Hostage Survival Probability

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The Hostage Survival Probability Model study was sponsored by JusticeAcademy, NTOA, and the California Association of Tactical Officers, and was conducted over a one period in order to capture the experiences of law enforcement agencies from across the country.

The study endeavored to identify and analyze discriminant factors that possess a degree of influence over the outcome of such situations.

Based on the information provided by approximately seventy SWAT teams from throughout the nation regarding past incidents, the research team used DFA to assemble these contributive factors into primary, secondary, and tertiary levels of influence in order to create a survivability equation that can be applied to future hostage situations.

The survivability equation created was determined to be exceptionally reliable ($p<.00001$) and MAY serve as a valuable tool to aide in making judgments about potential risk.

It is not a replacement for intuition, experience, or decisive action, but it MAY lessen the likelihood of harm to the hostage, based on statistical probability that is predicated on the analysis of the cases that were made available by the national audience of tactical teams.

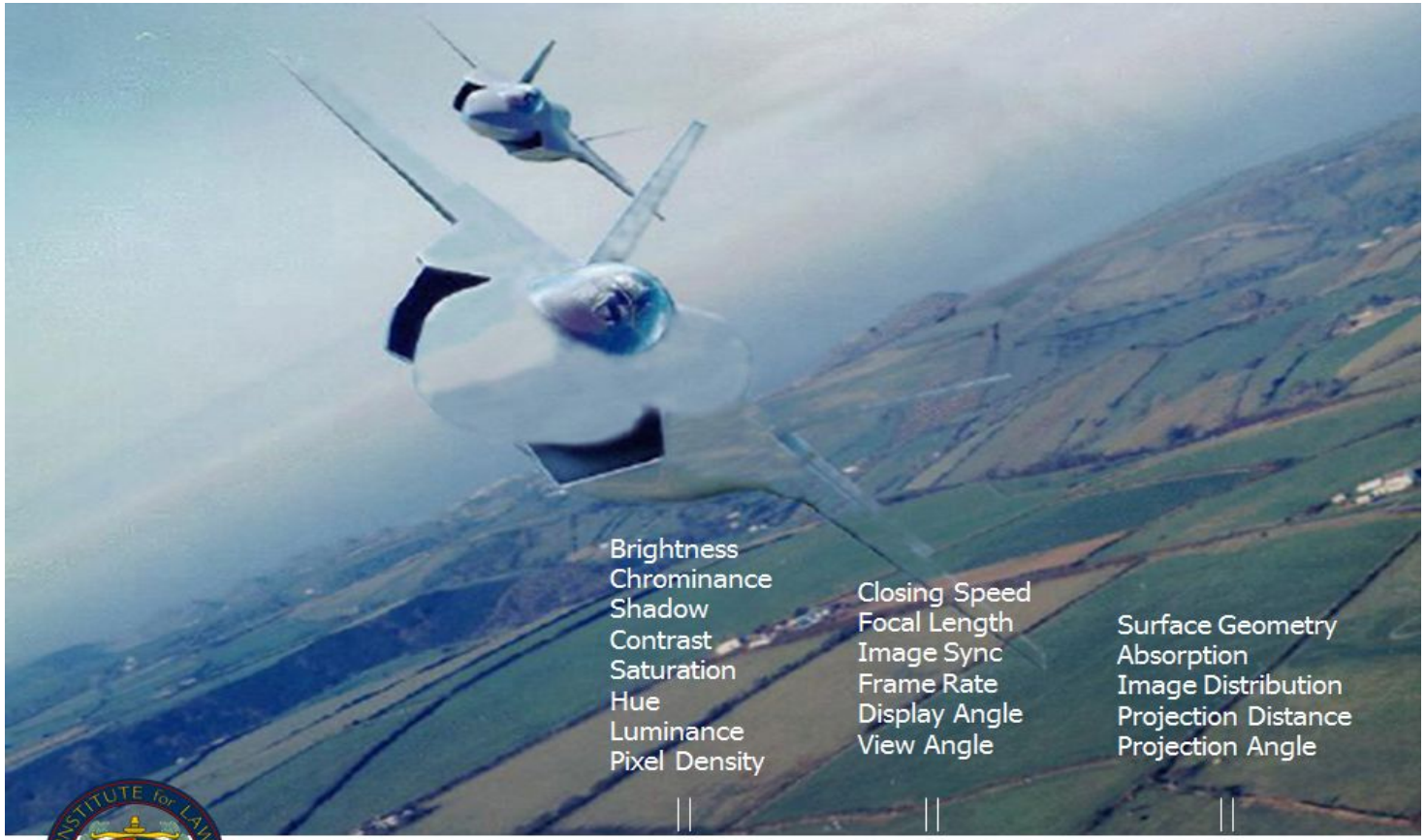
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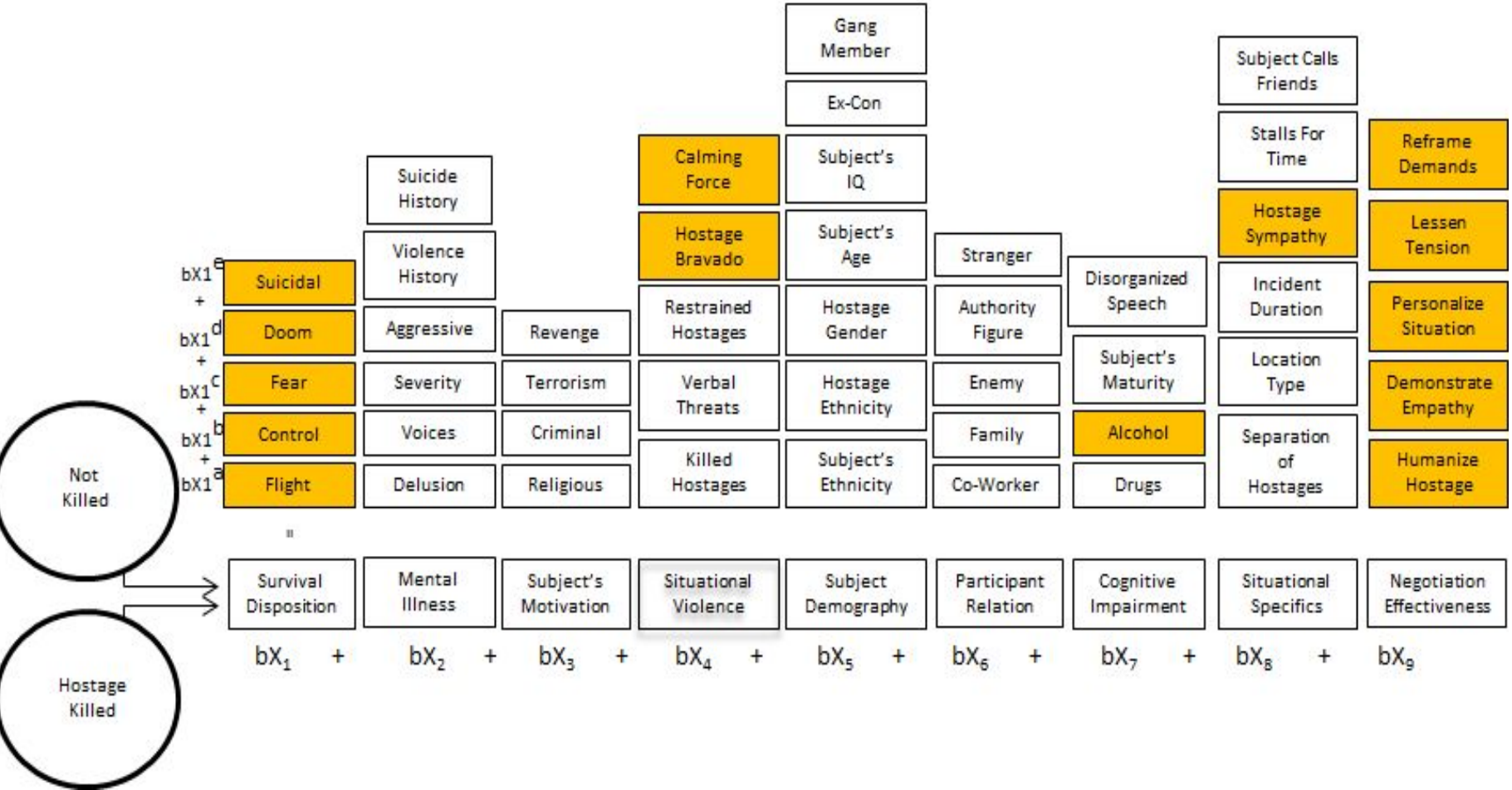
Image Distribution
Projection Distance
Projection Angle

$$Y' = X1 + X2 + X3$$

Hypothesized Two-Dimensional Variable Array for Discriminant Function Analysis



Regarding the interpretation of the discriminant functions associated with this study, an Eigenvalue of 11.93 was generated for the two sample groups. This relatively large Eigenvalue indicates that there exists a wide centroidal separation (geometrically) between the Hostage Killed and the Hostage Not Killed sample groups.

This finding leads to the next computation which measures the degree of association between the predictor variables and the two sample groups. This statistic is identified as the canonical correlation coefficient and in this case was calculated at .96. This finding indicates that a very strong positive correlation exists between the predictor variables (collectively) and their ability to predict group membership.

The next statistic important to the study was the Lambda. The Wilk's Lambda is used to determine the collective degree of residual discrimination possessed by the predictor variables in determining group placement beyond the sample elements and is portrayed in inverse fashion. The Lambda statistic obtained in this study was computed at .0773.

The level of significance for the Wilk's Lambda statistic achieved in this case can be determined by converting the Lambda coefficient into an approximation of a Chi-Square. The resulting Chi-Square achieved in this case was 106.23, df=45, which consequently provides statistical significance beyond the .00001 level.

Standardized Discriminant Function Scores by Predictive Power Ranking

Killed Hostage	-1.6918	Incident Duration	.3840	Subject Hears Voices	.1807
Delusional	-1.1841	Subject Calls Friend	- .3813	Lessen Tension	- .1796
Authority Figure	- .9959	Hostage Provokes	- .3541	Subject IQ	.1613
Absence of Empathy	.9663	Subject Senses Doom	- .3468	Crime Incident	- .1531
Subject Suicidal	.8112	Hostage is Enemy	.3326	Hostage Gender	.1234
Verbal Threats	.7179	Restrained Hostage	.3213	Subject's Ethnicity	- .0989
Suicide History	.6137	Hostage is Co-Worker	.3137	Subject Ex-Con	- .0783
Dehumanize Hostage	-.5539	Calming Force	- .3136	Subject's Gender	.0775
Hostage is Stranger	.5379	Hostage Bravado	.3006	Terrorism	- .0649
Location Type	.5289	Disorganized Speech	.2825	Subject on Drugs	.0431
Subject on Alcohol	- .5039	Religious Motivation	.2785	Subject Fearless	.0416
Flight Desire	.4490	Hostage is Family	- .2419	Personalize Situation	.0278
Mental Impairment	- .4092	Stalls for Time	.2355	Subject's Maturity	.0109
Subject's Age	- .4007	Violence History	.2011	Separated Hostages	- .0076
Situational Control	- .3854	Revenge	.1891	Subject Gang Member	.0028

Unstandardized Discriminant Function Scores

Flight Desire	.9094	Killed Hostage	-11.0514	Authority Figure	-3.4146
Situational Control	-.7237	Verbal Threats	1.2792	Hostage is Stranger	1.0765
Subject Fearless	.0703	Restrained Hostage	.6403	Subject on Drugs	.0514
Subject Senses Doom	-.4642	Hostage Bravado	.4983	Subject on Alcohol	-.5934
Subject Suicidal	1.119	Calming Force	-.4069	Subject's Maturity	.0197
Delusional	-1.678	Subject's Ethnicity	-.1956	Disorganized Speech	.4400
Subject Hears Voices	.2191	Subject's Gender	.6259	Separated Hostages	-.0150
Mental Impairment	-.4881	Hostage Gender	.1447	Location Type	.8934
Hostage Provokes	-.8838	Subject's Age	-.0348	Incident Duration	.0238
Violence History	-.3635	Subject's IQ	.2665	Stalls for Time	.3588
Suicide History	.6364	Subject Ex-Con	-.1089	Subject Calls Friend	-.5309
Religious Motivation	.3310	Subject Gang Member	.0036	Dehumanize Hostage	-.7554
Crime Incident	-.3265	Hostage Co-Worker	1.1404	Absence of Empathy	1.1554
Terrorism	-.3737	Hostage is Family	-.4839	Personalize Situation	.0329
Revenge	.2770	Hostage is Enemy	.7889	Lessen Tension	-.2525

Concerning the objective of using the results of the HSPM study to create a predictive equation that can be used to assess the statistical probability of hostage survival, the regression equation for the forty-five variables contained within the study is as follows:

$$Y' = 11.34 + .9094x_1 - .7237x_2 + .0703x_3 - .4642x_4 + 1.119x_5 - 1.678x_6 + .2191x_7 - .4881x_8$$
$$- .8838x_9 - .3635x_{10} + .6364x_{11} + .3310x_{12} - .3265x_{13} - .3737x_{14} + .2770x_{15}$$
$$- 11.0514x_{16} + 1.2792x_{17} + .6403x_{18} + .4983x_{19} - .4069x_{20} - .1956x_{21} + .6259x_{22}$$
$$+ .1447x_{23} - .0348x_{24} + .2665x_{25} - .1089x_{26} + .0036x_{27} + 1.1404x_{28} - .4839x_{29}$$
$$+ .7889x_{30} - 3.4146x_{31} + 1.0765x_{32} + .0514x_{33} - .5934x_{34} + .0197x_{35} + .4400x_{36}$$
$$- .0150x_{37} + .8934x_{38} + .0238x_{39} + .3588x_{40} - .5309x_{41} - .7554x_{42} + 1.1554x_{43}$$
$$+ .0329x_{44} - .2525x_{45}$$

Z **Situational Outcome** (1 – Hostage Survived, 2 – Hostage Died) **Revision Date Jan 25,2014**

bX1 **Survival Disposition of the Subject (1-Low, 2 - High)**

bX1a	Flight – No expressed desire to escape (1 – False, 2 – True)
bX1b	Control – Subject appears to enjoy the situational control (1 – False, 2 - True)
bX1c	Fear – Subject appears fearless (1 – Fearful, 2 – Fearless)
bX1d	Doom – Expression of impending doom (1 – False, 2 – True)
bx1e	Suicidal – Subject has expressed a suicidal tendency (1 – False, 2 - True)

bX2 **Mental Illness (1 – Not Impaired, 2 – Impaired)**

bX2a	Delusion – Subject displays a level of delusion that impacts reasoning (1 – No, 2 – Yes)
bX2b	Voices – Subject hears voices guiding their actions (1 – No, 2 – Yes)
bX2c	Severity – On scene judgment re: mental impairment (1 – Not Severe, 2 – Severe)
bX2d	Aggressive – Hostile and aggressive behavior toward hostage or police (1 – No, 2 – Yes)
bX2e	Violence History – Does the subject have a history of violent tendencies (1 – No, 2 – Yes)
bX2f	Suicidal History – Has the subject tried to commit suicide previously(1 – No, 2 – Yes)

bX3 **Subject's Violence Motivation (1 – Low, 2 – High)**

bX3a	Religious – Is the subject motivated by religious beliefs (1 – No, 2 – Yes)
bX3b	Criminal – Was the situation that perpetuated the incident a criminal act (1 – No, 2 – Yes)
bX3c	Terrorism – Is the subject a terrorist (1 – No, 2 – Yes)
bX3d	Revenge – Is the incident predicated on revenge (1 – No, 2 – Yes)

bX4 **Situation Violence (1 – Low, 2 – High)**

bX4a	Killed Hostage – Has the subject killed a hostage already (1 – No, 2 – Yes)
bX4b	Verbal Threats – Has the subject made verbal threats to kill the hostage (1 – No, 2 – Yes)
bX4c	Restrained Hostage – Have the hostages been neutralized by restraint devices (1 – No, 2 – Yes)
bx4d	Hostage Bravado – Hostage demonstrating a threat to the subject (1 – No, 2 – Yes)
bX4e	Calming Force – A calming force is involved in the situation (1 – True, 2 – False)

bX5 **Situational Demography (1 – Not Influential, 2 – Influential)**

bX5a	Subject's Ethnicity (1 – Caucasian, 2 – Minority)
bX5b	Subject's Gender (1 – Female, 2 – Male)
bX5c	Hostage Gender (1 – Female, 2 – Male)
bX5d	Subject's Age (Age in Years)
bX5e	Subject's Intellect Level (1 – Normal, 2 – Diminished)
bX5f	Ex-Con – Does the subject have a criminal history with time spent in prison (1 – No, 2 – Yes)
bX5g	Gang Member – Is the subject a member of a street or prison gang (1 – No, 2 – Yes)

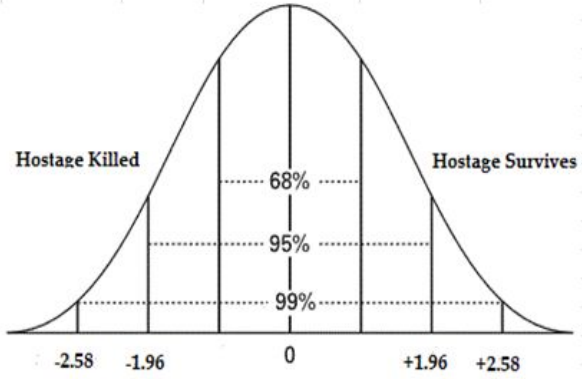
bX6 **Participant Relation (1 - Not Influential, 2 – Influential)**

bX6a	Co-Worker (1 – No, 2 – Yes)

Hostage Survival Probability Model - Predictive Equation

riable finition	Discriminant Variable	b Value	Insert X Factor	Iterative Score
nstant - DO NOT CHANGE	a	*11.34*	1	11.34
rvival Disposition of the Subject				
ght Desire	x1	*0.9094*	2	1.8188
uational Control	x2	*-0.7237*	3	-2.1711
bject Fearless	x3	*0.0703*	1	0.0703
bject Senses Doom	x4	*-0.4642*	2	-0.9284
bject Suicidal	x5	*1.119*	2	2.238
ental Illness				
lusional	x6	*-1.678*	1	-1.678
bject Hears Voices	x7	*0.2191*	1	0.2191
ntal Impairment	x8	*-0.4881*	1	-0.4881
stage Provokes	x9	*-0.8838*	1	-0.8838
lence History	x10	*-0.3635*	1	-0.3635
cide History	x11	*0.6364*	1	0.6364
bject's Violence Motivation				
igious Motivation	x12	*0.331*	1	0.331
me Incident	x13	*-0.3265*	1	-0.3265
rrorism	x14	*-0.3737*	1	-0.3737
venge	x15	*0.277*	1	0.277
uation Violence				
led Hostage	x16	*-11.0514*	1	-11.0514
rbal Threats	x17	*1.2792*	1	1.2792
strained Hostage	x18	*0.6403*	1	0.6403
stage Bravado	x19	*0.4983*	1	0.4983
ming Force	x20	*-0.4069*	2	-0.8138
uational Demography				
bject's Ethnicity	x21	*-0.1956*	2	-0.3912
bject's Gender	x22	*0.6259*	2	1.2518
stage Gender	x23	*0.1447*	3	0.4341

Change the X factor values to match the current hostage situation. Use the HSPM Quantification Strategy document to guide your coding of each variable. The number three (3) should be used if you are uncertain of the status of a current variable.



Survival Score

3.3745

Compare the value of the Survival Score to the range of Z ratio values along the bottom of the graph. If the Survival Score is between -1.96 and -2.58, then there is a 95% chance of the hostage being killed, given the value of the variables in the current situation. Changing the values in Column D may improve the survival probability of the situation and enhance the tactical perrogatives available to the SWAT Team . Conversely, if the Survival Score is +1.96 to +2.58, then the probability of hostage surviving is greater than 95%. Survival scores less than 1.96, on either side of the mean, may still be interpreted as being indicative of the probability of the outcome, but to a lesser degree than the 95% probability level. A Survival Score of - 1.25 for example would still indicate a probability of death to the hostage, but not at the 95% level of certainty. Values for each X factor may be changed on the spreadsheet to see how it may effect the Survival Score for the situation before such actions are actually initiated at the scene. In some cases, a combination of actions may be the most effective strategy to enhance the probability of changing the Survival Score to a positive value.

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Tactical Incident Team Advisory Network—TITAN

Special Operations Support for the Nationwide Law Enforcement Community

Email TITAN@JusticeAcademy.org for more information.

How TITAN Can Serve Your Department

JusticeAademy.org and our agency sponsors are pleased to announce the creation of the Tactical Incident Team Advisory Network. The purpose of the TITAN program is to establish a real-time video network of experienced tactical operation professionals who can provide advice and support to police departments and other agencies that find themselves in unfamiliar tactical situations such as;

Hostage negotiations,
Barricaded suspect incidents,
Terrorist incidents,
Explosive ordinance threats,
Other high risk scenarios

The program uses high speed tactical multipoint video conferencing to link any agency in the nation that is encountering such challenges with a team of highly experienced tactical officers, combat medicine experts, hostage negotiators, and command level personnel who can see the situation in real time and provide advice and guidance during such scenarios.

The TITAN network utilizes software made available by ooVoo.com, which provides every agency in the nation with a free multi-point video communications network capability that can support up to twelve participants simultaneously using iPhones, Androids, iPads/Tablets, or Mac and Windows based laptop computers. The system can be used to communicate instantly with multiple TITAN Team members across the country and elicit their advice on how best to resolve and respond to high impact events.

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