists: A Neurocognition Approach to Risk Assessment

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**Abstract**

This paper presents a newly developed and empirically validated RA tool (Dean 2014) based on a neurocognitive approach for assessing the risk/threat posed by violent extremists. Initially, the paper outlines the risks involved in risk/threat assessments, along with defining violent extremism, its types and risk categories, before presenting the neuroscience behind the theoretical and conceptual creation, development, and testing of a prototype model. Original research was conducted in six countries (Finland, Norway, Germany, United Kingdom, and America) from August to November in 2013 using an 'expert elicitation' methodology with specialist academics and experienced practitioners to validate through expert consensus the utility of this neurocognitive approach to violent extremism. The current version of the SAVE program (30.v1) offers an expanded set of risk indicators including a cognitive pathways timeline and enhanced functionality for 'tacit' knowledge capture of an assessor's professional judgment decision-making as well as 'in-built' alert prompts for risk minimisation checkpoints and safeguards. In summary, the SAVE application program is an integrated Knowledge Management and Risk Management System designed for *operational utility, 'tacit' knowledge capture,* and *risk minimisation* by policing and national security agencies involved in the very 'risky' business of detecting and stopping acts of violent extremism.

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## Introduction

This focus of this paper is on the presentation of a newly developed and empirically validated RA tool based on a neurocognitive approach for assessing the risk/threat posed by violent extremists.

Original research was conducted in six countries (Finland, Norway, Germany, United Kingdom, and America) from August to November in 2013. An 'expert elicitation' methodology was used with specialist academics and experienced practitioners to validate through expert consensus the utility of this neurocognitive approach to violent extremism. The published results[1] of this research can be found in book form and online at the Springer website.

At the time of this research the prototype RA tool was known by the acronym RAVE (*Risk Assessment of Violent Extremism*). RAVE was modelled like a Structured Professional Judgment (SPJ) checklist instrument but given mathematical weightings in order to input the ratings into a purpose-built visualisation software application known at that time by the acronym GRiPe (*Geometric Risk indicator Positioning of extremism*).

These two prototype modelling components (RAVE & GriPe) have since been significantly extended and developed by the author into an integrated NeuroCognitive Risk Assessment (NCRA) System now known by the single acronym **SAVE (*S**tructured **A**ssessment of **V**iolent **E**xtremism).*

The paper is divided into five main sections. Initially, the paper will outline the risks involved in risk/threat assessments. Next it will define violent extremism along with the types and risk categories of violent extremists. The third section will present the neuroscience behind the conceptual creation, development, and testing of the prototype RA model (RAVE & GriPe) components. This will be followed by a brief summary of the original research findings, their implications and limitations. Finally, the latest development of SAVE as an operationally ready and relevant NCRA system for police and security services around the world will be presented. Case studies will be used throughout the paper to illustrate significant findings.

[1] Geoff Dean, (2014). *Neurocogntive Risk Assessment for the Early Detection of Violent Extrem*ists Springer, New York. The web link is: http://link.springer.com/book/10.1007/978-3-319-06719-3

## Part 1: The 'Risky Business' of Risk/Threat Assessments

Violent extremism is a 'risky' business not only for the extremist but also for risk/threat assessment professionals who carry the heavy burden of responsibility for getting it right. It's a truism to say that violent extremists only have to get it right once, law enforcement has to get it right 'every' time.

The risks are double-sided for risk/threat assessment professionals. Figure 1 below outlines the two key sides involved and where the risks reside.

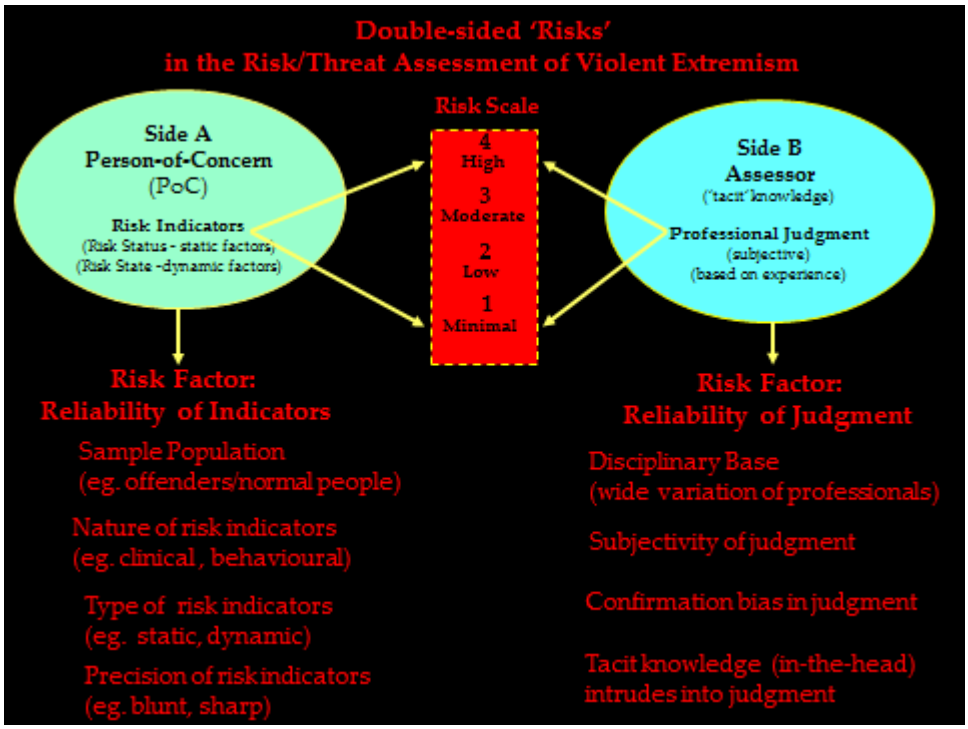


**Figure 1: The 'Risks' in Risk/Threat Assessments**

The above figure reveals that the reliability of risk indicators used to assess a PoC and the reliability of the assessor's professional judgment is the crux of the 'risky' business we are in.

Each of these elements of this 'double-sided reliability' risk will be covered and discussed thought the paper.

To assist with this endeavour, the next figure 2 depicts how the terms 'risk' and 'threat' are defined and viewed as interlocking circles intersecting along a plane from 'general' to 'specific' risk of violence.

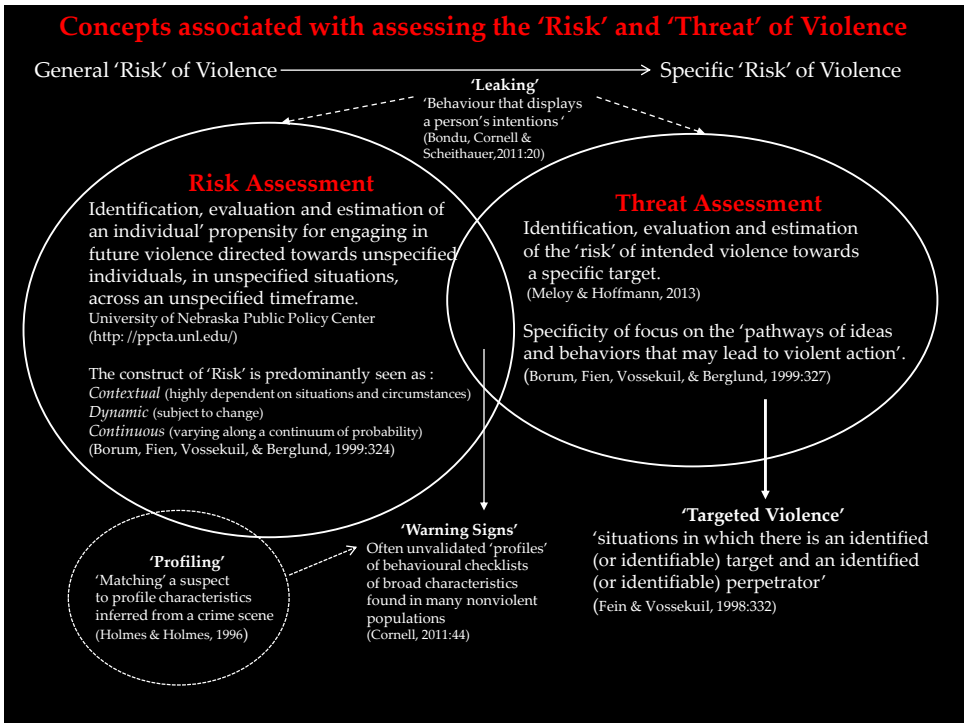


**Figure 2: Similarities and Differences between 'Risk' and 'Threat' Assessments**

As can be seen the nexus between risk and threat is conceptualised as two intersecting circles, one more general than the other, as depicted in Figure 2. Also, there are various related constructs that float around the concepts of 'risk' and 'threat'. Some of these constructs are more problematic (eg. 'profiling' and 'warning signs') than others in terms of assessing the general notion of 'risk' and the more specific notion of 'threat' and 'targeted violence'. Whilst, as indicated, the notion of 'leaking' is broader and more inclusive of both risk and threat as a form of assessment.

## PART 2: Violent Extremism: Definition, Types, Risk Categories

The following definition of 'violent extremism' by the Australian National Counter-Terrorism Committee (Nasser-Eddine, et al., 2011, p. 9) offers a generally standard way in which 'violent extremism' is defined as shown in Figure 3 below.


**Figure 3: Definitional Parameters of Violent Extremism**

Violent extremism is a broad church, with membership encompassing different types or categories of individuals and groups ranging from terrorists (politically-motivated), right/left-wing militants (ideologically-motivated), to active shooters (socially-motivated). These categorical boundaries are often more fluid, blurred, multi-factorial and random in reality with crossovers between terrorist-type acts committed by militants (eg. Anders Breivik in Norway in 2011) and school shooters (eg. Columbine massacre in 1999) as well as other forms of mass killings such as deadly riots, fatal stabbings and so forth. Such fixed categorical distinctions fail to capture the degree to which all violently extreme incidents are influenced by political, ideological, social, and cultural factors, antecedents, and other idiosyncratic drivers within specific contexts.

Moreover, each of these groups of violent extremists has quite distinctive features at the level of specific characteristics like age, motivation, personality type, psychological characteristics, mental state, intelligence, socio-cultural background, political affiliation, and so forth. The diagram below (Figure 4) is indicative of the wide variance 'in' and 'between' the three primary groups of violent extremists - terrorists, militants and shooters.

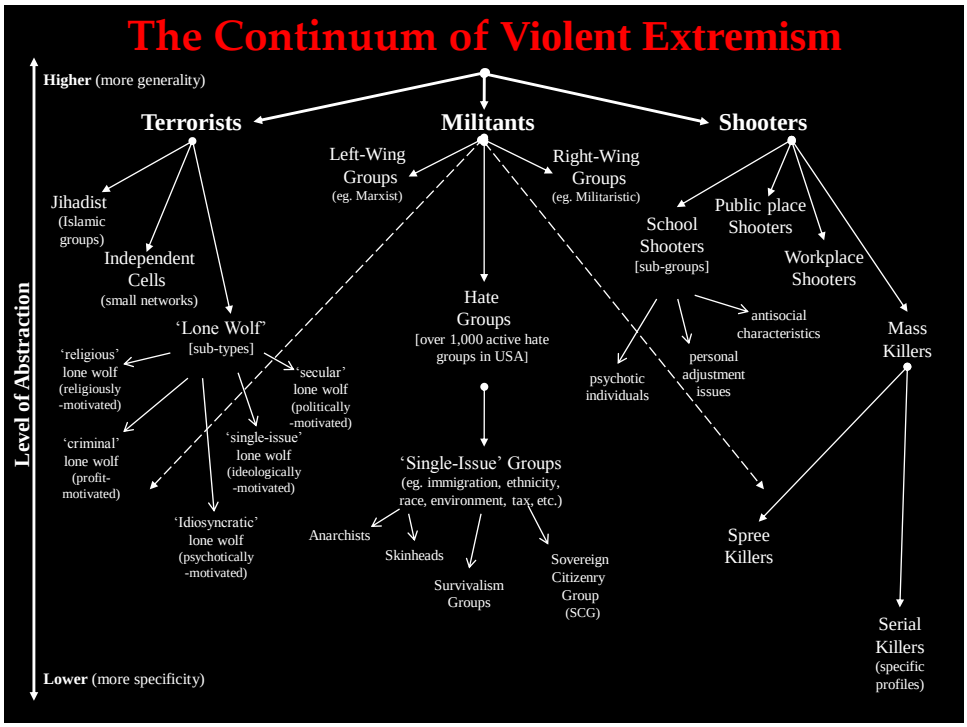


**Figure 4: Contunium of Types of Violent Extremists**

As can be seen, the motivations, issues, and tactics are vastly different for each group and become more uniquely particular to individuals as the level of abstraction moves further down the line from general to specific characteristics and features.[2]

The essential 'take-home' message of this categorical continuum is that at the highest level of generality what 'unites' these three disparate groups is their willingness to use and engage in violent and extreme actions to achieve their very different objectives.

The *common denominator* between terrorists, militants and shooters is their *'cognitive willingness'* towards violent extremism. Willingness is about 'beliefs' which reside in the minds of individuals. Beliefs are firmly held convictions that one accepts something as true or real, generally without definitive proof of its existence.

Thus, for this project the defintion of violent extremism presented in Figure 3 was operationalised as depicted in Figure 4.

Conceptually, 'risk' can be though of a existing within certain categories into which suspected PoC's at risk of being or become violent extremists would fall. The 'risk matrix' shown in

[2] The Department of Homeland Security has developed a number of case studies on violent extremism groups like violent anarchists, racist skinheads, and sovereign citizen extremists (DHS, 2012).

Figure 5 below is a graphcially way of depicting such a conceptualisation of the 'types' of violently extreme categories involved.

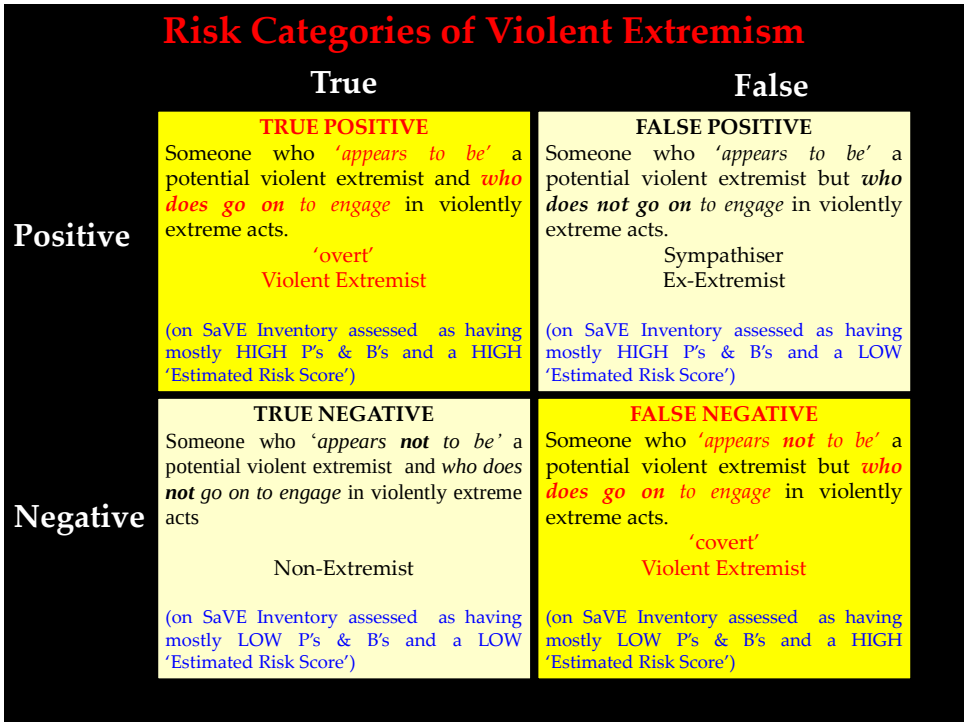


**Figure 5: Marix of Risk Categories of Violent Extremists**

As can be seen, those PoC's which fall within the 'yellow blocks' are of particular concern to be accurately assessed as to the current level of their 'risk potentiality.'

Of couse, just as people don't fall neatly into the intellectual 'boxes' of our own making, neither do violent extremists 'fit' or 'stay' within the box we conceptually put them in. Clearly, there is a lot of room for movement from one quadrant to another in this Risk Matrix.

However, it is useful from an analytic perespective to have at least some initial 'risk categories' on which to assess a PoC. The relevance od this risk matrix will be discussed later as well the 'SAVE inventory' rating comments noted at the bottom of each risk quadrant.

For now, the task is to understand the neurological basis for violent extremism and how 'neuroplasticity' plays a critical and defining role in shaping the mind of a would be violent extremist.

## Part 3: Neuroscience of Violent Extremism - Neuroplasticity-in-action

The field of neuroscience and is growing exponential, especially cognitive neuroscience where it is "well established that mental activity correlates with neuronal activity, and that as learning occurs, new connections are formed between neurons" Doidge, (2015:107). This discovery of the brain's ability to "change its own structure and function in response to metal experience" Doidge, (2015) is what is menat by the term 'neuroplasticity'. Hence, 'Neuroplasticity' ,can be defined as " the natural tendency of the brain architecture to shift in negative and positive directions in response to intrinsic and extrinsic influences." (Shaffer, 2012).

It was the Canadian psychologist Donald Hebb who, in 1949 "… described a mechanism in which neurons change pysiologically based on their experience, therby providing a basis for learning and brain plasticity"(Kurzweil, 2012:79). This Hebbian principle is capturted in the maxim 'neurons that fire together, wire together' (op. cit., 80). This is the basis of the 'plasticity' of the brain's remarkable ability to learn by experience. Hence, the precise technical term 'experience-dependent neuroplasticity' (Caporale & Dan, 2008).

Such 'wiring together' at the neural level by experience is dependant of a number of factors being present. Esentially, anything like an idea, a belief, a feeling, an image, a physical movement or an action that you give repeated attentional focus to over time will stimulate in the neocortex, the thin convoluted surface which covers the entire brain, the production of new neurons. These newly formed neurons in turn thicken and thereby strengthen the synapic connections with other neurons. Generally, neurons work in large groups by communicating electrically in widely distributed networks and are constantly reforming themselves into new 'neuronal assemblies' (Greenfield, 2014). See Figure 6 below:

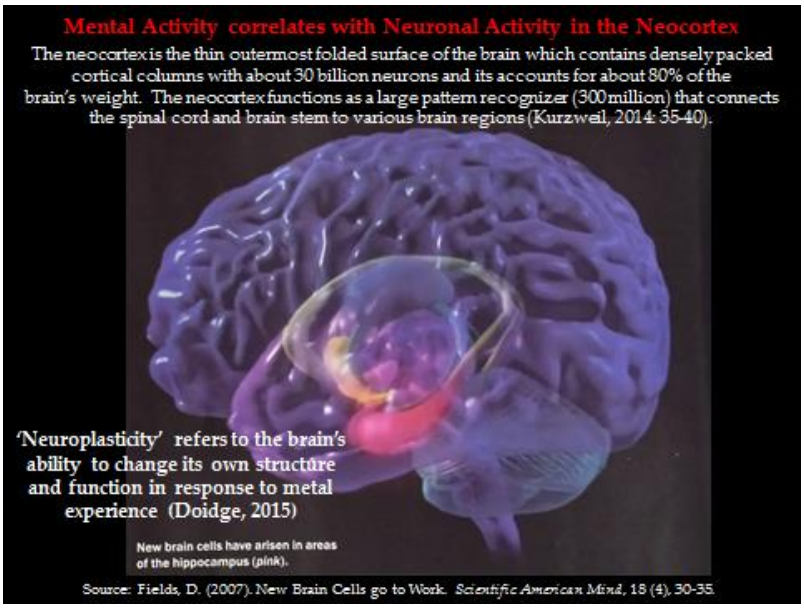


**Fig 6: Mental Activity correlates with Neuronal Activity in the Neocortex**

Doidge (2015:106) points out that different combinations of these neuronal assemblies occur on a daily basis. "Thus, as a person goes through the day, her brain is froming, unforming, and reforming new neuronal networks as part of itsw basic operating procedure." However, the converse is also true as Doidge (2015:8) explains:

> "When a peson stops performing an activity for an extended period, those connections are weakened, and over time many are lost. This is an example of a more general principle of plasticity: that it is a use-it-or-lose it phenomenon. Thousands of experiments have now demonstrated this fact. Often neurons that were involved in a skill will be taken over and used for other mental tasks that are now being performed more regularly. Sometimes one can manipulate the use-it-or-lose it principle to undo brain connections that are not helpful, because neurons that fire apart wire apart."

Figure 7 below shows are two images of a human neocortex captued at the the Martinos Center for Biomedical Imaging. The image on the left shows the 'grid structure' of the human brain's neural circuitry captured by Van Wedeen under massive magnification (Zimmer, 2014:36). As can be seen these cerebral pathways intersect at right angles to form a grid pattern that 'guides connectivity' in the neocortex. Kurzweil (2012;83) notes: "This (grid) pattern was found in all of the primate and human brains studied and was evident across the neocortex, from regions that dealt with early sensory patterns up to higher-level emotions."

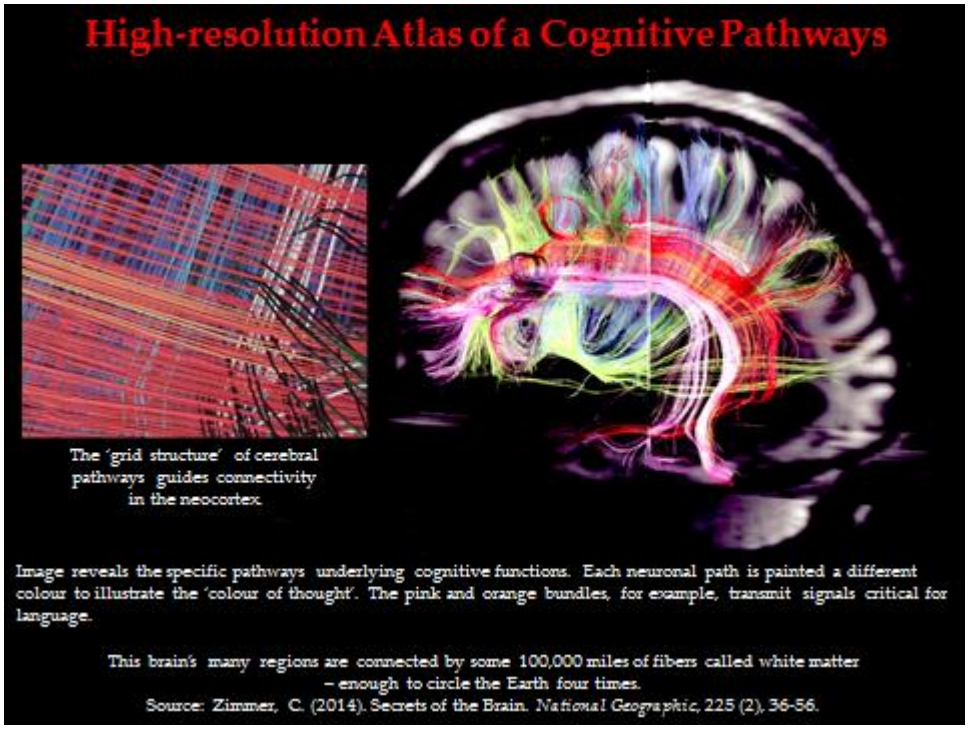


**Figure 7: Cognitive Pathways of Neuronal Assemblies in the Neocortex**

The next image shows the result of a diffusion spectrum imaging mapping technique used by Van Wedeen to build up a high-resolution atlas of a person's cognitive pathways. Wedeen paints each neuronal path a rainbow of colours to illustrate the 'colour of thought'. The image maps the " … bundles of nerve fibers that form hundreds of thousands of pathways carrying information from one part on the brain to another" (Zimmer, 2014:38). The note below the image points out that " this brain's many regions are connected by some 100,000 miles of fibers called white matter – enough to circle the Earth four times. This Image taken at the Martinos Center for Biomedical Imaging reveals the specific pathways underlying cognitive functions. The pink and orange bundles, for example, transmit signals critical for language" (Zimmer, 2014:36).

**Neuroplasticity of 'Extreme Thinking' Pathways**

Extremist thinking results from 'neuroplasticity-in-action' (Greenfield, 2014; Goleman, 2013; Hanson, 2013; Siegel, 2011) as repeated attentionally-focused brain-based neural patterns become over time expressed in mind-based cognitive pathways that can lead to a rigid 'mind-set' of violent extremism if left unchecked and unchallenged.

The bulk of the literature on violent extremism makes it very clear that violent extremists are not in the main 'crazy', 'mentally ill', or 'psychiatrically disturbed', individuals (Schmid, 2013, Saucer et al, 2009; Silke, 2008; Loza, 2007). Nor for that matter is there a 'single identifiable profile' or 'personality type' into which they fall (Borum, 2011).

It is the very 'normality' of violent extremists that makes the usual diagnostic tools of psychology and psychiatry, which only apply to 'personalities with pathology', essentially very limited when it comes to trying to assess the risk a violent extremist poses. There apparent 'normality,' at least in psychiatric terms, makes them the 'hidden' enemy.

A violent extremist in most cases, with the exception of a few clearly clinically disturbed individuals, engages in normal thinking that has been taken to the 'extreme' end of 'normality' in terms of a rigid intolerance for anyone that does not agree with their view of the world.

Thus, the NeuroCognitive Risk Assessment (NCRA) sytem developed for this project is based on a 'normal' population. Its focus is less on profiling 'what kind of person' a violent extremist is and more on how the 'normal neurocognitive processes of the mind' have been taken over and conditioned, by themselves (self-radicalisation) or by others (group-radicalisation), to become a rigidly 'set' mind, bent on potentially carrying out violent and extreme acts of terror. In essence, a NCRA is about mapping out the 'risk potentiality' of a 'normal' individual's progression towards violently extreme thinking. The conceptual model below in Figure 7 illustrates the psychological processes that underpin the developent of extremist thinking.

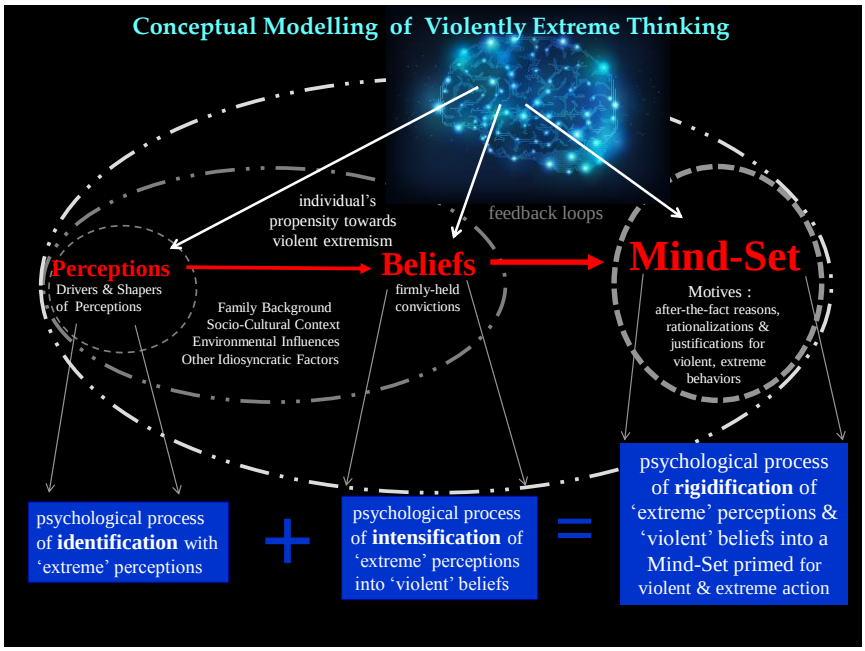


**Figure 8: Psychological Proceses invovled in Violenty Extreme Thinking**

This conceptual model of the psyschological processes of *identification*, *intensification* and *rigidification* of an extremist worldview primed for violent action operates along a timeline of entry, engagement and potential disengagement for a would-be violent extremist. The folowing Figure 8 depict this 'Timeline Pathway' to or from violent extremism.

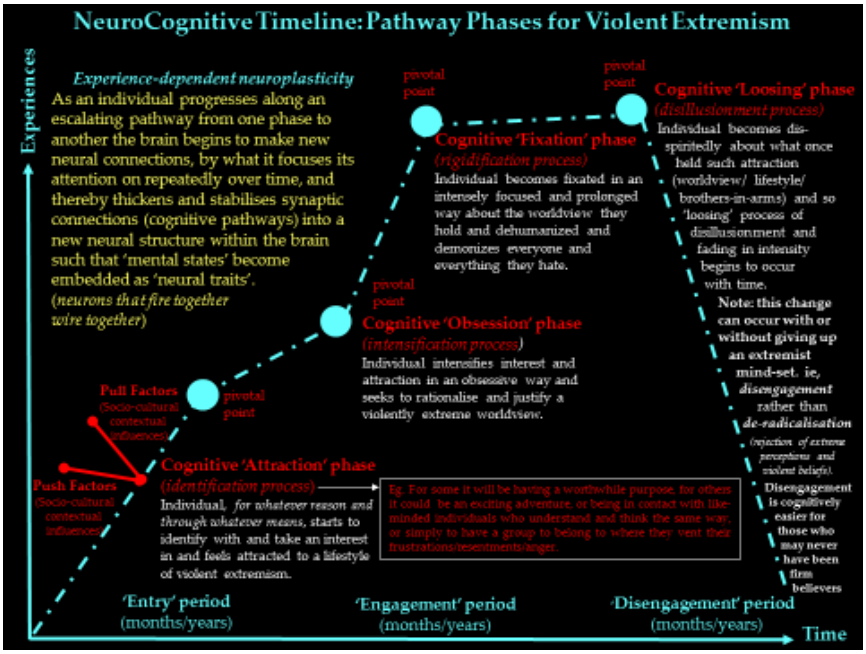


**Figure 9: NeuroCognitive Timeline Pathways to and/or from Violently Extreme Thinking**

In essence, this '*entry-engagement-disengagement'* timeline is a series of pivotal points or decision stages in the psychological journey towards violently extreme thinking. Such pivotal points can be understood as existing on a progressive NeuroCognitive pathway within the neocortex of a violent extremist from the intial 'attraction' phase to a more 'obessional' phase which then can lead to a stronger 'fixated' phase due to the influence of experience-dependent neuroplasticity. This escalating pattern of cognitive phases is depicted in Figure 9.

Also, as can also be seen over time there can be a de-escalation or 'congitive loosing' phase for some violent extremists due to a multipliity of factors whereby a violently extreme lifestyle ceases to hold the attraction once felt and drawen to by the wold-be violent extremist.

The time dimension can vary enormously from one individual to another. For instance, under condtions of prolonged repetitive attentional focus by a person on particular thoughts and/or emotions or actions, then in a relativley short period time, as little as 4 - 6 weeks, such repeated neural firings will 'wire together' these budding neural conections into an entire neural network of neuronal assemblies that can 'think no other way' in the mind of potenrial violent extremist.

## Case Examples: Timeline Pathways towards Violent Extremism

For others their willingness to act out their extremist ideas are years in the making. The following Figure 10 provides two snapshots of such timeline variance (The Age Newspape, 2014).


**Figure 10: Case Examples of variability of Timeline Pathways**

The Haron Case is particuatly pertinent to the risky business of risk assessmemt. For instance, The Austrralian Security and Intelligence Organisation (ASIO) has, at least, acknowledged in the Parllimentary Commission Report release on 23 February 2015 that Monis was not only well known to them for several years and ahd been 'risk assessment' on a number of occaisons in the past as posing no threat. On their own admission their reasoning was that on the 'behavioural' threshold they use to asscess risk/threat Monis was below the 'risk level requited to trigger an alert watch. This was in spite of the fact that there were 18 known warning calls to the Violent Extremism Hotline within the two week period leading up to the Lindt cafe siege.

This oversight is largely due to the fact that 'behavioural-based' risk assessment models are 'blunt' tools. They are not focusing on the 'bad ideas' that are the currency of violent extremism.

There in a lack of real understanding in the political and national secutrit domains that the 'war on terror' is fundamentally about a 'war on ideas'. Peter Neumann, Director of the Centre for the Study of Radicalisation in the UK made essentially the same point in his recent address to President Obama's 'White House Summit on Countering Violent Extremism held on 19 February 2015.

Everything flows from the initial 'risk/threat assessment', like the prioritization of Persons-of-Concern, their case management, and setting intervention strategies. Until we get better and more reliable risk assessment models then incidents like the Lindt café will unfortunately happen from time to time.

Hence, the quest to develop a sharper, more precise risk assessment application using the latest neuroscientific research. The next section details the developments in that quest.

## PART 4: Validation Research: Methodology and Findings

An extensive, global research study involving 41 experts in violent extremism, mainly specialist academics and experienced practitioners, in six countries (Finland, Norway, Netherlands, Germany, United Kingdom, and America) from internationally recognized institutions and agencies was conducted during Aug to Nov 2013.

### Aim, Participants, Methodology, Method

The primary **aim** of the study was to test, refine and validate a new neurocognitive-based approach to risk assessment using what was then known as a 'Risk Assessment Toolbox' or RAT. The toolbox was composed in a similar manner to a Structured Professional Judgment (SPJ) protocol and used a checklist rating instrument then known as the *Risk Assessment for*

*Violent Extremism* (RAVE)[3] tool, and a visual verification software then known as the *Geometric Risk indicator Positioning of extremists* (GRiPe)[4]. The GRiPe[5] tool is used for checking the veracity of an expert's risk assessment which is modelled on a 3-D 'risk surface' in relation to the known outcome of each case used for tuning purposes in this study.

The contemporary approach to risk assessment is to combine clinical and actuarial approaches into what is known as a Structured Professional Judgment (SPJ) protocol. Hence, RAVE is an SPJ-like instrument developed from several literature sources though an extensive, comprehensive, systematic and selective review of distinct but separate literatures on terrorists, militants, and active shooters (schools, workplaces, public places, and mass killings). The theoretical-conceptual basis of the RAVE instrument draws on a neuroscience perspective to establish the core set of perceptions and beliefs held in common both *within* and *across* each of these three key categories of violent extremism.

The methodology adopted for this research is based a peer review, 'expert elicitation' consensus model based on a case comparison of known violent extremists and non-extremists. Through this process of comparative case analysis it becomes possible to arrive at a set of expert-validated outcomes for each case under review and hence by extension to derive an overall validation of the components of the Risk Assessment Toolbox (RAT).

The **participant pool** for this expert elicitation study comprised 41 participants from six countries (see Table 1). This sample constituted a wide and diverse number of specialist academics (N = 26) and experienced practitioners (N = 15) from a broad range of internationally-recognized institutions and agencies that were visited as part of the Expert Elicitation study.

| **Country** | **Location** | **Centre/Institution/Agency** |
|---|---|---|
| Finland | Turku | *University of Turku* - Faculty of Social Sciences, Department of Social Research, Economic Sociology<br>*Youth Research Network* |
| Norway | Oslo | *Norwegian Police University College*<br>*Norwegian Security Service*<br>*Norwegian Institute of International Affairs* |
| Netherlands | The Hague | *University of Leiden* - Centre for Terrorism and Counterterrorism (CTC) & International Centre for Counter-Terrorism (ICCT) |
| Germany | Berlin | *Freie Universitat, Berlin (Free University of Berlin)* - Faculty of Educational Science and Psychology, Department of Psychology Unit Developmental Science and Applied Developmental Psychology; Networks Against School Shootings (NETWASS) |

[3] The original RAVE instrument used for this validation research has since been further refined and extensively developed into a different operationally-aligned version known by the acronym SAVE, which stands for *Structured Assessment of Violent Extremism*.

[4] Likewise, the original GRiPe software has been re-coded, modified and further developed for operational purposes and is now known by the acronym VaVE, which stands for *Visualised Assessment of Violent Extremism*.

[5] GRiPe uses a specific computational algorithm collaboratively developed in conjunction with my colleague Professor Pettet into a purpose-built program that specifies the position of a PoI on a three-dimensional risk surface as to their assessed risk level.

| | | |
|---|---|---|
| | | *Berlin School of Economics and Law* - Department of Police and Security Management |
| United Kingdom | Scotland | *University of St Andrews* - School of International Relations, Centre for the Study of Terrorism and Political Violence |
| America | New York | *John Jay College of Criminal Justice, City University of New York* - Department of Law, Police Science, and Criminal Justice Administration; Emergency Management Department, Academy of Critical Incident Analysis; Investigative Psychology Research Unit |
| | Washington | *George Washington University* - College of Professional Studies, Graduate Education Center, Police Science Program<br>*DC Metropolitan Police Department* - Strategic Services Bureau<br>*Metro Transit Police*<br>*US Department of Justice* - Office of Public and Governmental Affairs, Bureau of Alcohol, Tobacco, Firearms and Explosives<br>*Federal Bureau of Investigation* (FBI) - Directorate, Weapons of Mass Destruction (WMD)<br>*US Department of Homeland Security* (DHS) - Cyber Forensics Branch, Internal Security and Investigations Division, DHS HQ, Office of Security |

**Table 1: Centres/Institutions/Agencies visited for Expert Elicitation Study**

There were 30 males and 11 females who voluntarily participated in the study. The age of participants covered wide range from late 20's to early 60s, with the majority in their late 30s to early 40s. The occupational mix is contained in Table 2 below.

| **Occupational Categories of Participants (mix of academics &practitioners)** | **Study Data Set N=41** |
|---|---|
| Academic – Police/Security (Research) | 13 |
| Academic- Psychology (Forensic/Clinical/Social) | 7 |
| Academic-Criminology/Sociology/Political Science | 6 |
| **Academic Experts** | **26** |
| Practitioner-Police/Security (Intelligence/Analysts) | 8 |
| Practitioner- Police/Security (investigations/cyber) | 5 |
| Practitioner – Psychology(Forensic/Clinical/Social/) | 2 |
| **Practitioner Experts** | **15** |
| **Total number of Experts** | **41** |

**Table 2: Occupational Characteristics of Data Set for Expert Elicitation Study**

As can be sent in Table 2, the participants were an occupationally diverse group. Experts were selected on the basis of having recognised expertise in one of the domains covered by violent

extremism, which is terrorism, militancy and active shooters. Such experts were made up of specialist academics and experienced practitioners.

The **methodology** used was a form of 'expert elicitation' where experts[6] were asked to peer review and rate a number of case studies prepared on persons defined as violent extremists. Expert elicitation is a structured process designed to elicit tacit knowledge in the form of subjective judgments from experts. In essence, it is a scientific consensus methodology used generally for rare events and allows for "parameterization, an 'educated guess', for the respective topic under study" (Wikipedia, 2012). Moreover, "it is widely used for quantitative risk analysis to quantify uncertainties in cases where there are no or too few direct empirical data available to infer on uncertainty" (CXDD, 2014).

The **method** employed was a peer-review rating process of presenting a select number of prepared case studies with known outcomes to each participant and asking them to rate each case according to the ten (10) cognitive indicators listed on the RAVE checklist instrument.

These cognitive indicators consisted of five (5) perception items and five (5) belief items representing a combination of static risk factors (indicative of 'Risk Status') and dynamic risk factors (indicative of 'Risk State').

An 'Instruction Booklet' for the Risk Assessment Toolbox (RAT) was presented and discussed with each participant prior to the peer-review rating exercise. The entire peer-review rating process took between 1 to 1.5 hours.

## Protocols for Tuning Cases

For this validation study a small number of prepared case studies (9 in all) were used that covered the full range from 'false positives' to 'true negatives' (see previous risk categories matrix'- Figure 5) in terms of 'known outcome' for each of the three groups of violent extremists (terrorists, militants or shooters) being assessed by the expert sample using the RAVE checklist instrument.

These 9 case studies based on real cases were specifically prepared following a set of protocols for 'tuning' purposes based on the neurocognitive parameters of the RAVE Checklist. The 'tuning case' protocols were:

1. Each 'tuning case' must have a verified 'known outcome' based on reputable source material and be able to be categorised as clearly falling within one of the four risk matrix categories (true positive, true negative, false positive, false negative) see previous Figure.

[6] These experts *voluntarily* participated in a peer-review interview designed to elicit their rating of the parameters of RAVE, the SPJ checklist rating instrument developed by the author. Hence, their participation in the study should not be seem as any form of endorsement by the institution or agency they are or were employed with in so far as this study is concerned.

2. The only information included in a 'tuning case' is *what would have been known* or *could be reasonably inferred to be known* prior to the individual in question came to the attention of police/corrections/security personnel. Since much of the source material for a real case is post-incident confirmatory information that would not have been known at the time of the incident.

3. The source material used to prepare a one page *briefing sheet* on a 'tuning case' is to be written in such a way as to embed only those specific perceptions and beliefs contained on the RAVE checklist (now SaVE inventory) which can be *reasonably inferred to have been held in the mind* of the individual in question when they came to the attention of police/corrections/security personnel. In other words, all reference to behaviourally-based risk indicators are to be kept to a minimum in order to kept the focus of the 'briefing sheet' on the identification of those specific perceptions and beliefs associated with violent and extreme thinking patterns.

### Software Outputs: Interpreting 2-D and 3-D Plots

The RAVE checklist is the heart of the GRiPe software as it specifies the *geometric position* of a specific PoI on the 'risk surface' though a series of weighted calculations to produce a 'best-fit' surface that graphically depicts where an assessor has plotted a particular PoI on the risk contour gradients ranging from minimal to high risk. The GRiPe software produces two types of outputs.

1. The first output is a 'risk contour' plot that contains a grid which shows the *relative position* of an expert's *Estimated Risk Score* (ERS) assessment as a 'blue dot' for a particular PoI in a particular tuning case as falling within a particular bandwidth of progressive increasing 'Risk Levels' from *minimal* to *high* risk.

2. The second output is a 'risk surface' plot that illustrates the extent of any *over'* or *'under' estimation* by an expert of the risk posed by a particular PoI due to the 'tacit knowledge' variance between this expert's Calculated Risk Score Position (CRSP) and their actual Estimated Risk Score Position (ERSP) based on the 'known risk outcome' for tuning cases.

It is necessary to have an accurate understanding of how to interpret these two GRiPe output plots before looking at the research findings in detail. The following plots provide a brief overview on how to correctly visualised and interpret these 'risk contour' and 'risk surface' plots produced by the GRiPe algorithm.

The visualisation in Figure 9 below is an example pf a **risk contour plot** of three militant-type cases (C2, C3, and C5) rated by seven (7) Academic experts in the policing/security fields.

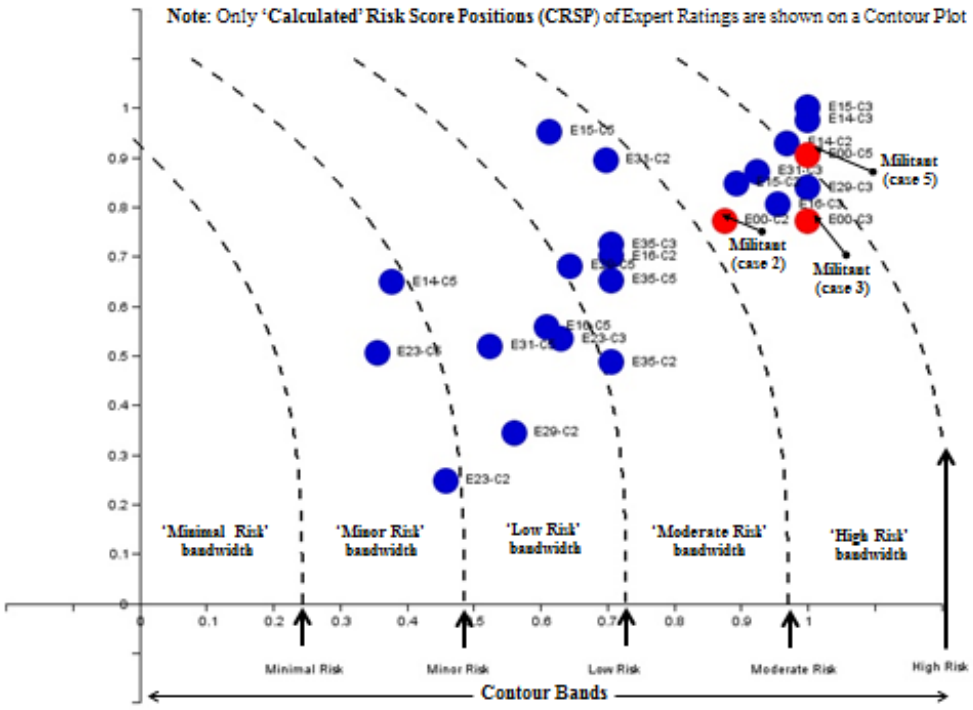


**Figure 11: 'Risk Contour' Plot of three Militant Cases rated by Academic Experts**

As can be seem in Figure 11, a 'risk contour' plot is a 2-D 'flat' view the 'risk bandwidths' being modelled for a particular type of violent extremist. In the example, there are three (3) militant cases (all 'true positives' C2, C3, and C5) and all are correctly located in the 'high risk' bandwidth as indicated by the 'red dots'.

The 'blue dots' on the contour plot represent the *calculated* 'risk value' point derived from the combination of how an expert has scored the 'Ps' (indicator items for perceptions) and 'Bs' (indicator items for beliefs) and their *estimated* 'Risk Score' on the RAVE instrument for a particular tuning case. Hence, the 'blue dots' on the contour plot show the *assessed location* on the risk surface bandwidths for each expert's calculated risk score position (CRSP).

The spread of 'blue dots' shows calculated risk positions (CRSP) provided by the seven academic experts who rated each of these three militant (C2, C3, C5) cases. As can be seen several 'blue dots' are correctly clustered around the three militant cases (red dots) in the 'high risk' bandwidth. Several more 'blue dots' are grouped in the 'moderate risk' bandwidth with the remaining 'blue dots' more or less evenly spread across the 'low risk' (4 dots) and the 'minor risk' (3 dots) bandwidths.

The correct interpretation to be drawn is that 5 out of the 7 academic experts correctly positioned (assessed) all three (3) of these violently extreme militant cases (C2, C3, C5) as 'high risk' (see cluster of 'blue dots' around 'red dots'). Furthermore, the majority of experts were able to successfully identify one or more of these militants a having an unacceptable level of risk (see 'moderate risk' bandwidth cluster of 'blue dots').

Therefore, dot clusters on a contour plot are a strong indication of consensus as it shows the extent of agreement by experts in how their Ps and Bs contribute to Risk and also demonstrates they have a good understanding of how this neurocognitive model of violent extremism works.

The next Figure 12, below, is an example of how the **<u>contour plot</u>** in figure 5 can be transformed into a 3-D view of the 'risk surface' bandwidths for the three militant cases. It contains two snapshots of the 'risk surface' for the same three militant cases and academic expert ratings as on the contour plot in Figure 9 above.

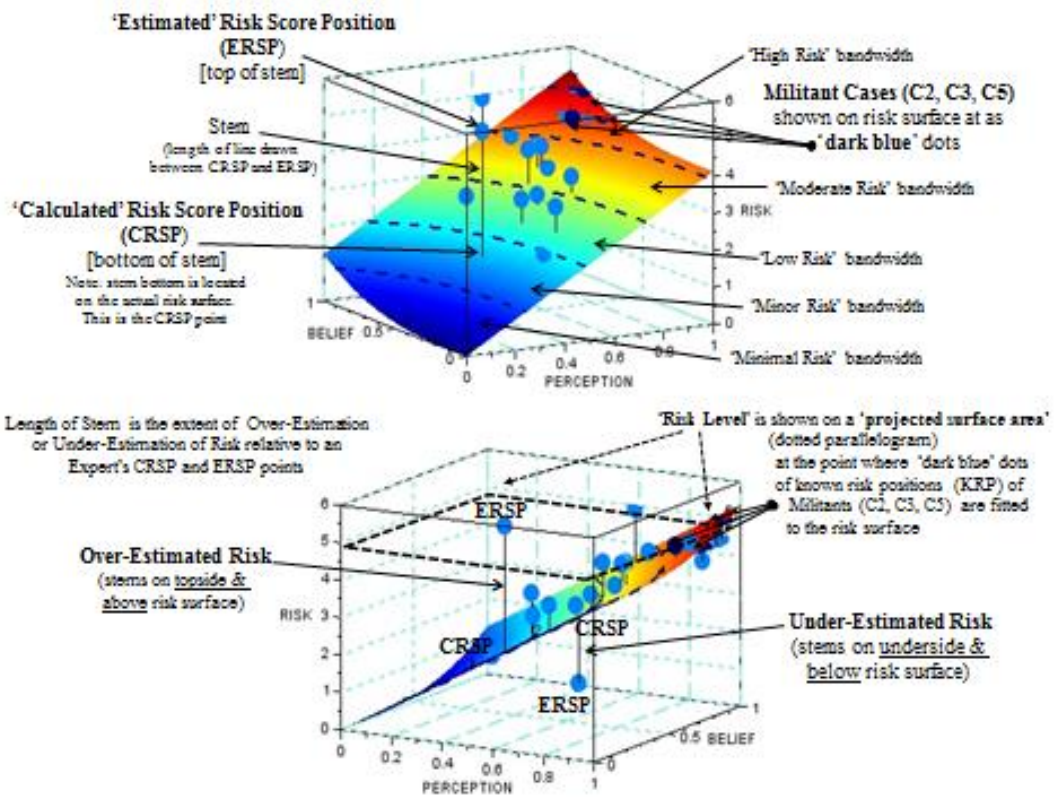


**Figure 12: 'Risk Surface' Plot of the same three Militant Cases rated by Academic Experts**

As can been in the example for Figure 12, the three (3) militant cases and their expert ratings on the contour plot in Figure 9 have been converted to a 'risk surface' plot. What results is a visualisation which illustrates the extent of the *'over'* or *'under' estimation* of the *risk* posed by a particular PoI as assessed by the expert assessors.

To interpret this plot it is important to understand that the closer the '*location*' of a an expert's 'blue dot' is on the actual 'risk surface' then the less variance there is between how the expert has scored the items of the RAVE checklist to get their 'Calculated' RSP for a PoI and how they have used their 'tacit knowledge' to arrive at their 'Estimated' RSP for this particular PoI.

Theoretically speaking, the 'ideal' mathematical assessment is one where the 'Calculated' RSP is the same as the 'Estimated' RSP. In other words, there is no quantifiably measurable difference between the two risk scores (calculated and estimated) by the expert.

Where there is quantifiable variance between 'calculated' and 'estimated' risk scores for the same expert this indicates the use of *some other thinking parameters* ('tacit knowledge' in the head of the expert) being applied to the assessment of a particular PoI than what can be discernibly revealed from the details on the 'Briefing Sheet' for that particular tuning case.

Furthermore, where there is no or little difference between 'calculated' and 'estimated' risk scores positions on the 3-D risk surface demonstrated the expert understands how to use the neurocognitive risk model correctly because their 'blue dot' (CRSP) is fitted 'on or close to' the risk surface and their 'stem line' (ERSP) is very 'short or minimally' on or close to the risk surface as well.

The length of a stem line, as shown on the 3-D 'risk surface' plot provides a quantifiable and graphic measure of the extent of any '*over*' or '*under*' estimation of risk by an expert for a particular PoI. In other words, <u>stem line length is a measure of 'inconsistency' between the assessors's calculated and estimated risk values.</u>

To understand the significance of a stem line, as can be seen where a stem line is on the 'top side', (<u>*above* the projected risk surface area of the dotted parallelogram</u>) this represents an *over-estimation* of risk and the *height of the stem line* the quantifiable degree of over-estimation. Conversely, where a stem line is on the 'bottom side', (<u>*below* on the 'underside' of the risk surface area</u>) this represents an *under-estimation* of risk and the *depth of the stem line* the quantifiable degree of under-estimation.

Also, the 3-D risk surface like the 2-D contour plot, shows whether or not the expert has *correctly* 'located' in the right bandwidth the 'known risk' for a particular PoI based on the 'known risk outcome' for these tuning cases (shown as 'black dots' on risk surface in 'high risk' contour bandwidths).

In regard to interpreting the stem lines as can be seen there are a few experts where the stem lines are quite long, <u>above</u> and <u>below</u>, the risk surface which indicates a considerable variance between what they rated the risk level to be as *calculated* (CRSP) by their P and B scores, but *estimated* (ERSP) the risk to be either much more (overestimated) as in the stems 'above' the risk level or much less (underestimated) as the stem 'below' the risk surface illustrates.

Moreover, where an expert has no or little stem line this shows that the expert's calculated risk value is actually 'fitted' to the risk surface which demonstrates this expert's ratings are performing as this neurocognitive risk model predicts, which is that Ps and Bs contribute to Risk.

Of course, while an expert may demonstrate the correct 'ideal' mathematical use the RAVE checklist with little or no variance shown between 'calculated' and 'estimated' risk scores positions this does not guarantee that the expert has 'correctly and accurately positioned' a PoI an the right 'risk level' bandwidth for the known risk position for this particular PoI.

## Case Example: Missing the Needle in the Haystack

For this terrorist case the distribution of CRSP dots (N= 41 experts) on the contour plot (top visualisation) shows a quarter of the experts correctly scored the case as lying within the *moderate-to-high* risk bandwidths. The remaining three quarters of the experts assessed this terrorist case as spread across the *minimal-minor-low* risk spectrum, with the main cluster at the *minor* risk level.

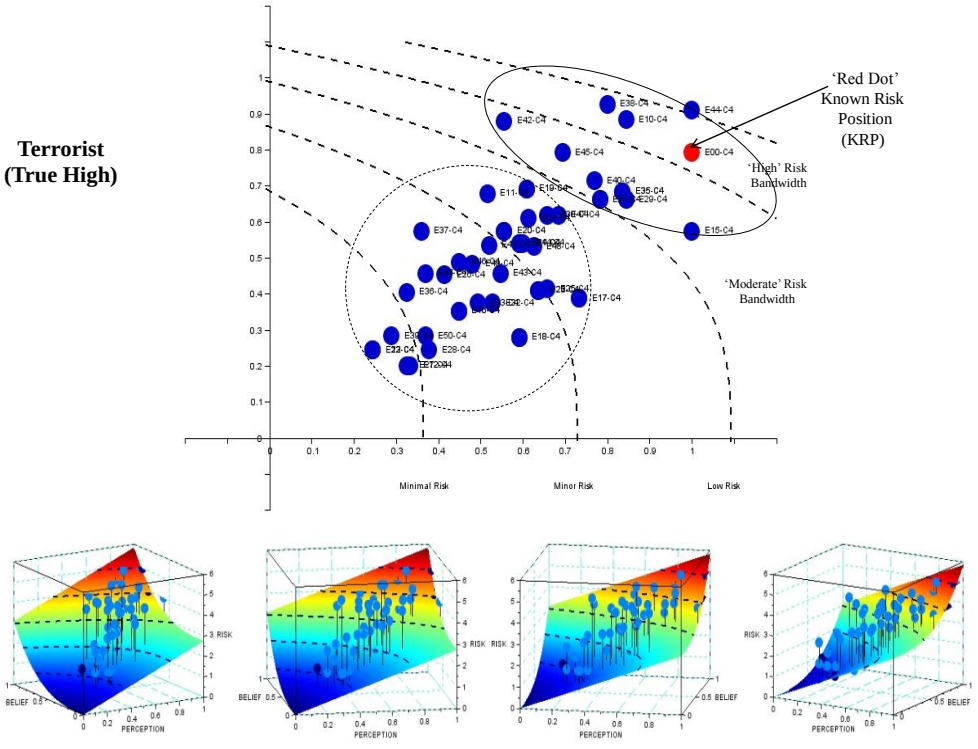


**Figure 13: Risk 'Contour' and 'Surface' Plots of Terrorist Case**

The risk surface plot (bottom visualisation) indicates that by far the majority of experts missed picking this PoI as a potential 'high' risk terrorist who went to become one of al-Qaeda's leading figures.

Moreover, yet again we see a by now familiar pattern of assessment occurring within the expert sample whereby in relation to the topside of the risk surface there is a significant number of experts who tend to provide a low calculated risk score (bottom point of stem – the CRSP point)

but end up subjectively judging a PoI at a higher risk level by their estimated risk score (top of stem – the ERSP point).

Conversely, as seen more clearly in the three preceding cases in relation to the underside of the risk surface, there are some experts who considerable under-estimate the risk posed by a PoI by assigning a long stem line where their calculated risk score or CRSP point is the spot 'fitted' to the underside of the risk surface with a stem line extending down to their estimated risk score point (ERSP) far below the risk surface.

In summary, the outcome for this terrorist case found the expert consensus (three quarters) clustered across the *minor-to-low* risk bandwidths which were an incorrect positioning for this terrorist. That is, only a *quarter* of the experts *correctly identified* this PoI as posing a *moderate-to-high* risk of terrorism. Whilst the majority of experts failed to assess this PoI as having *high* risk potential relative to their c*alculated* risk scores (CRSP) they nonetheless consistently over-estimated the risk (ERSPs) as in some of the previous cases used in this research study.

## Overall Findings of Study

The results of the comparative case analysis confirmed the specific objectives of this research, which were as follows:

The **first objective** - 'fine-tuning' the parameters of the RAVE checklist – was confirmed. This parameterisation exercise demonstrated the acceptability and reliability of the underlying theoretical assumption of this neurocognitive risk model that Ps (specific perceptions) and Bs (specific beliefs) predict Risk.

The **second objective** - testing of the *fitted* 'risk surface' model of GRiPe software – was confirmed. The 'risk surface' model reliably functioned as a verification check on the veracity of an expert participant's *calculated* and *estimated* 'risk level' ratings for each particular tuning case.

The **third objective** - achieving an expert consensus on the reliability of the RAVE and GRiPe components of this Risk Assessment Toolbox (RAT) – was confirmed. That is, for six (6) out of the nine (9) tuning cases there was extensive expert consensus, ranging from three quarters to the vast majority of experts, who **correctly** positioned a PoI at the appropriate 'risk level'. For the remaining three (3) cases {1 public shooter, 1 terrorist, 1 militant} there was consistent expert consensus (three quarters of expert sample) who ***incorrectly*** positioned a PoI at a lower 'risk level.' That is, there was *consistent under-estimation of risk* for these three incorrectly assessed cases. Why such under-estimation of risk occurred will be discussed later in paper.

In summary, this research validated these earlier prototype versions (RAVE & Gripe) as a consistent, empirically-grounded, neurocognitive-based model of risk assessment for the three main types of violent extremist –Terrorists, Militants, and Shooters).

The significance of this research is that it underscores the value and benefit of not only having a more reliable way to assess the 'risk potentiality' of a PoI but also of having a way to reliable assess the subjectively-driven tacit knowledge of practitioners making the risk assessment of a PoI in the first instance.

## Research Implications

The findings from this study raise several interesting and indeed important implications not only for using a NeuroCognitive approach to Risk Assessment but also for the general risk/threat assessment field.

Firstly, the bulk (6 out of 9) of the tuning cases found the expert's calculated risk value (CRSP) 'fitted' the risk surface which demonstrates how expert ratings were performing in this neurocognitive model of risk prediction, which is that Ps and Bs contribute to Risk.

This finding supports the assumption that the majority of the experts in this sample did understand and know how to correctly interpret the P's and B's for each of the cognitive indicators used on the RAVE (SPJ) rating checklist instrument.

Secondly, the issue of consistency between assessors in their risk assessments is not a sufficient or necessary indication of the veracity of a PoI's 'risk level' of being and/or becoming a violent extremist.

For example, there were several case examples in this study in which experts were 'internally consistent' in 'estimated' and 'calculated' rating scores but still failed to locate a PoI in the correct 'risk level' bandwidths.

Thirdly, inconsistencies in 'estimated' and 'calculated' rating scores picked up by the GRiPe software and visually displayed in risk surface plots are useful markers to alert managers to run verification checks on the veracity of a rater's assessment to ensure there is no incomplete or missing data which would account for such inconsistencies.

This is especially important in an operational context, where unlike this expert elicitation study the case outcome is known, in a 'live' context the outcome is not known so any inconsistencies in a risk assessment would require more intelligence/information to be obtained on various cognitive indicators to further check out the reliability of a rater's tacit knowledge/experiential input, which may be influencing the rating, before either ruling such extraneous input 'in' or 'out' of the overall risk assessment.

Hence, 'risk surface' plot visualisations act as this type of verification tool, along with other measures/instruments, to enhance the accuracy, reliability and validity of the assessed 'risk level' for a PoI.

Fourthly, there was wide variation between experts in estimated risk levels (ERSP). This is not altogether surprising as experts from different disciplines and backgrounds will often have a different view of similar situations. Expert disagreements even in the same profession are not uncommon.

For example, In relation to expert disagreement on assessment scoring Van der Sluijs, Craye, Funtowicz, Kloprogge, Ravetz, & Risbey (2005, p. 490) makes the point that this is "…. valuable uncertainty information because it indicates the existence of epistemic uncertainty, such as competing schools of thought within the scientific peer community." Hence, variance in expert judgement is another marker to ensure appropriate verification checks are carried done before accepting any expert's opinion. The GriPe software allows for the quantification of such uncertainties in risk assessments.

In this regard, what is somewhat more surprising in this study is that some experts were matched on a number of criteria like same profession (forensic psychology), roughly the same length of time in job, same research areas and so forth and yet quite different risk levels were assessed to the same tuning case of a terrorist. Figure 8 below depicts these differences.

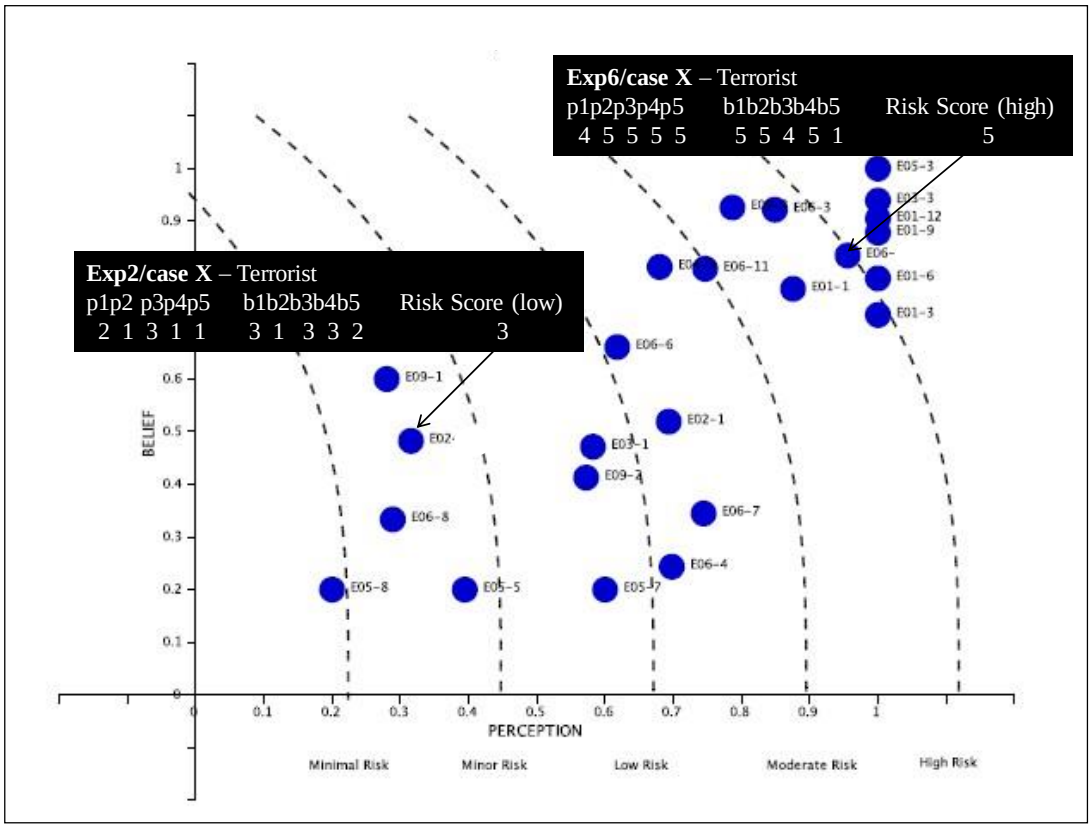


**Figure 14: Variance in 'risk level' assessments between experienced practitioners**

What is evident from Figure above that whilst both values ('minor' risk for Expert 2 and 'high' risk for Expert 6) are acceptable estimates of risk, only one can be true or more accurate.

In this case it is Expert 6 that accurately rated this terrorist as 'high' risk. This finding further underscores the importance of quantifiable verification checking of risk assessments.

Fifthly, a common pattern that emerged from the comparative analysis was where experts over-estimated the risk level by consistently providing low calculated risk scores (bottom of stem – the CRSP point) yet subjectively judging a PoI at a higher risk level by their estimated risk score (top of stem – the ERSP point).

Such differential rating points as indicated by long stem lines are indicative of a number of factors. The most plausible seems to be that of over-estimating the risk as a function of *risk-aversive behaviour* and a desire to 'play to safe' so as to not let a violent extremist through the safety net. Such a *confirmation bias* presents a real concern for PoI who is innocent but who just happen to be in the wrong place at the wrong time.

Sixthly, a significant implication highlighted by this comparative analysis is that a 'low' risk rating for a PoI should be regarded a <u>provisional assessment only</u> that requires further information and follow-up to determine more precisely the veracity of the future risk posed by the individual given a 'low' risk rating. Therefore, a 'low' risk rating is a *threshold* assessment which is 'conditional' on having more follow-up data before a 'risk level' assessment can be considered valid and reliable.

Seventh, an assessor's tacit knowledge plays a crucial and critical role in risk decision-making. In that, 'stem length' between *estimated* and *calculated* risk positions on a risk surface plot quantifies the extent of variance in an expert's subjective risk decision-making behaviour. For example, a long stem line indicates that an assessor has based their risk decision-making on some other factor other than their scoring of the cognitive indicators for P's and B's. A short stem line or one close to the risk surface, on the other hand, demonstrates to a significant extent the appropriate reliance on the cognitive indicators for P's and B's in determining the risk level for a PoI, rather than considering other subjective tacit knowledge factors.

Finally, it should be clear that conceptually, RAVE's focus is on how the multi-factorial pathways and drivers of violent extremism get *interpreted* and *translated* 'neurocognitively' in the mind of individuals into an interlocking set of extremist perceptions and beliefs to justify and rationalise, to themselves and others, their willingness to kill and destroy for what they 'believe'.

In other words, what people 'obsessionally' think about as revealed through their perceptions and beliefs, and *the degree* to which they subscribe to them, is the 'keyhole' the RAVE instrument and its numerical translation in the GRiPe software is designed to look through and into the neural-wired brain/mind that sits on top of a person's shoulders.

These tools, RAVE and GRiPe, and their operational equivalent (SaVE) do not aim to capture all the psycho-social-cultural drivers/factors (demographic, historical, contextual, familial, attitudinal, motivational, ideological, political, etc.) associated with a PoI, like VERA and other TRA's models. Clearly such drivers/factors are influential in pushing/putting individuals on the pathway to violent extremism.

Noteworthy and important as this is, to have a comprehensive understanding of the genesis and drivers of violent extremism, a NCRA trades off comprehensiveness for specificity and particularity in a person's cognitive domain. An NCRA is designed to capture knowledge about and at the sharp end of violent extremism, not its starting point.

## Research Limitations

The generalisability of findings from this 'expert elicitation' case review and comparative analysis of true and false cases of violent extremism is the main limitation. A larger data pool of known cases for rating using the RAVE instrument is necessary to substantively increase the generalisability of the findings for all categories of violent extremists used in this study – terrorists, militants, and shooters.

Another limitation noted in the literature concerns the use of a 'cognitive indicators' approach in this study. Some behaviourally-oriented researchers considered such indicators as too subjective to be useful for valid data analysis. An example of this criticism and its rationale is expressed in a US Government interagency study (2011, p. 1) of *homegrown violent extremists (HVEs) as* follows:

> A mobilization-based approach to identifying extremists poised for violence focuses on behavioral indicators that are observable and well suited for analytic assessments using objective criteria. By contrast, efforts aimed at detecting indicators of radicalization often rely on subjective assessments of factors—such as an individual's mental state, degree of ideological convictions, and personal motivations—that do not readily lend themselves to data-based analysis.

The validity of this criticism of 'subjective assessments' using indicators based on - mental states, ideological convictions and personal motivations – depends on the nature of the indicators being used. That is, a mix of 'static '(stable) and dynamic (changing) risk indicators is the optimal choice.

Research on contemporary risk assessment approaches to violence demonstrate that Structured Professional Judgment (SPJ) models outperform and are superior to simply relying on either standalone actuarial (mainly 'static' risk factors) and clinical approaches (mainly 'dynamic' risk factors) to risk assessment ((Ogloff, 2009, 2002; Ogloff & Davis, 2005; Ogloff & Daffern, 2004).

If large scale data-based analysis is the goal then using 'behavioral indicators' based on 'objective criteria' is a reasonable way to proceed for these types of 'analytic assessments'.

However, for the early detection of violent extremists and for a more reliable risk assessment tool based on a NCRA model then cognitive indicators of the type presented in this paper that are grounded in literature-based empirical research is far more useful than a simple behavioural approach.

Finally, this case review and comparative analysis approach does highlights the potential value of assessing the risk of violent extremism 'neurocognitively' for individuals who become Persons-of-Interest (PoIs). The addition of a neurocognitive perspective to the range of risk/threat assessment packages available for predicting the likelihood of identified persons acing out violent extremism is considered a step worth taking, based on the preliminary results of this 'expert elicitation' study.

## Future Research

The results of this Expert Elicitation study is a first step in a broader research agenda. The long term goal for this neurocognitive model of risk detection of potentially violent extremists is to repeat this study over time with more data sets of known cases with participants specifically-trained in cognitive indicator analysis.

This systematic and structured approach to risk assessment research would ensure that it should be theoretically possible to improve the strike rate of getting both 'correctly positioned' PoI's risk bandwidths and more 'risk level' clusters packed tighter together, through reducing the variance between these trained participants and the distribution spread of their *calculated* risk score position (CRSP) dots on a risk contour plot. In addition, this methodical research approach should also reduce the extent of 'over' and 'under' estimation of risk by these trained participants.

A significant area for future research only touched on in this study is to explore in rehabilitative possibilities of the brain's neuroplasticity as a two-edge mechanism for enablement and inhibition. That is, neuroplasticity has the capacity to act as an 'enabler' to strengthen neural pathways in an individual's mind towards the radicalisation end of violent extremism. Moreover, neuroplasticity can also act as an 'inhibitor' by blocking such violence-inducing synaptic linkages and creating new neural connections and thinking pathways out of an extremist mind-set towards deradicalisation. Hence, this neurocognitive understanding of neuroplasticity on which a NCRA is build offers significant hope to law enforcement, prison, correctional, and community agencies involved in the recovery effort to 'deradicalise' the minds of those who still believe in a cause worth killing others for (Bjorgo, 2011; Borum, 2011; Horgan, 2008).

# Part 5: The SAVE (30.v1) System - Operational Program

The **SAVE** 30.v1 (**S**tructured **A**ssessment of **V**iolent **E**xtremism) program builds on the empirically validated findings of earlier versions (RAVE inventory and GRiPe software) of this NCRA system and has expanded the operational utility of this NCRA system. This section will overview the latest developments in the SAVE system before providing working examples of case comparisons of various types of violent extremists by assessors using RAVE data.

## Overview of SAVE Application Program

The current **SAVE** application program consists of an Inventory checklist of 30 'cognitive' risk indicators and a Software visualisation application that produces a 3-D 'risk surface' plot depicting the extent of the 'risk potential' of an identifed Person-of-Concern (PoC) who falls within the spectrum of violence extremism, which includes Terrorists, Militants, and Shooters/killers (schools, workplaces, public spaces).

An individual is identified as a PoC by an agency (eg. police/law enforcement/national security/government institution/or private organisation) because they *appear to hold* a violently extreme worldview. The SAVE program quantitatively scores and assesses specific *perceptions* and *beliefs* that correlate with and underpin a violently extreme worldview.

In this NeuroCognitive model *perceptions* are 'interpretations of reality' by a PoC because individuals 'see' with the 'eyes' but 'perceive' with the brain, and *beliefs* are 'firmly-held convictions' accepted as 'true' by the PoC but without the need for any empirical 'proof' to determine the veracity of such beliefs.

The neurological foundation for these particular violence-enhancing 'cognitive' risk indicators of particular *perceptions* and *beliefs* used in the **SAVE** program is based in well established research which shows 'mental activity correlates with neuronal activity' (Doighe, 2015). Furthermore, the brain uses *experience-dependent neuroplasticity* on a daily basis to form and reform new neural connections (Greenfeld, 2014) as well as strengthen those cognitive pathways most often used due to the brain's basic operating principle of 'neurons that fire together, wire together' (Hebb, 1949).

The converse is also true, if you don't use certain neural pathways for some time then the brain's electro-chemical circuitry adapts by reallocating unused or underused neurons to other neuronal functions on the principle of 'use-it-or-lose-it' (Doighe, 2015; Kurzweil, 2012).

## Managing Knowledge and Risk in the SAVE system

Figure 15 below provides a graphical overview of the SAVE 30.v1 program's schematic structure and output capabilities.

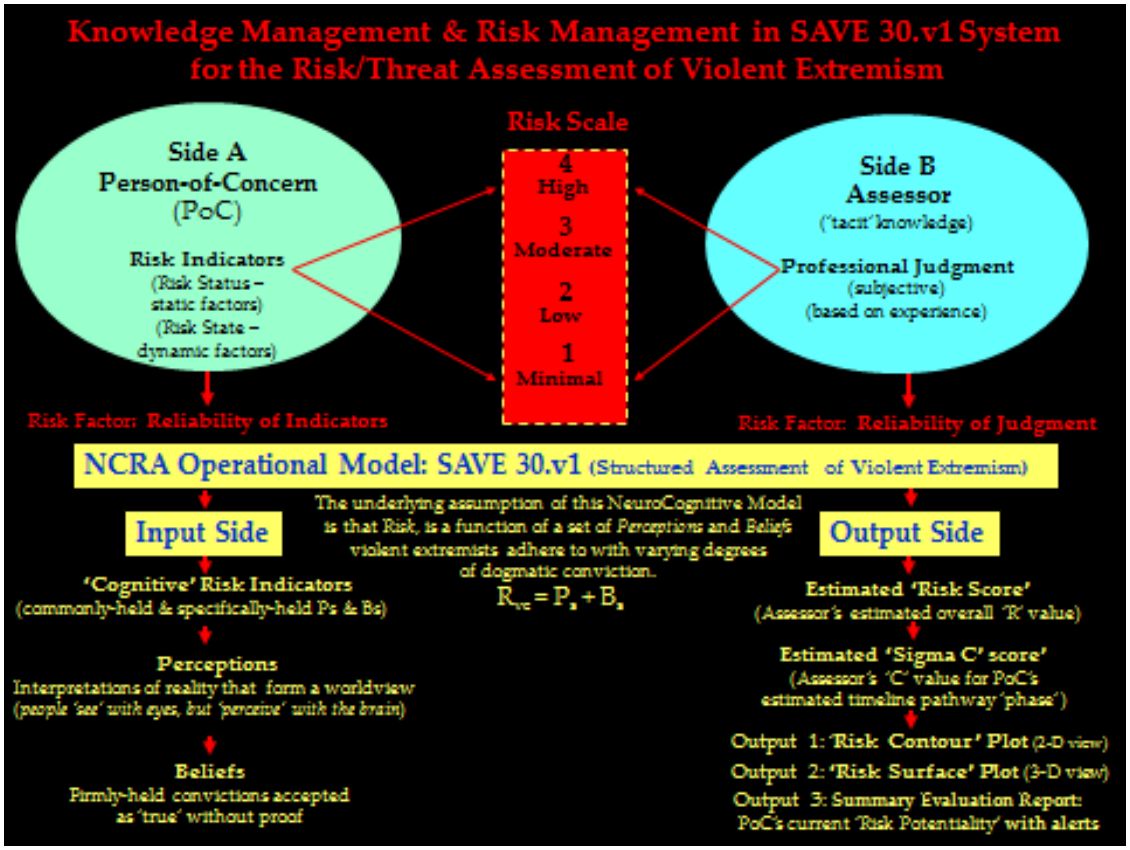


**Figure 15: Knowledge Management and Risk Management in SAVE 30.v1 Program**

As can be seen, essentially, SAVE functions as a Knowledge Management system with database capability for the comparative analysis of risk assessment evauations of various types of violent extremists. It also combines a Risk Management system with risk minimisation capability incorporated in the software visualisation outputs of an assessor's 2D and 3D plots for their risk assessment of a PoC.

## Risk Minimisation 'Alert' System in SAVE Software

To correctly evaluation the risk assessment done by an assessor it is necessary to understand the system of 'alert' prompts in the SAVE program before any case comparison is done. The in-built 'alert' system in the SAVE software works on warning case managers/supervisors of any scoring 'inconsistencies' at two levels. They are:

'Level 1' alert prompt - message pops up on the SAVE software console stating that *'Alert declared as assessors r and c are different'* whenever such an inconsistency in scores is detected and shows up on the 2D 'risk contour' plot as a 'red dot' for the assessor. If there is no score difference between 'R' & 'C' values then the assessor will be a 'blue dot'.

That is, the 'R' value is the score given by an assessor of their '*overall estimation of risk'* for a particular PoC and the 'C' value is the score given by an assessor of their estimate of the '*timeline pathway phase'* this particular PoC is at in their professional judgment.

Theoretically, the current working assumption is that there should be 'no difference' between how an assessor scores the estimated the overall level of risk and how they score the PoC for where they 'expect' to see the PoC at this current point in time in terms of how far along PoC is on their violent extremism pathway journey.

For example, if an assessor thinks a PoC is 'low' risk (score of 2) then they should also think the PoC is still only at the 'cognitive attraction' stage (score of 2) on their timeline pathway progression and score then appropriately. Similarly if estimated risk is 'moderate' (score of 3) then also the PoC should be at least at the 'cognitive obsession' stage 9 (sore of 3).

The point is an assessor gives a higher or lower rating for either the 'R' or 'C' value then an alert prompt will be sent so further investigation of the reasons/rationale for the difference can be explored so a more informed decision can be made about the risk potentiality of the PoC in question.

'Level 2' alert prompt – requires a *visual inspection* of the 3D 'risk surface' plot to determine the extent of 'scoring consistency' between an assessor's combined weighted and calculated 'Ps+Bs' scores and their 'R' value score.

The *stem line length* displayed on 3D surface plot the indicates the extent of any scoring inconsistency between 'Ps+Bs' value and 'R' value. This is because the 'PB' point is the place where the stem line is in 'actual contact' with the risk surface (either above {*indicative of over-estimation of risk*} or below {*indicative of under-estimation of risk*} the surface contact point). While the assessor's 'R' value is their *overall estimated risk score* which may be different from the predicted 'PB' surface contact point. The extent of difference is shown by how long the stem line is between these two points – the 'PB' surface point and assessor's 'R' point shown as 'blue dot' at other end of stem, either above or below surface plane.

The point of this visual alert prompt to inspect the stem line length is again to further investigation why the assessor has factored in by their scores differential ('PB' and 'R' scores) 'too much' over or under estimation.

Note, this over or under-estimation of risk will not change the PoC's position at or location in the particular risk bandwidth as this is solely determined by the combined calculated Ps &Bs scores given by the assessor.

The difference in 'PB' and 'R' scores may simply mean the assessor has not correctly understood how Perceptions and Beliefs contribute to Risk and therefore provided a lower risk contact point on the actual surface then was intended given the assessor's higher estimated Risk score.

To correct this misunderstanding of how the NCRA model works would then be a matter of additional training so that the assessor can calibrate their scoring of Ps & Bs to be more in line with their overall estimation of risk.

What the 'stem line' alert does is warn the case manager/supervisor that there is a significant difference in how the assessor is seeing this PoC and therefore a re-think as to how 'risky' the PoC is required. The may involve another one or two assessors also rating the same PoC independently to then triangulate and display the scoring outcomes for consistency.

Such a process of requiring 'Independent Multiple Assessor Input Scoring' (IMAIS) for cases where the 'stem line discrepancies are significant' would considerable boost the confidence level that a police/security agencies can have in the reliability of this NCRA model to accurately predict violent extremism risk.

## Case Comparison Examples using SAVE Software

The next series of figures depict various analytical capabilities of the SAVE 30 system which are unique to a NeuroCognitive approach to risk assessment of violent extremists.

### Case Analysis: Shooter

This first example is of a 'true positive' Shooter case that occurred in Germany in 2009 that left 15 people dead before the shooter shot himself in a gunfight with the police. The plots displays of this Shooter case are shown below on Figure 16.

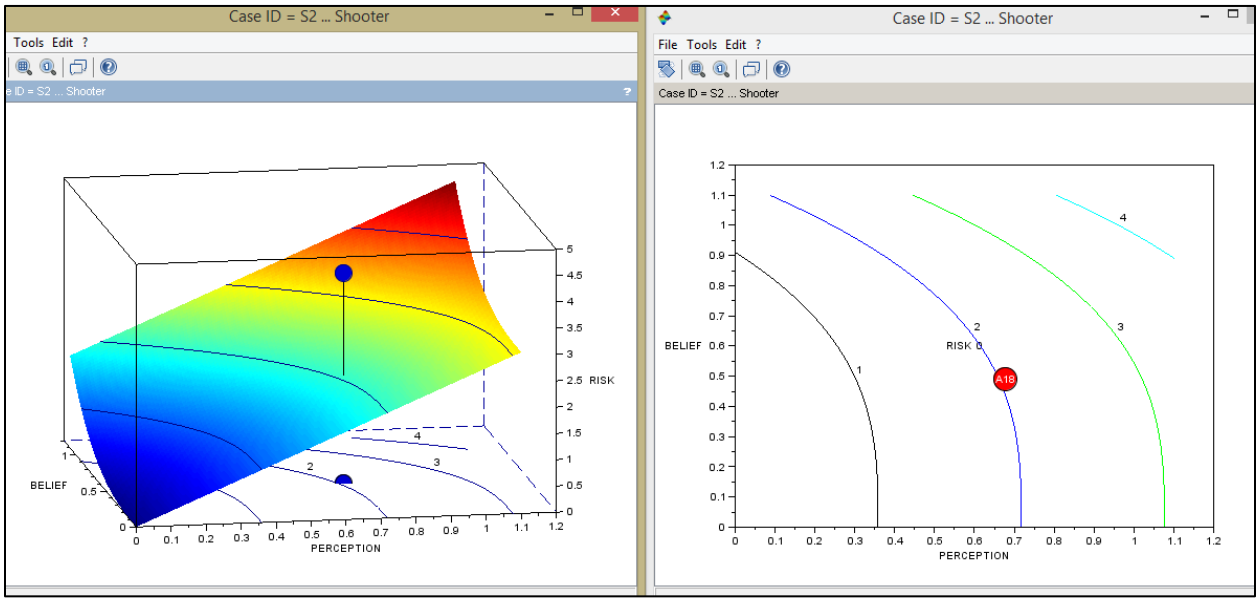


**Figure 16: Shooter 1_Assessor A18_Risk Surface & Contour Plots**

Firstly, if we examine the 'Risk Contour' 2D plot on the right-hand side of the figure, what we see is the 'red dot' colour of the assessor, A18, is an 'alert' prompt to indicate that the assessor's 'R' value (*overall estimation of risk*) and their 'C' value (*timeline pathway phase*) are different. Hence, such an alert prompts the case manager to investigate further this discrepancy in rating values given by the assessor.

Note: There is an important clarification here to always keep in mind when examining the meaning of the 'red' dot' alert prompt. A 'red dot' does not necessarily imply the assessor's ratings are 'wrong' only that there is an 'inconsistency' which needs to be examined further.

The alert prompt simply means that a case manager/supervisor now needs to input more 'knowledge' by eliciting from the assessor their reasoning behind their 'overall estimation of risk' ('R' value) posed by this particular PoC and where they think he/she is at on the pathway timeline journey ('C' value) towards or from violent extremism based on the 'naturalistic' conversations with this particular PoC on which the risk assessment was made. As noted in the previous section these alerts are risk minimisation checks and safeguards.

Secondly, when we examine the 'Risk Surface' 3D-2D plot, what we see is a long stem line extending from the assessor's 'PB' point on the actual surface to their 'R' value ('blue dot') point above the surface. As mentioned in previous 'alert' system section, this indicates the assessor has 'over-estimated' the risk this shooter poses relative to the risk surface location in the 'low' risk bandwidth. The magnitude of this risk over-estimation is evident from a visual inspection of the 'risk scale' of around 2.5 at 'PB' point on surface compared with how far up the stem line is at the 'blue dot' 'R' point of around 4.5.

In other words, while this risk surface plot clearly shows the assessor has rated this known PoC at the incorrect 'risk level', that is 'low' rather than 'high' this is only in terms of misaligning the Ps&Bs scores. As can be further seen, the long 'length' of the stem line matches the 'high' risk level. Therefore, it is clear that for reasons other than correctly scoring the Ps&Bs for this shooter this assessor 'thinks' the PoC is still a 'high' risk.

Again, as mentioned previously, to get better alignment between this assessor's 'PB' and 'R' points and the correct risk level location in the 'high risk' bandwidth then this would require a re-scoring of the assessors Ps & Bs as discussed in previous section. This is because for the assessor to have rated this known 'high risk' PoC as falling within the 'low risk' bandwidth at the actual surface contact point is a function of mainly low Ps & Bs scores to account for positioning the Shooter as 'low risk'.

The next figure shows the same case with the same assessor but with the expert comparison points added to illustrate the value of having a quantifiable way to do a comparative analysis of a case where the alert system has picked up scoring inconsistencies.

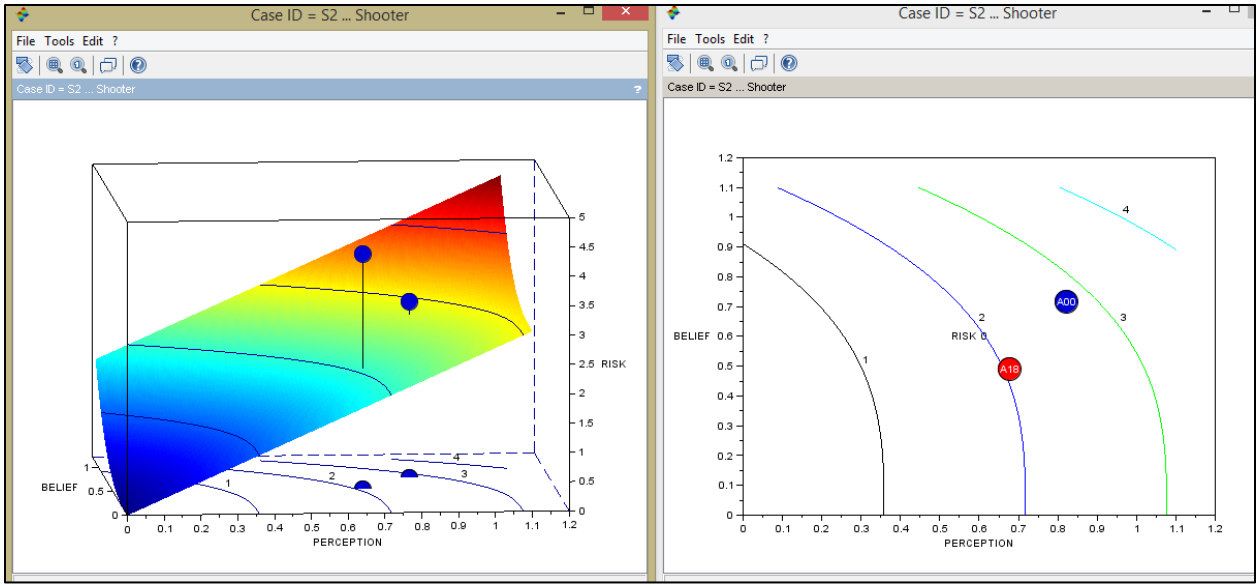


**Figure 17: Shooter 1_Assessor A18 plot points compared with Expert plot points**

The figure above makes it abundantly clear there is need to re-assess this case urgently. Also, note the expert's has not only positioned this shooter at the topside of the moderate-to-high contour bandwidth line but also has a short, almost negligible, stem line. In other words, the expert's Ps&Bs scores and 'R' score almost 'fit' the surface perfectly. This indicates the predictive risk value of the NCRA model is working correctly.

Interesting, both this assessor and the expert got the assessment 'right' in relation to the assessor predicting an estimated 'high' risk as evident by a stem line well above the expert's correct position. However, more importantly, the assessor got it 'right' on some other basis of tacit knowledge (*experience*, *'gut' feeling*, or *'risk aversive' bias* of not wanting to be the one to let anyone through the gate that has the slightest chance of being a violent extremist[7]) than by using the NCRA model correctly.

**Case Analysis: Terrorist**

In the case comparison below it is evident the assessor (A18) has located this known Terrorist incorrectly as falling on the 'low' risk contour line (2D plot).

[7] This was a reoccurring findings in the validation research study on the RAVE prototype that most experts consistently 'over-estimated' the risk. The implication is that this may be evidence of a skewed 'risk aversive' mind-set bias with police/security practitioners.

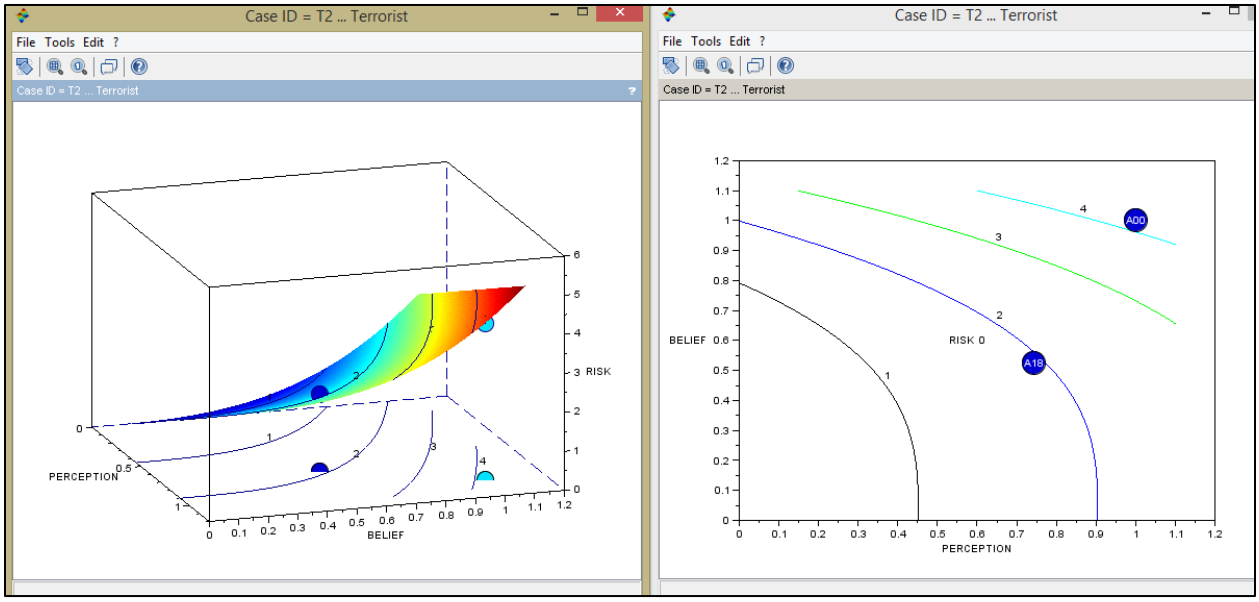


**Figure 18: Terrorist 2_Assessor A18 plot points compared with Expert plot points**

Interestingly, from the 3D plot for this case, the assessor has not over-estimated the risk as there is no stem line as the dark 'blue dot' of A18 lies directly on the risk surface. In other words, this assessor's calculated 'P&B' and estimated 'R' values are the same.

Also, as can be seen the expert's risk assessment dot (A00) has changed to 'light blue' when compared with the previous Figure 17. This colour change from 'dark' to 'light' blue is used in the SAVE system to signify that the 'risk position' defined by an assessor lies below the risk surface.

The value of this convention is that it visually helps to distinguish various dot points when evaluating plots where multiple assessor points are being compared to determine the veracity of a particular risk assessment of a PoC.

**Case Analysis: Militant**

The two figures above, 19 and 20, show a similar story for this assessor 9(A18). Figure 19 indicates that the assessor's location of this militant as 'low' risk is incorrect compared the known outcome of this case depicted as 'high' risk by expert 9(A00).

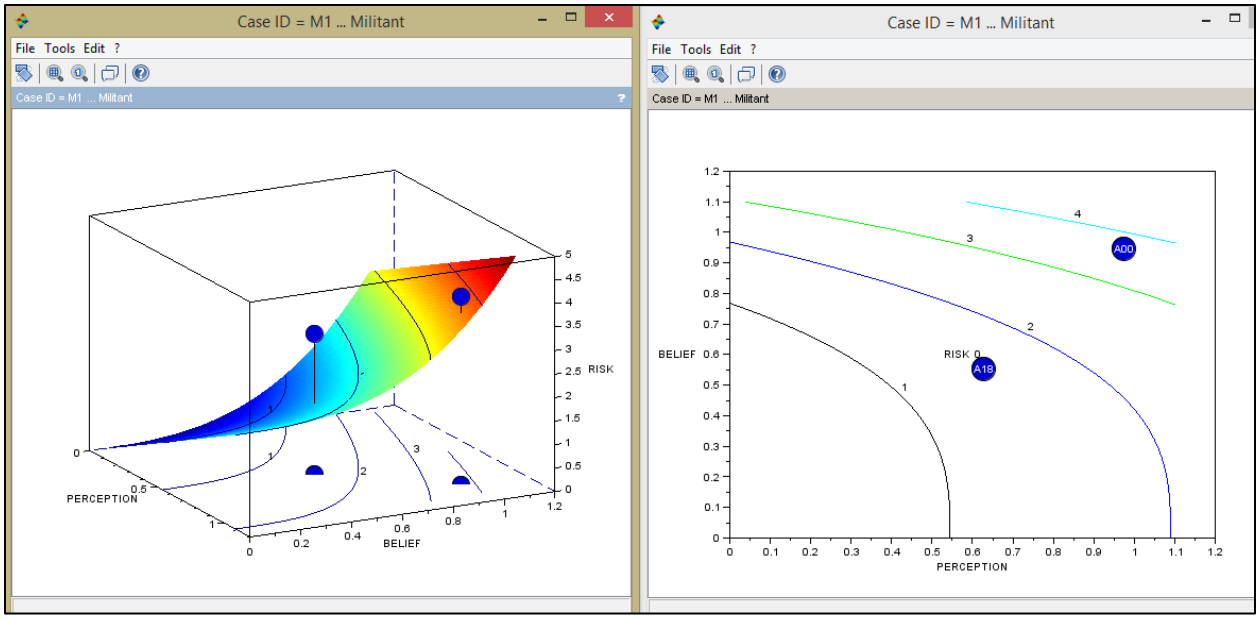


**Figure 19: Militant 1_Assessor A18 plot points compared with Expert plot points**

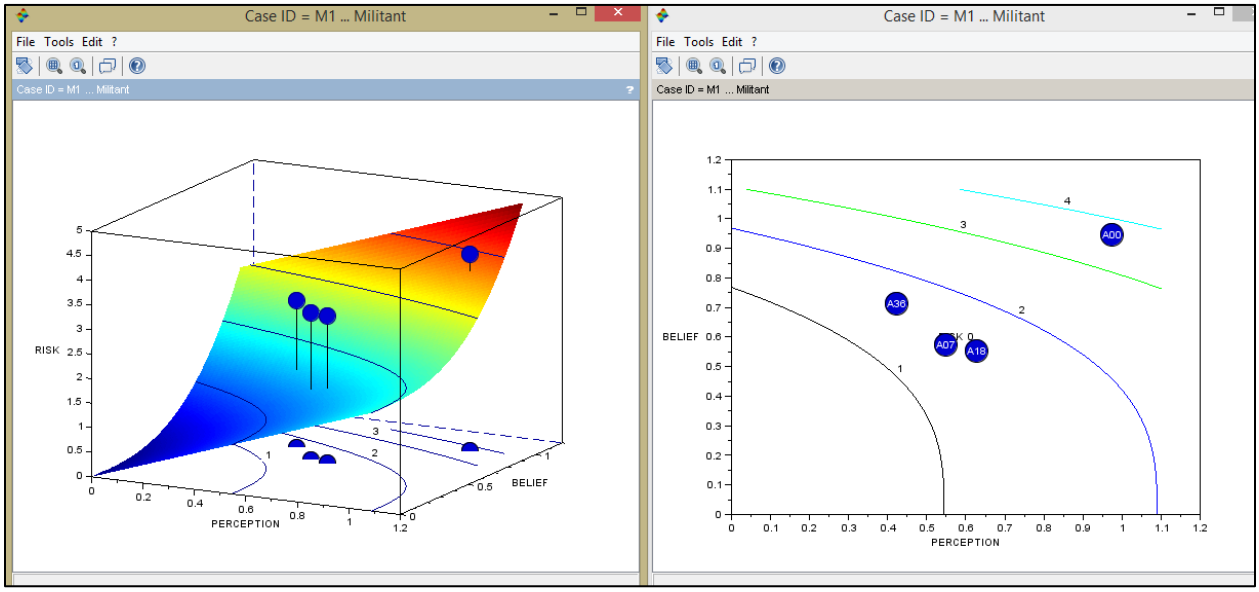


**Figure 20: Militant 1_Assessor A18 plot points compared with multiple Assessor points**

Figure 20 is the same case compared by two other assessors (A07) and (A36). As can be seen they also have a 'low' risk contact position on the risk surface. But as mentioned previously, the stem lines of all three assessors (A18,A07,A36) are far above the surface at about 4 on the risk scale indicating an 'over-estimation' of risk which is correctly for this militant.

As discussed previously, there can be several reasons for such over-estimation of risk by an assessor. The important point is that such 'long' stem lines alert the assessor and case manager/supervisor to an inconsistency in the risk assessment that needs further exploration.

## NeuroCog Training for 'Field Trials' of SAVE Program

The significance, value and benefits of the current SAVE 30.v1 application program are threefold.

*Firstly,* the **SAVE** program demonstrates the practical usefulness of having a consistently reliable and quantifiable way to assess the 'risk potentiality' of a PoC (Person-of-Concern).

*Secondly*, the **SAVE** program also demonstrates the value of having a consistently reliable and quantifiable way to 'capture' the subjectively-driven tacit knowledge underpinning an assessor's professional judgment when making a risk assessment based on 'naturalistic' conversations.

*Thirdly*, the **SAVE** program, apart from its operational utility and knowledge capture value, has the additional benefit of providing in-built risk management and risk minimisation checkpoints and safeguards (alert prompts) for not only the police/security practitioner doing the risk assessment but also for the identified PoC and the police/security agency as a whole to ensure they have got the assessment 'right' as far as reasonable possible at the time of assessment.

The value of capturing an assessor's tacit knowledge lies in having a RA system that makes 'explicit' such tacit knowledge so that it can be explored further. Such an exploration would involve determining the usefulness of the assessor's tacit knowledge in not only making a more informed evaluation of the potential 'risk level' posed by a PoC but also in prioritising the case management options required for that PoC.

Finally, the utility of this NCRA system is that it only requires some initial but limited training of a police/security practitioner before they can be operationally deployed to conduct covert 'naturalistic' conversations with identified PoCs.

These informal 'conversations' are then inputted into the specialised SAVE software in order to ascertain the nature and extent of specific perceptions and beliefs they may hold as to their 'risk potentiality' and, where relevant, the SAVE software will trigger 'alert' messages for follow-up investigation.

An operational version of the SAVE 30.v1 program is now available for police, law enforcement and national security agencies to use for 'field trial' testing in partnership with the program creator and developer.

## Conclusion

This paper has presented a neurocognition-based approach to the risk assessment of violent extremists in the form of a quantitative algorithm-driven model of 'neuroplasticity-in-action'.

It is what people '*obsessionally' think about* as revealed in their worldview through their perceptions (interpretations of reality) and beliefs (firmly-held convictions accepted as 'true' without proof) and *the degree* to which they subscribe to these perceptions and beliefs, that is the 'keyhole' through which this NeuroCognitive Risk Assessment (NCRA) system works.

The SAVE application program is designed for police, law enforcement and national security agencies as an 'all-in-one', purpose-built, Knowledge Management and Risk Management System for the detection and management of violent extremists. The SAVE system has been rigorously validated through its early prototype version (RAVE) as a reliable and quantifiable NeuroCognitive-based Risk Assessment application.

The current version of the SAVE program (30.v1) offers an expanded set of risk indicators including a cognitive pathways timeline and enhanced functionality for 'tacit' knowledge capture of an assessor's professional judgment decision-making as well as 'in-built' alert prompts for risk minimisation checkpoints and safeguards.

In summary, the SAVE application program is an integrated Knowledge Management and Risk Management System designed for *operational utility, 'tacit' knowledge capture,* and *risk minimisation* by policing and national security agencies involved in the very 'risky' business of detecting and stopping acts of violent extremism.

The benefits of the SAVE 30.v1 operational program lies in is its practical application of having a reliable and quantifiable way of assessing, managing, prioritizing, and mininising the risks involved for police/ national security agencies when dealing with identified Persons-of-Concern (PoCs) at risk of being or becoming terrorists, militants, or active shooters/killers.

The payoffs are substantial for those police/security agencies that take a 'big picture' strategic knowledge view of making a relatively small investment now by engaging in 'field trials' of the SAVE 30 program in combating and countering the ever-growing global problem of violent extremism. If investing in new cutting-edge neurocognitive-based knowledge is seen as too expensive, then try the alternatives - keep using blunt tools, try nothing new, or in the worst case scenario, remain ignorance.

The SAVE 30.v1 application program is now operationally ready to begin the 'field trails' stage of testing and development in various countries with appropriate 'joint venture' partners in policing, law enforcement and national security organisations/agencies.

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