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STO TECHNICAL REPORT

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ANNEX D

SAS-114 Experiment Update: Effect of Source Reliability, Information Credibility, and Classification Level on Analysts' Uncertainty about Information Accuracy

David R. Mandel, Mandeep K. Dhami, Greg Weaver, and Mark Timms

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Canada

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Background

- Three commonly used markings in intelligence production are (a) source reliability, (b) information credibility, and (c) classification.

- credibility speaks directly to information quality: i.e., probability that information received is accurate; reliability should be positively related, and classification is at best a weak indicator of accuracy.

- Our overarching goal was to examine how intelligence analysts' judgments of information accuracy are influenced by these meta-informational markings.

Scales from AJP 2.1 and other intelligence doctrine

Source Reliability		Information Credibility	
A	Completely reliable	1	Completely credible
B	Usually reliable	2	Probably true
C	Fairly reliable	3	Possibly true
D	Not usually reliable	4	Doubtful
E	Unreliable	5	Improbable
F	Reliability cannot be judged	6	Truth cannot be judged

Pertinent literature

- Baker et al. (1968) found that 87% of spot reports in an Army field exercise used A1, B2, C3, D4, E5, F6. More striking B2 comprised 72% of ratings!
- Samet (1975) studied 37 Army captains familiar with the scales and found using multiple methods that credibility had a stronger effect on assessed information accuracy than reliability.
- Travers et al. (2014) found that non-analysts exhibit a “secrecy heuristic” in which they assign more weight to classified than to unclassified information, so it is of interest to verify whether analysts are similarly biased.

Hypotheses

H1: Judged accuracy will increase with reliability and credibility

H2: Analysts will not be susceptible to the secrecy heuristic, and classification will have little or no effect on accuracy.

H3: The test-retest reliability of analysts will be proportional to the congruence of the reliability and credibility scales.

H4: Likewise, the inter-analyst reliability of accuracy judgments will be proportional to the congruence of the reliability and credibility scales.

Method

Sample

- *N* = 44 UK and US analysts/operators.
- 77% male
- *M* age = 41.8 y (*SD* = 12.7)
- *M* experience in operational community = 16.2 y (*SD* = 13.6)

Method

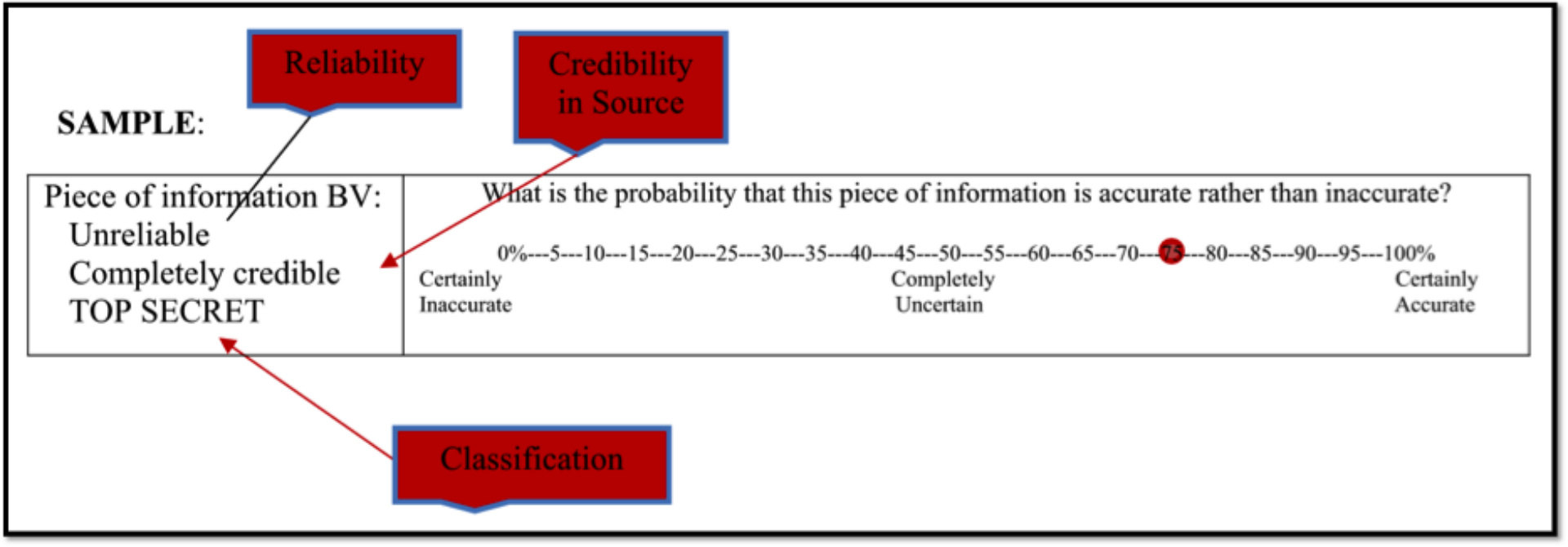
- 96% familiar with official/FOUO and TS distinction
  - 2 participants unfamiliar were omitted from analysis.
- 50.0% familiar with source reliability scale
- 53.0% familiar with information credibility scale

Method

Design and Stimuli

- Independent variables
  - Source reliability (all 6 levels)
  - Information credibility (all 6 levels)
  - Security classification (2 Official/FOUO and Top Secret)
- Full factorial repeated measures design: 6 x 6 x 2 = 72 cases plus 10 resampled cases, all presented in randomized order.
- Resampled cases all at official/FOUO level and varied degree of reliability-credibility scale congruence (low, med, high)

Method


Reliability
Credibility in Source
SAMPLE:
Piece of information BV:
Unreliable
Completely credible
TOP SECRET
What is the probability that this piece of information is accurate rather than inaccurate?
0%---5---10---15---20---25---30---35---40---45---50---55---60---65---70---75---80---85---90---95---100%
Certainly Inaccurate
Completely Uncertain
Certainly Accurate
Classification

Results testing H1 and H2

H1: Judged accuracy will increase with reliability and credibility

H2: Analysts will not be susceptible to the secrecy heuristic, and classification will have little or no effect on accuracy.

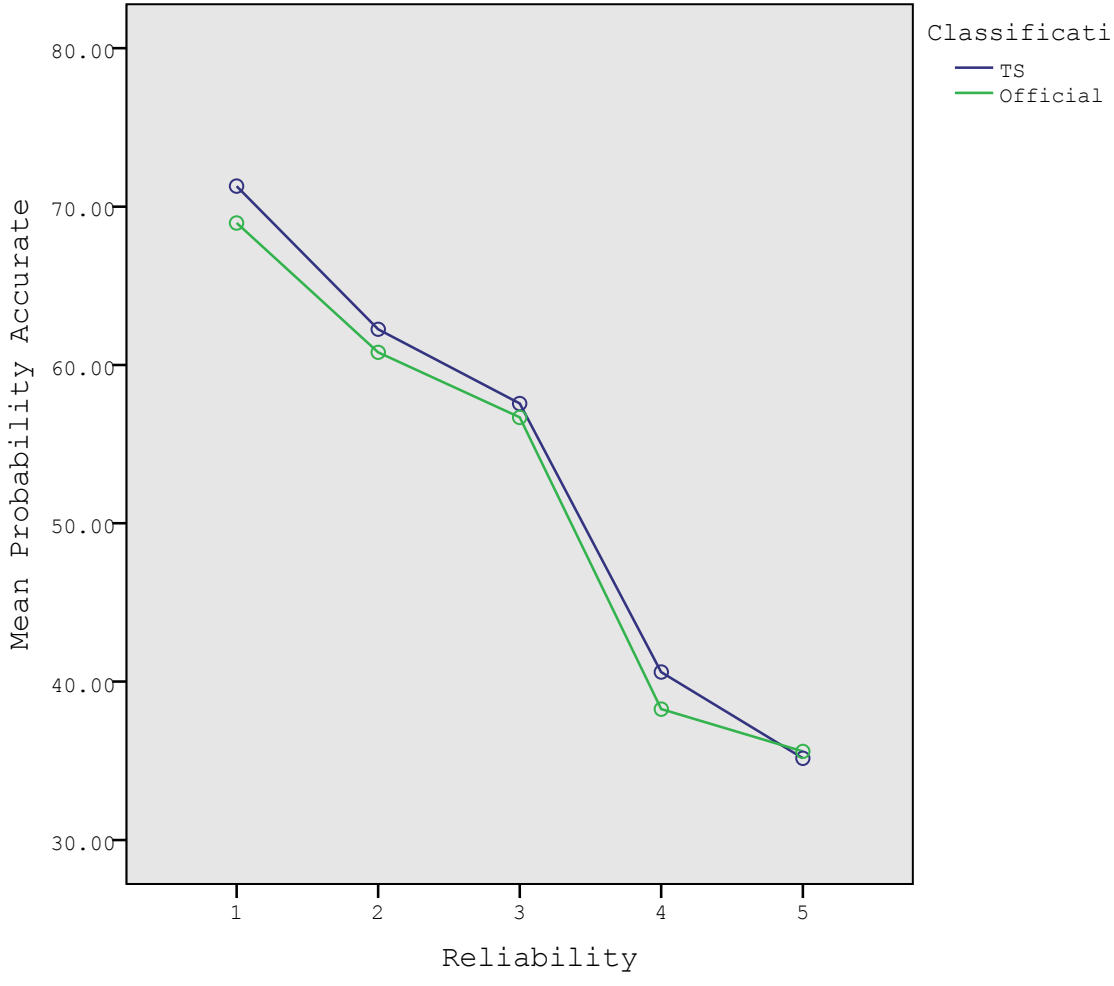
Results

Multivariate Tests

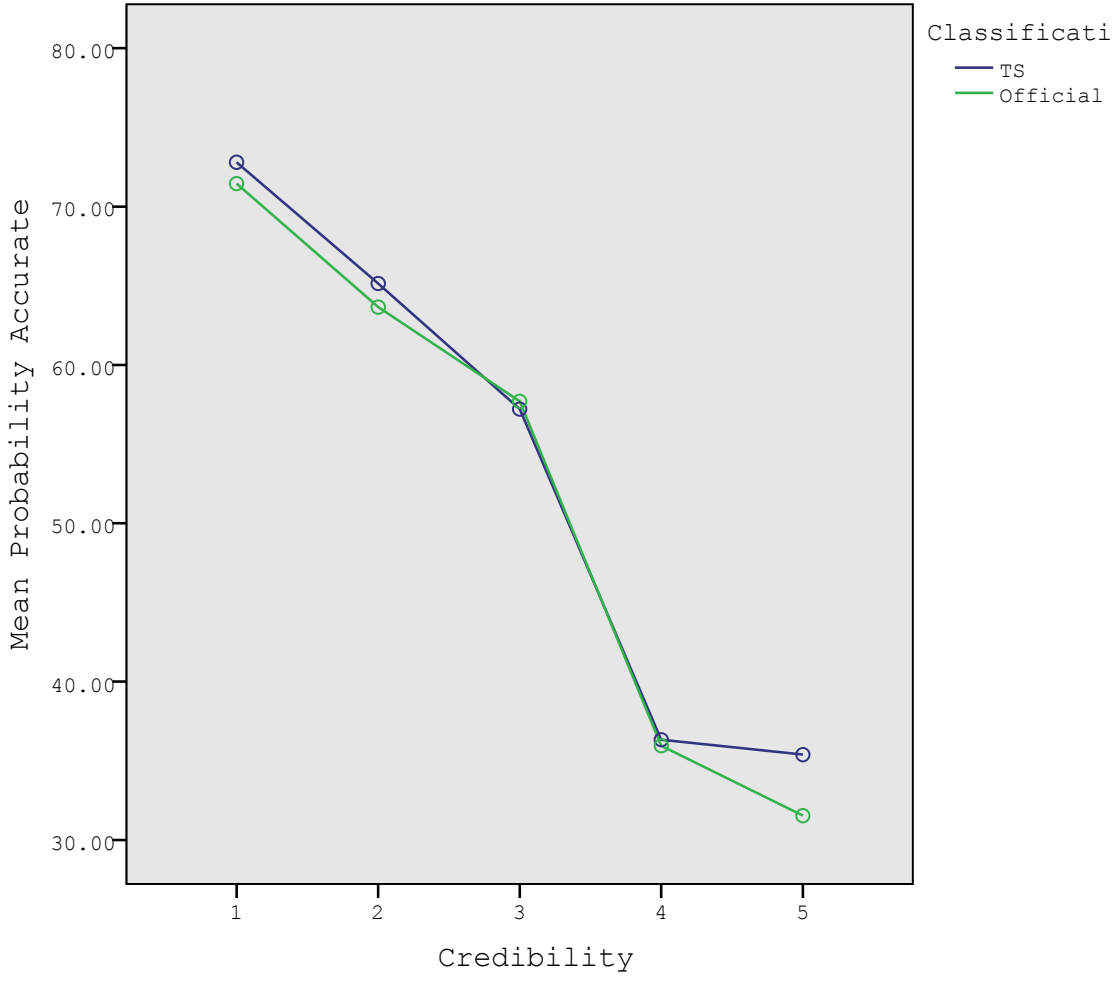
Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Reliability	Pillai's Trace	.873	65.062[b]	4.000	38.000	.000	.873
	Wilks' Lambda	.127	65.062[b]	4.000	38.000	.000	.873
	Hotelling's Trace	6.849	65.062[b]	4.000	38.000	.000	.873
	Roy's Largest Root	6.849	65.062[b]	4.000	38.000	.000	.873
Credibility	Pillai's Trace	.893	79.689[b]	4.000	38.000	.000	.893
	Wilks' Lambda	.107	79.689[b]	4.000	38.000	.000	.893
	Hotelling's Trace	8.388	79.689[b]	4.000	38.000	.000	.893
	Roy's Largest Root	8.388	79.689[b]	4.000	38.000	.000	.893
Classification	Pillai's Trace	.096	4.365[b]	1.000	41.000	.043	.096
	Wilks' Lambda	.904	4.365[b]	1.000	41.000	.043	.096
	Hotelling's Trace	.106	4.365[b]	1.000	41.000	.043	.096
	Roy's Largest Root	.106	4.365[b]	1.000	41.000	.043	.096
Reliability * Credibility	Pillai's Trace	.709	3.962[b]	16.000	26.000	.001	.709
	Wilks' Lambda	.291	3.962[b]	16.000	26.000	.001	.709
	Hotelling's Trace	2.438	3.962[b]	16.000	26.000	.001	.709
	Roy's Largest Root	2.438	3.962[b]	16.000	26.000	.001	.709
Reliability * Classification	Pillai's Trace	.174	2.001[b]	4.000	38.000	.114	.174
	Wilks' Lambda	.826	2.001[b]	4.000	38.000	.114	.174
	Hotelling's Trace	.211	2.001[b]	4.000	38.000	.114	.174
	Roy's Largest Root	.211	2.001[b]	4.000	38.000	.114	.174
Credibility * Classification	Pillai's Trace	.230	2.842[b]	4.000	38.000	.037	.230
	Wilks' Lambda	.770	2.842[b]	4.000	38.000	.037	.230
	Hotelling's Trace	.299	2.842[b]	4.000	38.000	.037	.230
	Roy's Largest Root	.299	2.842[b]	4.000	38.000	.037	.230
Reliability * Credibility * Classification	Pillai's Trace	.507	1.668[b]	16.000	26.000	.119	.507
	Wilks' Lambda	.493	1.668[b]	16.000	26.000	.119	.507
	Hotelling's Trace	1.027	1.668[b]	16.000	26.000	.119	.507
	Roy's Largest Root	1.027	1.668[b]	16.000	26.000	.119	.507

a. Design: Intercept
Within Subjects Design: Reliability + Credibility + Classification + Reliability * Credibility + Reliability * Classification + Credibility * Classification + Reliability * Credibility * Classification

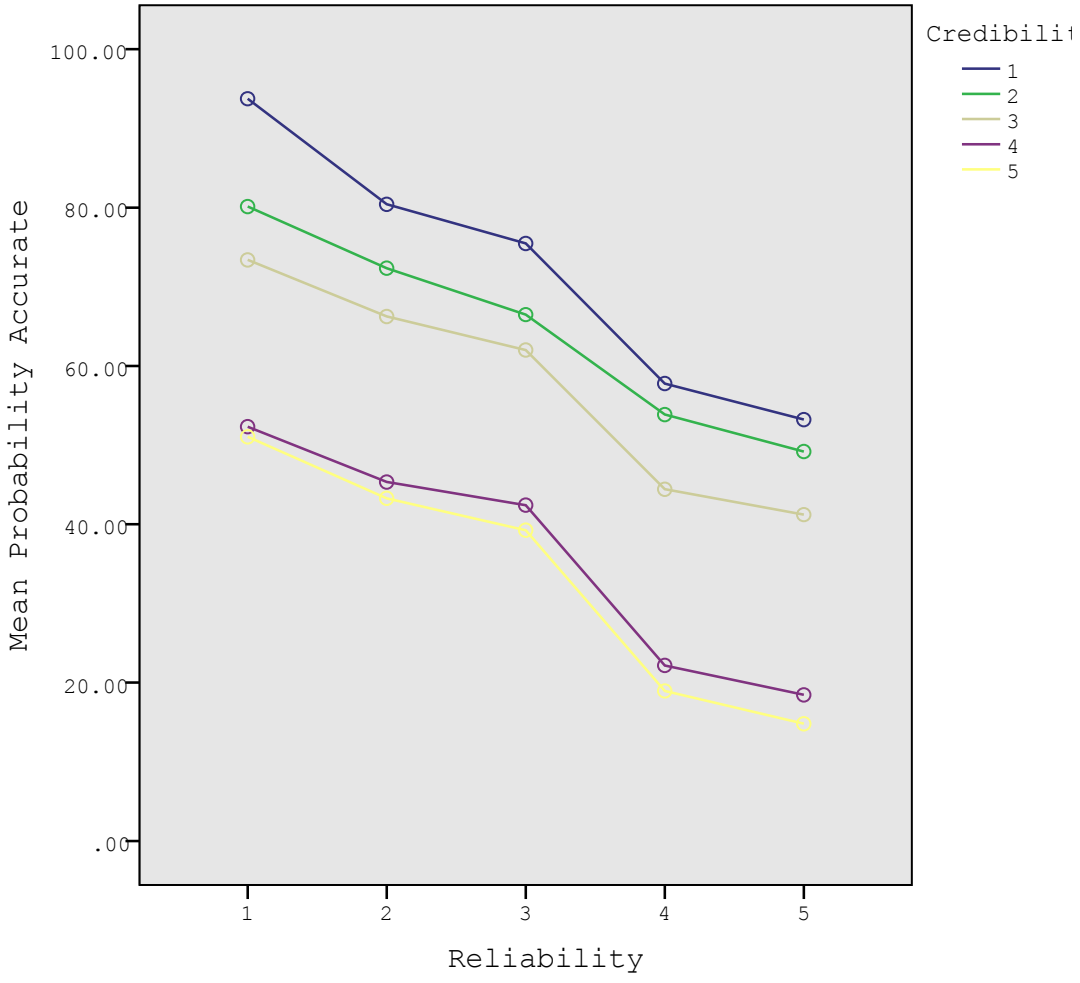
Results


Classificati
TS
Official
Mean Probability Accurate
80.00
70.00
60.00
50.00
40.00
30.00
1
2
3
4
5
Reliability

Results


Classificati
TS
Official
Mean Probability Accurate
80.00
70.00
60.00
50.00
40.00
30.00
1
2
3
4
5
Credibility

Results


Credibili
1
2
3
4
5
100.00
80.00
60.00
40.00
20.00
.00
Mean Probability Accurate
1
2
3
4
5
Reliability

Results

T-Test

[DataSet3] /Users/davidrmandel/Desktop/Dataset3_Allvariables_replaced_8Nov (1).sav

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
EffectClassification	42	1.3130	4.07267	.62843

Cohen's d = .3

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
EffectClassification	2.089	41	.043	1.31298	.0439	2.5821

Results

Bootstrap for Coefficients

Model		B	Bootstrap[a]				
			Bias	Std. Error	Sig. (2-tailed)	BCa 95% Confidence Interval	
						Lower	Upper
1	(Constant)	1.208	-.030	.837	.155	-.468	2.692
	YearsofExp	.005	.004	.051	.931	-.089	.117
2	(Constant)	4.121	-.749	5.230	.448	-5.545	12.650
	YearsofExp	.125	-.030	.163	.497	-.184	.351
	Age	-.135	.035	.178	.498	-.463	.297
	Gender	.617	-.090	1.314	.623	-2.219	3.061

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Results testing Hypothesis 3

H3: The test-retest reliability of analysts will be proportional to the congruence of the reliability and credibility scales.

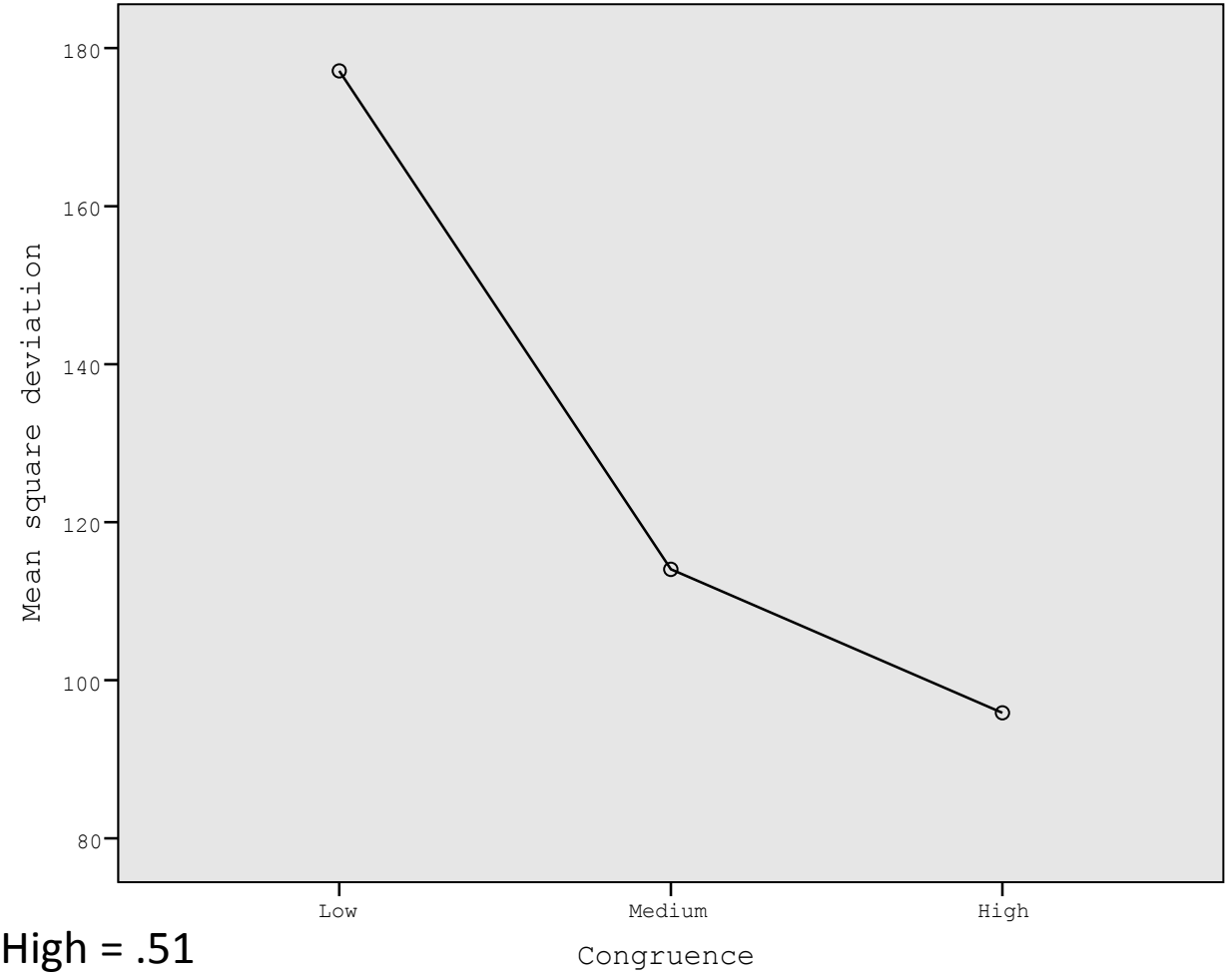
Results

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Congruence	Pillai's Trace	.178	4.345[b]	2.000	40.000	.020	.178
	Wilks' Lambda	.822	4.345[b]	2.000	40.000	.020	.178
	Hotelling's Trace	.217	4.345[b]	2.000	40.000	.020	.178
	Roy's Largest Root	.217	4.345[b]	2.000	40.000	.020	.178

a. Design: Intercept
Within Subjects Design: Congruence

Results



ES(d) for Low vs. High = .51

Results

Bootstrap for Coefficients

Model		B	Bootstrap[a]				
			Bias	Std. Error	Sig. (2-tailed)	BCa 95% Confidence Interval	
						Lower	Upper
1	(Constant)	148.555	-.875[b]	90.351[b]	.126[b]	-34.448[b]	340.394[b]
	FamRel	47.659	-.899[b]	88.981[b]	.592[b]	-135.327[b,c]	231.080[b]
	FamCred	-25.826	3.630[b]	93.582[b]	.782[b]	-187.871[b]	177.572[b]
2	(Constant)	-202.806	17.689[b]	247.766[b]	.420[b]	-673.514[b]	374.254[b]
	FamRel	16.262	-3.055[b]	64.390[b]	.780[b]	-103.745[b,c]	159.107[b]
	FamCred	37.245	-2.904[b]	67.523[b]	.572[b]	-118.905[b]	154.111[b]
	Age	7.811	-.422[b]	5.347[b]	.163[b]	-3.941[b]	17.342[b]
	Gender	-4.082	2.476[b]	85.638[b]	.960[b]	-149.280[b]	174.726[b]
	YearsofExp	-.593	.415[b]	4.654[b]	.904[b]	-9.395[b]	9.728[b]

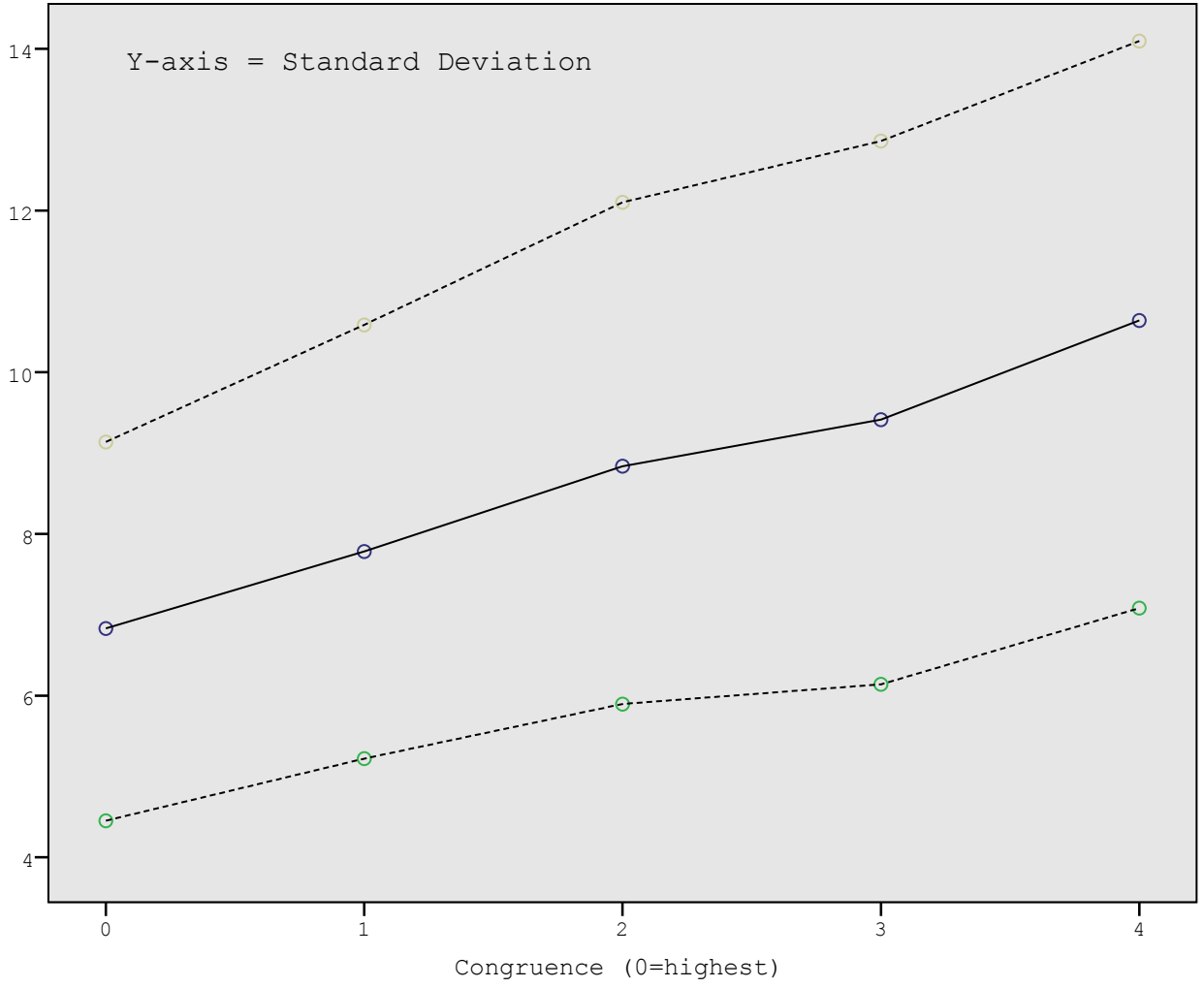
a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

b. Based on 949 samples

Results testing Hypothesis 4

H4: Likewise, the inter-analyst reliability of accuracy judgments will be proportional to the congruence of the reliability and credibility scales.

Results


Y-axis = Standard Deviation
14
12
10
8
6
4
0
1
2
3
4
Congruence (0=highest)

Results

Bootstrap for Coefficients

Model		B	Bootstrap[a]				
			Bias	Std. Error	Sig. (2-tailed)	BCa 95% Confidence Interval	
						Lower	Upper
1	(Constant)	12.034	.022	.657	.001	10.606	13.338
	CongValue	1.453	-.021	.312	.001	.850	2.004
2	(Constant)	12.995	.041	.733	.001	11.446	14.491
	CongValue	.876	-.028	.399	.040	.050	1.643
	CongPolarity	.961	.014	.332	.005	.255	1.624
3	(Constant)	12.995	.044	.716	.001	11.444	14.547
	CongValue	.876	-.028	.372	.041	.107	1.562
	CongPolarity	.961	.010	.306	.008	.293	1.611
	RminC	-.327	.002	.114	.015	-.537	-.092

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

CongValue = ABS(R-C). CongPolarity: 0= RC Polarity congruent; 1= RC polarity incongruent.
RminC = R – C.

Results

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.626[a]	.392	.380	2.21538
2	.670[b]	.449	.426	2.13080
3	.710[c]	.505	.472	2.04329

a. Predictors: (Constant), CongValue

b. Predictors: (Constant), CongValue, CongPolarity

c. Predictors: (Constant), CongValue, CongPolarity, RminC

CongValue = ABS(R-C). CongPolarity: 0= RC Polarity congruent; 1= RC polarity incongruent. RminC = R – C.

Discussion

H1: Judged accuracy will increase with reliability and credibility

- H1 confirmed, and information credibility had only a slightly larger effect size than source reliability (cf. Samet, 1975).
- There was a polarity effect such that moving from a positive polarity term to a negative polarity term led to the largest decline in assessed probability.
- The latter finding suggests that a scale without a polarity change in the middle might be better. This could be tested (next?).

Discussion

H2: Analysts will not be susceptible to the secrecy heuristic, and classification will have little or no effect on accuracy.

- H2 disconfirmed; there was a small effect of classification on assessed accuracy in line with the secrecy heuristic.
- The magnitude of the effect was not predictable on the basis of years of experience, age, or gender.

Discussion

H3: The test-retest reliability of analysts will be proportional to the congruence of the reliability and credibility scales.

- H3 confirmed; low vs. high RC-value congruence yielded a medium size effect on test-retest reliability.
- The result is impressive given that retest happened within a single 30 min session.
- What does this say about reliability in the field over much longer timeframes?

Discussion

H4: The *inter*-analyst reliability of accuracy judgments will be proportional to RC value congruence.

- H4 confirmed. Inter-analyst variability increased with RC value incongruence.
- Variability also increased with RC *polarity* incongruence (i.e., when one scale had positive polarity and the other had negative polarity).
- Variability also increased with information credibility exceeded source reliability (consistent with the view that R enables C).

Extra material: Specific resampled cases used for test-retest reliability

- Completely reliable, confirmed by other sources
- Completely reliable, possibly true
- Completely reliable, improbable
- Fairly reliable, confirmed by other sources
- Fairly reliable, possibly true
- Fairly reliable, improbable
- Unreliable, confirmed by other sources
- Unreliable, possibly true
- Unreliable, improbable
- Reliability cannot be judged, truth cannot be judged