Modeling the Behavior of Violent Extremists:

An Evidence-Based Methodology and System for Instruction and Analysis

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Abstract—**This paper presents an evidence-based methodology and a web-based system for modeling the behavior of violent Sunni extremists. The system can teach and guide its users to assess whether an English translation is an authoritative text in Sunni Sharia, and whether a definition or rule of behavior from an authoritative text is accepted and followed by violent Sunni extremists. More importantly, it can teach and guide its users how to assess complex hypothesized behavior by using evidence and the verified definitions and rules of behavior, helping to investigate, comprehend, and anticipate the behavior of violent extremists.**

Behavior modeling; violent extremists; evidence-based reasoning; hypotheses analysis; analytic tool; cognitive assitant

I. INTRODUCTION

This paper presents an evidence-based methodology for modeling the behavior of individuals and groups that follow a set of rules documented in authoritative sources. An example of such a set of rules is any system of law, such as US Constitutional, English Commons, or Sharia. Other examples are published Soviet military doctrine, the US military doctrine, and any other well-documented doctrine.

The paper illustrates the application of this methodology to the modeling of the behavior of violent Sunni extremists who advocate strict adherence to Sunni Sharia.

Coughlin [1, p. 29] made the following observation: "For the WOT (war on terror), … the relevant enemy doctrine used to drive the IPB (intelligence preparation of the battlefield) and subsequent decision making starts with the stated doctrine of Islamic 'extremists' irrespective of our assumptions of correctness. Specifically, 'extremist' doctrine calls for a return to Islamic law, Islamic governance, a return of the Caliphate and the willingness to wage *jihad* (which we call terrorism) in furtherance thereof. If these views accurately reflect the core principles of the enemy in the WOT and its followers believe it, act in furtherance of it, and are willing to kill because of it, then this is the idea-based doctrine that represents a threat to the United States, its citizens and allies."

If it is true that "violent Sunni extremists" advocate strict adherence to Sunni Sharia and act according to its rules, then modeling their ideology, doctrine, goals, and planning has to be based on the strict Sunni Sharia rules that are followed by them. But how can one identify the rules that are important for the WOT, such as the rules of jihad, and make sure that they are indeed followed by the violent Sunni extremists? One can use evidence-based reasoning with the TIACRITIS system [2-4] to:

(1) Identify classical Sharia texts that are recognized as authoritative in Sunni Sharia.

(2) Identify rules of behavior in the authoritative texts, and use evidence to determine whether they are indeed followed by violent Sunni extremists.

(3) Use the verified rules of behavior and evidence to investigate, comprehend, and anticipate the behavior of violent Sunni extremists.

The rest of the paper illustrates this approach and is structured as follows:

Section II very briefly presents how to perform evidence-based hypothesis analysis with the TIACRITIS web-based system, which is at the basis of the proposed approach.

Section III shows how TIACRITIS teaches and guides its users to assess whether an English translation is an authoritative text in Sunni Sharia.

Section IV presents how TIACRITIS teaches and guides its users to assess whether a definition or rule of behavior from an authoritative text is accepted and followed by violent Sunni extremists. An example of an investigated rule is the following one: "For violent Sunni extremists, lying is permissible for circumventing those forbidding what is the permissible in Sunni Sharia."

Section V presents how TIACRITIS teaches and guides its users to assess hypothesized behavior of violent Sunni extremists by using evidence and the identified definitions and rules of behavior. Examples of such hypotheses are:

"The burning of the Koran by a Florida pastor creates a serious threat of retaliation against UN and NATO personnel in Afghanistan from violent Sunni extremists."

"The goal of the Muslim Brotherhood is to take full control of Egypt in order to establish an Islamic state governed by enforced Sharia, and it has adopted a language of freedom and justice as a step in this process, in accordance with its Milestones doctrine which is based on the Sharia principle of progressive revelation and the rule of abrogation."

"The Muslim Brotherhood will have effective control of the new parliament of Egypt through its direct or indirect influence over key emerging political parties from a seemingly wide political spectrum."

As will be discussed in Sections IV and V, TIACRITIS may easily be extended with other rules of behavior of violent Sunni extremists, and may be used to analyze any user-formulated hypothesis. Moreover, it learns from such analyses to facilitate the analysis of other hypotheses.

Finally, Section VI ends this paper with the claim that TIACRITIS can become an effective tool for teaching military, intelligence, law enforcement, and government personnel, on a topic which is very important in the war on terror and homeland defense, and can also become an effective analysis tool.

II. HYPOTHESES ANALYSIS WITH TIACRITIS

Assessing the authority of a Sunni Sharia text, assessing whether a certain elementary rule of behavior is followed by violent Sunni extremists, or assessing a more complex hypothesized behavior of violent Sunni extremists are all done by building argumentation structures that link evidence to the hypothesized behavior by evaluating the relevance, believability, and inferential force of evidence, as discussed in the TIACRITIS textbooks [3, 4]. These argumentation structures are developed by employing a general divide and conquer approach through problem reduction and solution synthesis, which is illustrated in Fig. 1.

Consider the problem "Assess hypothesis H_1" from the top of Fig. 1. We want to solve it by employing various strategies that reduce it to simpler problems.

"Which is an assessment strategy? Assess H_{11}, H_{12}, and H_{13}."

Therefore we reduce the assessment of the top level hypothesis H_1 to the assessment of three simpler hypotheses: H_{11}, H_{12}, and H_{13}. We continue this reduction process down to the level of elementary hypotheses to be assessed based on evidence.

Let us consider H_{12} as elementary hypothesis. We ask the question: "Which is a relevant item of evidence?" If E_1 is such an item of evidence, then we reduce the assessment of H_{12} to two simpler assessments: "Assess the relevance of E_1 to H_{12}" and "Assess the believability of E_1" (see the bottom left of Fig. 1).

If E_2 is another relevant item of evidence, then we can also reduce the assessment of H_{12} to two other simpler assessments: "Assess the relevance of E_2 to H_{12}" and "Assess the believability of E_2" (see the bottom right of Fig. 1).

Now let us assume that we have obtained the solutions of the leaf problems, as shown at the bottom of Fig. 1 (notice that we only show the likelihoods):

"If we assume that E_1 is believable, then H_{12} is very likely to be true" and "The believability of E_1 is likely."

"If we assume that E_2 is believable, then H_{12} is certain to be true" and "The believability of E_2 is almost certain."

We now need to combine all these solutions, from bottom-up, to obtain the solution of the top level problem. First we need to combine the relevance of E_1 (very likely) with its believability (likely) to obtain the inferential force of E_1 on H_{12}, which is the solution associated with the question/answer pair "Which is a relevant item of evidence? E_1." We may use various combination functions (e.g., min, max, average, weighted sum) but in the case of these problems it makes sense to use min since only evidence that is both relevant and believable will convince us that a hypothesis is true. We thus obtain "Based on E_1 the hypothesis H_{12} is likely." Similarly we obtain the inferential force of E_2 on H_{12}, "Based on E_2 the hypothesis H_{12} is almost certain." This is the solution associated with the question/answer pair "Which is a relevant item of evidence? E_2."

Next we have to combine the solutions associated with these two question/answer pairs to obtain the inferential force of both items of evidence on H_{12}, which is the evidence-based assessment of H_{12}. While various combination functions may again be used, in this case it makes sense to use max. Thus the obtained solution is: "Based on E_1 and E_2 the hypothesis H_{12} is almost certain."

We assess H_{11} and H_{13} in a similar way, obtaining the solutions likely and very likely, respectively.

Then we have to combine the solutions of H_{11} (likely), H_{12} (almost certain), and H_{13} (very likely), to obtain the solution corresponding to the employed strategy which, in this illustration, is associated with a weighted sum composition function (with the weight "high" for H_{11}, "very high" for H_{12}, and "medium" for H_{13}). This produces a likelihood of very likely which is also the likelihood of the top-level hypothesis (because the maximum of a single value is the value itself).
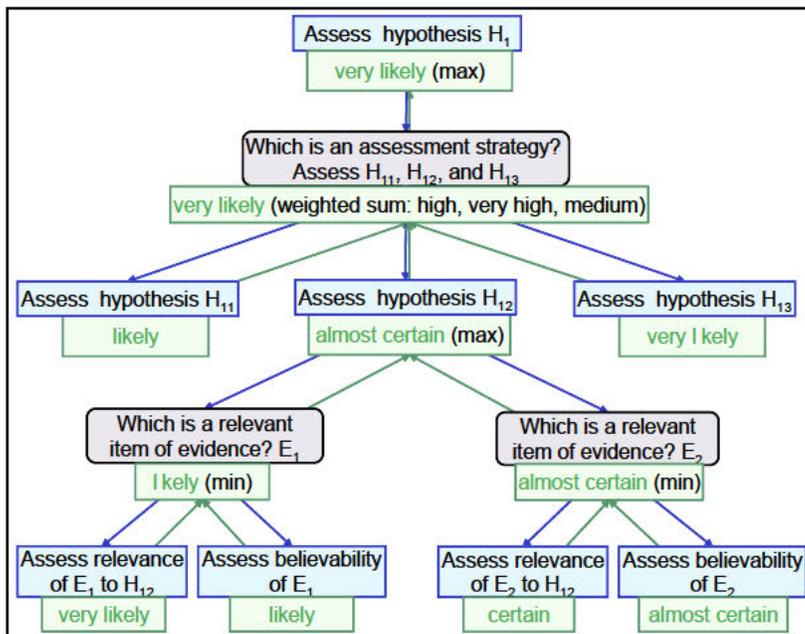

Figure 1.   Illustration of the problem reduction / solution synthesis analysis paradigm.

It is through such an evidence-based problem reduction and solution synthesis process that all the hypotheses are assessed, as discussed in the following sections.

III. ANALYZING THE AUTHORITY OF SOURCE MATERIALS

The basis of the developed approach to assessing whether a text is considered authoritative by violent Sunni extremists is to identify a set of criteria and sub-criteria which need to be satisfied by the text. In establishing these criteria, we prefer to be wrong in assessing an authoritative text as non-authoritative, rather than being wrong in assessing a non-authoritative text as authoritative. Thus, our criteria might seem more stringent than necessary. However, this choice is justified by our goal of identifying texts on Sunni Sharia that are undisputably authoritative, and using these texts to extract the behavior rules that appear to be followed by violent Sunni extremists.

With the criteria and sub-criteria established, evaluating the authority of a text follows the problem reduction / solution synthesis approach discussed in the previous section:

(1) The top-level criteria for text authority are successively reduced to simpler and simpler criteria, down to the level of elementary criteria.

(2) The elementary criteria are assessed using evidence.

(3) The results of the assessments of the elementary criteria are composed, from bottom-up, to obtain the overall assessment of text authority.

As Coughlin, we take the position that the Islamic law (Sharia) is a real body of law in the same sense as U.S. Constitutional, English common or European civil law, and hence it will be analyzed accordingly. "Individuals and sources broadly recognized as authorities or as authoritative sources inside the Islamic legal world will be presumed to be correct on the issues of law authoritatively attributed to them." [1, p. 45]

The Sunni Sharia doctrine is documented in classical texts in Arabic which are recognized as authoritative sources by the four orthodox Sunni Sharia schools of law: Hanafi, Hanbali, Maliki, and Shafi'i. However, because most of the intended users of TIACRIRIS are English speakers who do not understand Arabic, we need to identify criteria for authoritative texts on Sharia in English. This should not be an insurmountable problem because most Muslims that follow Sharia do not speak Arabic and thus need to rely on non-Arabic works that convey authority.

Fig. 2 illustrates the identified criteria and subcriteria as they are applied to the evaluation of the authority of Ibn Naqib 1994, the 1994 edition of the English language translation of Ahmad ibn Naqib al-Misri's 'Umdat al-Salik (*Reliance of the Traveller: A Classic Manual of Islamic Sacred Law*). The book is "in Arabic with facing English text, commentary, and appendices edited and translated by Nu Ha Mim Keller" [5, book cover].

As shown in Fig.2, there are four top-level criteria: (1) The content that is translated should be authoritative in one of the four Sunni schools; (2) The text should be an accurate translation into English; (3) The text should be reflective of the current views on Islam of a segment of the Muslim population; and (4) The text should be certified by recognized authority in the corresponding Sunni school.

Each of the first three criteria is further reduced to several elementary criteria, while the fourth criterion is an elementary one. Then each of the elementary criteria is assessed based on evidence. Let us consider the elementary criterion that the text should be certified by recognized authority. As shown at the bottom part of Fig.2, there are four items of favoring evidence and no disfavoring evidence. They correspond to the certifications received from national authorities in Egypt, Saudi Arabia, Jordan, and Syria. Particularly convincing is the endorsement of Cairo's al-Azhar University (the most prestigious and authoritative institute of Islamic higher learning), in Arabic and English, with signature and stamps: "... concerning the examination of the English translation of the book 'Umadat al-salik wa 'uddat al-nasik by Ahmad ibn Naqib in the shafi'i school of jurisprudence, together with appendices by Islamic scholars on matters of Islamic law, tenets of faith, and personal ethics and character: we certify that the above-mentioned translation corresponds to the Arabic original and conforms to the practice and faith of the orthodox Sunni Community" [5, p. xx-xxi]. As a result of this and the other three certifications, it is assessed as being certain that Ibn Naqib 1994 is certified by recognized authority.

After all the other elementary criteria are assessed based on evidence, their assessments are combined, indicating that Ibn Naqib 1994 is almost certain to be an authoritative text in the Shafi'i law.
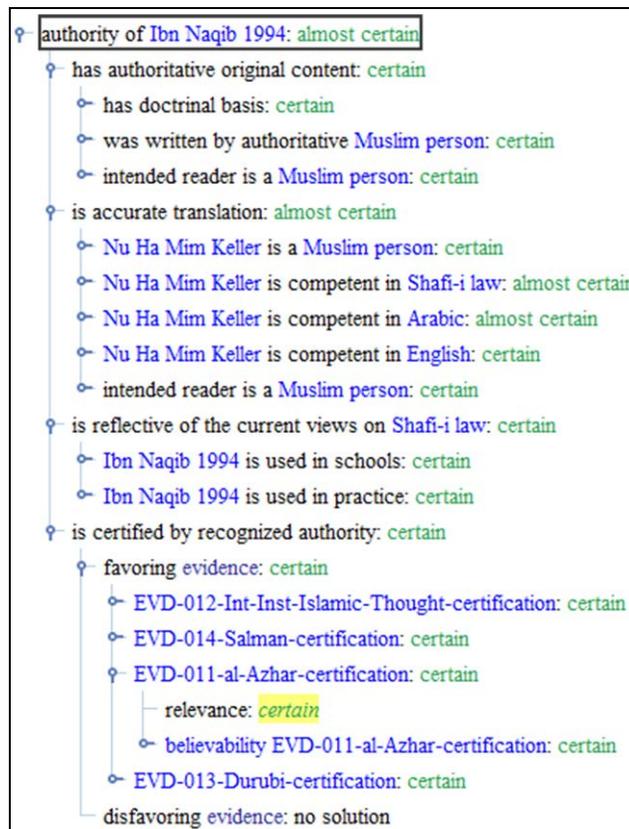

Figure 2. Evidence-based assessment of a Sunni Sharia text.

IV. ANALYZING DEFINITIONS AND RULES OF BEHAVIOR

Violent Sunni extremists advocate strict adherence to Sharia and "openly declare that they fight *Jihad* in furtherance of Islamic causes" [1, p. 15]. Thus, the first problem is to identify the definitions and rules that have doctrinal basis in Sunni Sharia. Additionally, however, one also needs to show that these definitions or rules are affirmed by contemporary religious authorities, and are actually confirmed by the behavior of violent Sunni extremists. To show that there is doctrinal basis for a statement (definition or rule) one may show that there is ijma-scholarly consensus on that statement among all the four doctrinal schools of Sunni Sharia: Hanafi, Hanbali, Maliki, and Shafi'i. Alternatively, one may show that there is doctrinal basis for that statement in any one of these doctrinal schools. This, in turn, requires showing that there is either Koranic basis, or Sahih hadith basis, or classical writing basis in any one of these schools.

Fig. 3 shows an abstract argumentation structure for assessing a specific statement, such as "For violent Sunni extremists, jihad means to wage war against non-Muslims to establish religion." Other analyzed hypothesized statements are:

For violent Sunni extremists,

– jihad is required until the entire world is brought under Islam.
– fighting jihad is required when non-Muslim forces enter Muslim lands.
– lying is permissible for circumventing those forbidding what is the permissible in Sunni Sharia.
– lying is obligatory when necessary to achieve an obligatory Sunni Sharia goal.
– taqiyya-deception is permitted against non-Muslims in furtherance of Islamic objectives or the protection of Islam.
– ghiba-slander means to mention anything concerning a person that he would dislike.
– ghiba-slander is unlawful.
– namima-talebearing consists of quoting someone's words to another in a way that worsens relations between them.
– namima-talebearing in unlawful.

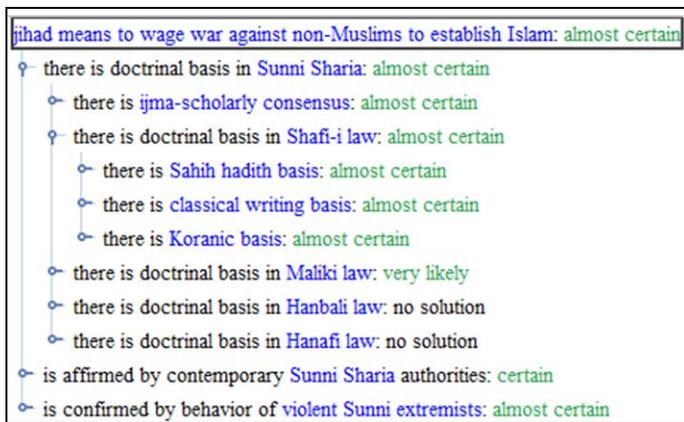The user may hypothesize any statement like the above

Figure 3. Assessing whether, for violent Sunni extremists, jihad means to wage war against non-Muslims to establish religion.

ones, and TIACRITIS will guide her in assessing it based on evidence and the argumentation structure from Fig. 3. Examples of statements to hypothesize are:

For violent Sunni extremists,

– killing of non-Muslims in furtherance of Islam is permissible.
– own death in furtherance of killing non-Muslim forces in Muslim land is allowed.
– shahid-martyrdom means to be killed in jihad.
– martyr is the only person guaranteed paradise in the Koran.
– offensive jihad is required when Muslim forces can defeat non-Muslim forces.
– refraining from engaging in violence is required when non-Muslim forces are too powerful to defeat or when there is a likelihood of non-Muslim forces becoming Muslim.
– truces are understood as the suspension of jihad for a limited period and never just for maintaining the status-quo.
– all land on Earth has been given by Allah to Muslims in perpetuity.
– Muslims are required to regain any territory that was ever claimed for Islam that has since been lost.
– Muslims are required to progressively claim new territory for Islam until the entire world has been claimed.
– peace means submission to Islam.
– world peace comes when the entire world has submitted to Islam.
– abrogation means that the later revealed Koranic verses control or overrule previously revealed verses where there is conflict.
– as law, Sharia represents the end-state of Koranic revelation where conflicting earlier revelations are abrogated or controlled.
– Sharia is the law of the land that governs all aspects of Muslim life individually and collectively and is understood as such.
– freedom means complete servitude to Islam by liberating man from the laws and desires of man.
– justice means justice according to Sharia.
– apostasy denotes the free act of leaving Islam or engaging in acts codified in Sharia as acts that entail leaving Islam.
– voluntarily leaving Islam is apostasy punishable by death.

V. UNDERSTANDING AND PREDICTING BEHAVIOR

TIACRITIS allows its users to:

• Define behavior hypotheses;
• Develop argumentation structures to assess the behavior hypotheses;
• Collect evidence and represent it in the knowledge base of TIACRITIS;
• Associate evidence to elementary hypotheses in the argumentation structure;
• Assess and justify the relevance and the believability of evidence;
• Make assessments and assumptions with respect to certain sub-hypotheses;

- Select the composition functions for determining the inferential force of evidence; and
- Assess the hypothesized behavior.

The hypothesized behavior logic may use the definitions and rules that were assessed as discussed in Section IV. Moreover, TIACRITIS will learn from the analyzed hypotheses to more efficiently support the analysis of new behavior hypotheses.

We will illustrate the above capabilities with an example. Following the Britain's award of knighthood to author Salman Rushdie, Mohammed Ijaz ul-Haq, Pakistani religious affairs minister, formulated the following threat reported in Washington Times (see Fig. 4):

ISLAMABAD, Pakistan (AP) — Pakistan yesterday condemned Britain's award of a knighthood to author Salman Rushdie, and a Cabinet minister said *the honor provided a justification for suicide attacks. "This is an occasion for the world's 1.5 billion Muslims to look at the seriousness of this decision*," Mohammed Ijaz ul-Haq, religious affairs minister, said in parliament. "The West is accusing Muslims of extremism and terrorism. If someone exploded a bomb on his body, he would be right to do so unless the British government apologizes and withdraws the 'sir' title," Mr. ul-Haq said. … "The 'sir' title from Britain for blasphemer Salman Rushdie has hurt the sentiments of the Muslims across the world."

Figure 4. Fragment from a Washington Times article [6].

Soon after this declaration, two British doctors of Pakistani origin loaded their cars with explosives which were later found in populated London locations prior to detonation, and two people, one a Pakistani medical student, attacked the Glasgow airport [7].

The question is: Do the above events illustrate a general pattern of behavior of violent Sunni extremists that could be used to understand and predict their future behavior?

Using TIACRITIS, the user formulates the hypothesis analysis problem in English and selects its instances, as shown in Fig. 5. This allows TIACRITIS to learn the following general hypothesis analysis pattern:

"Assess whether the characterization of ?O1 as ?O2 by ?O3 creates a serious threat of retaliation against ?O4 from ?O5."

Then the user and TIACRITIS reduce the initial problem to simpler and simpler problems, down to the level of elementary hypothesis analysis problems to be assessed based on evidence, as shown in Fig. 6 and discussed in the following.

Notice that each hypothesis analysis problem is followed by a question/answer pair which guides the decomposition of that problem into simpler problems. Thus the top level problem is decomposed into two subproblems. The first one is further decomposed into three simpler problems, while the second one is an elementary hypothesis to be assessed based on evidence.

The reasoning step from the middle-bottom part of Fig.6 is:

Assess whether the offense to Muslim world is a serious crime in Sunni Sharia requiring mandatory punishment.

Q: What Sunni Sharia rule is violated by the offense to Muslim world?

A: ghiba-slander is unlawful, where ghiba-slander means to mention anything concerning a person that he would dislike, and where penalty for ghiba-slander of the Prophet or Islam can be death.

Therefore, one may conclude:

It is certain that the offense to Muslim world is a serious crime in Sunni Sharia requiring mandatory punishment.

Notice that the answer of the above question is based on Sunni Sharia definitions and rules of behavior which have been proven by evidence, as discussed in Section IV.

Some of the reasoning steps in Fig. 6 may be suggested by TIACRITIS, if it has encountered similar steps in past analyses. Additionally, at the request of the user (see the "**Reformulate Statement…**" command from the menu at the right of Fig. 6), TIACRITIS may suggest reformulations of a hypothesis analysis problem in order to reuse a previously learned reasoning pattern. For example, by using its natural language processing capabilities, TIACRITIS suggested to reformulate

"Assess whether Britain will be punished by violent Sunni extremists for its Sunni Sharia crime." into

"Assess whether violent Sunni extremists will punish Britain for a crime requiring mandatory punishment in Sunni Sharia."

Because the user accepted this reformulation as a good statement of the problem to solve, TIACRITIS automatically decomposed it, as shown in Fig. 7. Then, after the user assessed as almost certain the likelihood of the right-hand side problem "Assess whether violent Sunni extremists have capability to punish Britain for a crime requiring mandatory punishment in Sunni Sharia", TIACRITIS automatically assessed the likelihoods of the other reasoning nodes in the tree from Fig. 7.

The argumentation structure shown in Fig. 6 and in Fig. 7 successively decompose the top-level hypothesis analysis problem from the top of Fig. 6, down to the level of elementary hypotheses or solutions. Next the user may directly assess an elementary hypothesis (as illustrated with the problem from the right-hand side of Fig. 7), or she may do this based on relevant evidence, as discussed below.

The user may associate any number of search criteria with elementary hypotheses which are then used by TIACRITIS to search for evidence in various repositories. This is illustrated in Fig. 8. The top part shows an elementary hypothesis for which there is no evidence in TIACRITIS. The bottom part shows a search criteria defined by the user, to guide TIACRITIS in

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Assess whether the characterization of the award of knighthood to Salman Rushdie by Britain as offense to Muslim world by Mohammed Ijaz ul-Haq creates a serious threat of retaliation against Britain from violent Sunni extremists.

Figure 5. Formulation of a hypothesis analysis problem.
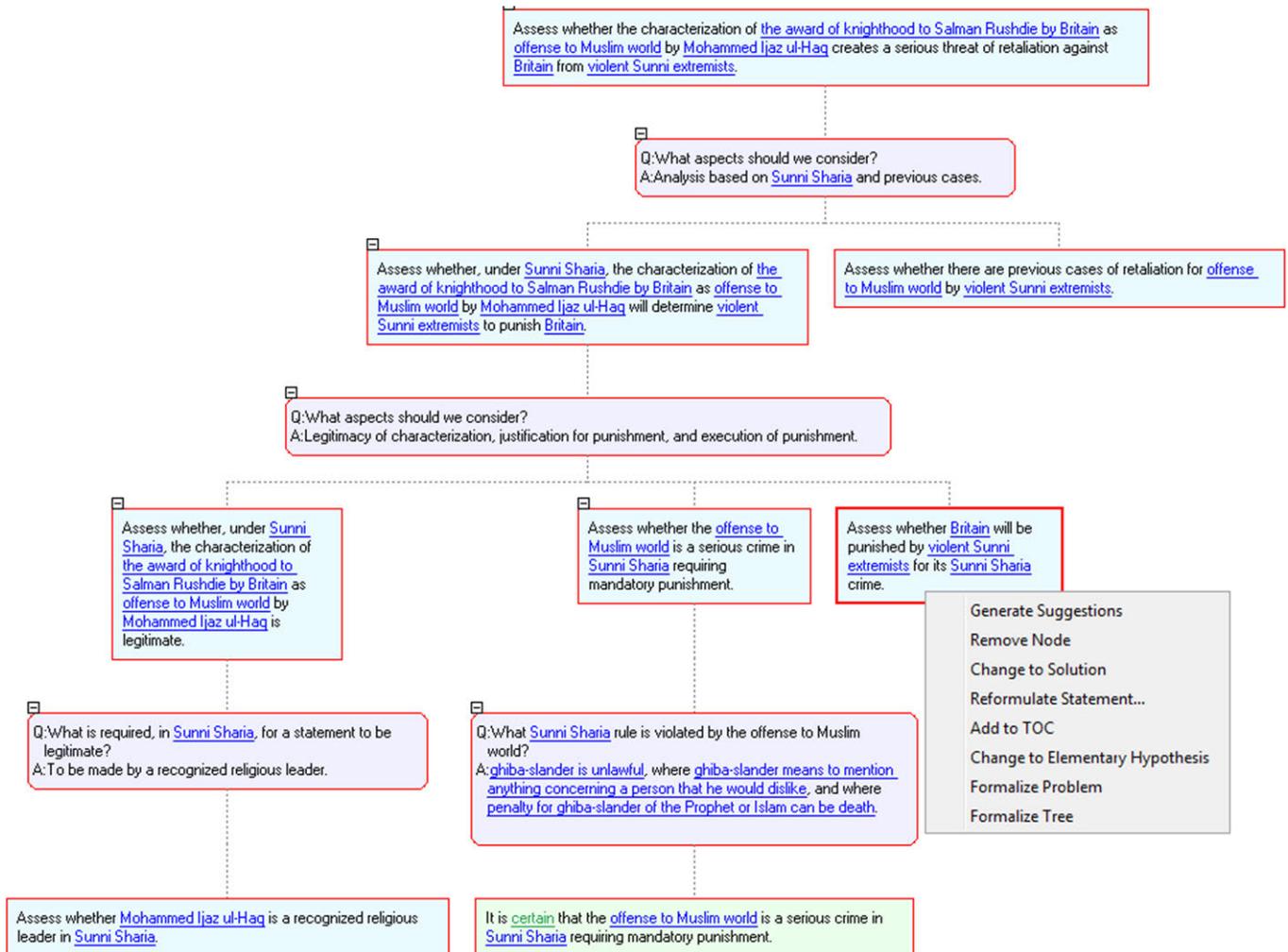
Figure 6. Reduction of a hypothesis analysis problem.

searching for relevant evidence on the Internet with BING, GOOGLE, or YAHOO (or with other search engines and in other repositories).

The user may easily define new items of evidence, and may associate them with the hypotheses they favor or disfavor, as illustrated in Fig. 9. The top part of Fig. 9 is the description of the evidence item EVD-001-ul-Haq, a Washington Times article fragment with a citation from the Associated Press indicating that Mohammed Ijaz ul-Haq is the religious affairs minister of Pakistan. The user has selected the type of EVD-001-ul-Haq as unequivocal testimonial evidence obtained at second hand because the source, Washington Times, received the information from another source (Associated Press). Then the user indicated that this item of evidence favors the hypothesis "Mohammed Ijaz ul-Haq is a recognized religious leader in Sunni Sharia," as shown in the bottom part of Fig. 9.

As a result, TIACRITIS automatically generated the corresponding evidence-based analysis, as shown in Fig. 10. Notice that it considered both favoring and disfavoring evidence, and included EVD-001-ul-Haq as favoring evidence for which one needs to assess the relevance and the believability. Because EVD-001-ul-Haq is unequivocal testimonial evidence obtained at second hand, its believability

depends both on the believability of the primary source and on the believability of the secondary source. The believability of each source depends on that source's competence and credibility. Competence depends on access and understandability, while credibility depends on veracity, objectivity, and observational sensitivity.

The user has assessed the relevance of EVD-001-ul-Haq as certain, and its believability as almost certain. Then TIACRITIS has combined these assessments into an inferential force of almost certain, and has computed the likelihood of the corresponding elementary hypothesis.

Notice that although TIACRITIS has provided a detailed believability analysis, the user may drill down into this analysis at the desired level and, in this case, decided to assess directly the believability of EVD-001-ul-Haq, rather than assessing lower level believability credentials, such as veracity.

After all the elementary hypotheses have been assessed, either based on evidence or by making assumptions, the user has to select the solution composition functions (e.g., min, max, average, weighted sum) to be used by TIACRITIS to determine the likelihoods of all the intermediary hypotheses and of the top level hypothesis, as shown in Fig. 11, and discussed in Section II.
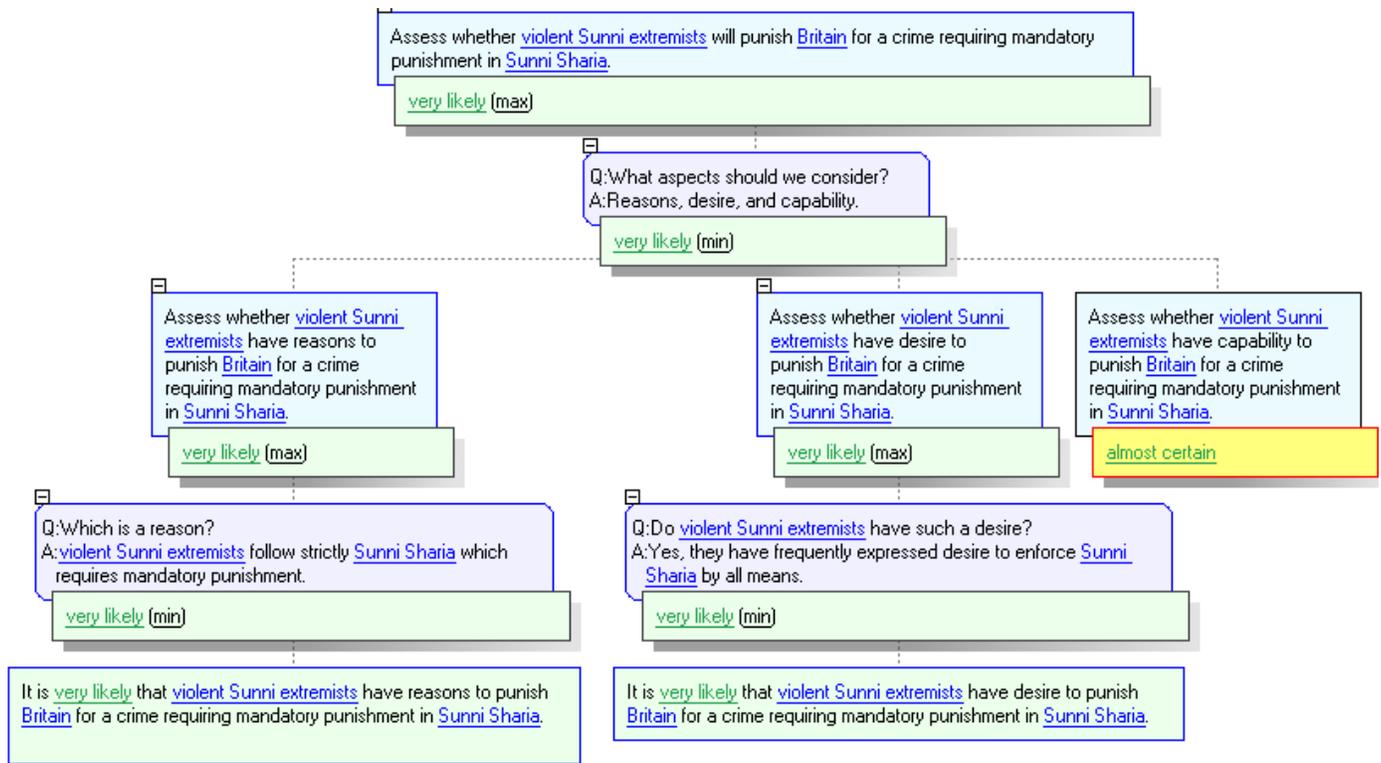
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Figure 7. Hypothesis assessment.

TIACRITIS not only supports its user in analyzing such hypotheses, but it also continuously learns from this joint problem solving process, to facilitate the analyses of new hypothesis. Consider, for examples, the following hypothesis analyses problems:

"Assess whether the characterization of the call by Pope Benedict XVI for the repeal of the Pakistan blasphemy law as offense to Muslim world by Liaqat Baloch creates a serious threat of retaliation against Vatican from violent Sunni extremists."

and

"Assess whether the characterization of the burning of the Koran by Florida pastor as offense to Muslim world by Afghani imam creates a serious threat of retaliation against NATO and UN forces in Afghanistan from violent Sunni extremists."

For each of them, TIACRITIS will suggest argumentation structures similar to those shown in Fig. 6 and Fig. 7 which the

Figure 8. Evidence collection.

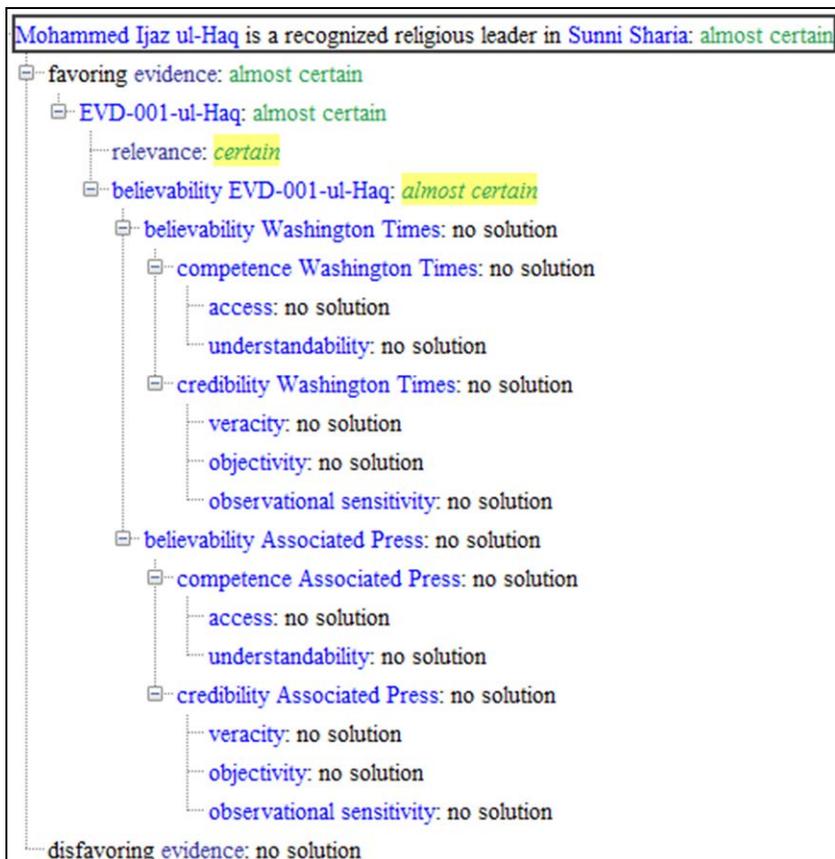Figure 9. Evidence representation and use.

Figure 10. Evidence-based assessment of elementary hypotheses.

user can change, if desired.

VI. FINAL REMARKS

We have presented an evidence-based methodology and a web-based system for modeling the behavior of violent Sunni extremists. The system contains numerous case studies for teaching military, intelligence, law enforcement, and government personnel, on a topic which is very important in the war on terror and homeland defense. Its use is supported by a textbook which provides more details on the methodology and more explanations of the case studies [3].
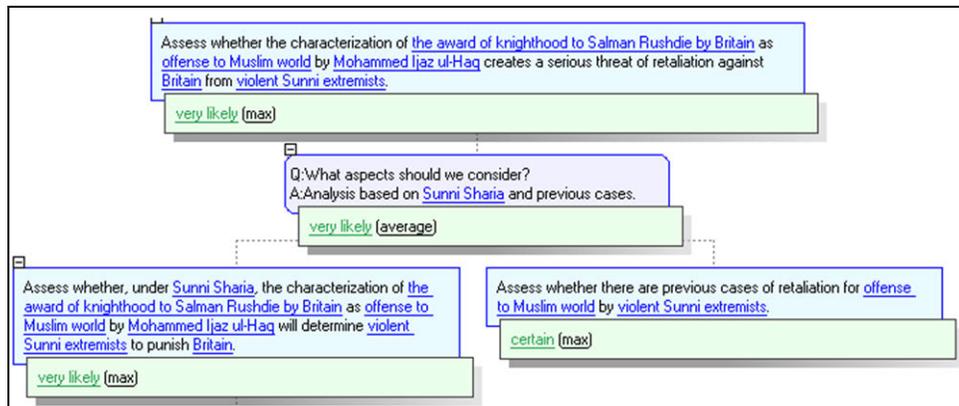
The system can be extended with additional rules of behavior and, as illustrated in the previous sections, supports its users during the entire process of hypothesis formulation, evidence collection, and hypothesis testing, based on the Computational Theory of Intelligence Analysis developed in the Learning Agents Center [2-4]. TIACRITIS has a client-server architecture and is available to government organizations who can run the TIACRITIS client in a web browser. Several such organizations already have TIACRITIS accounts, including the Defense Intelligence Agency, the National Counterterrorism Center, the Army War College, and the Joint Forces Staff College.

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Figure 11. Top part of the hypothesis analysis tree showing the solution composition functions.