

Don't Believe Your Eyes: Lessons from Cognitive Science on Inattention Blindness for International Nuclear Safeguards Verification



PRESENTED BY

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Introduction to inattention blindness

Relevance for safeguards

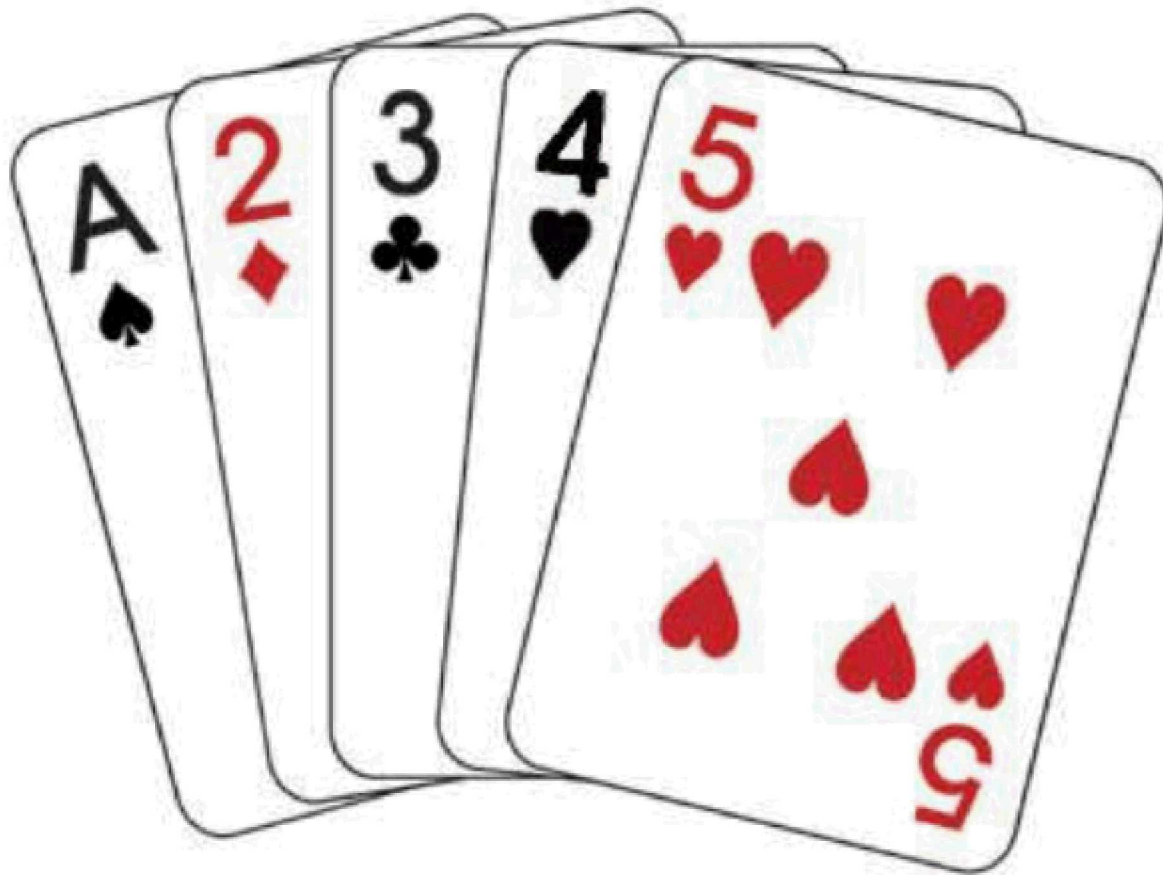
Safeguards/inattention blindness research at SNL

Other applications for international nuclear safeguards

For more information...



Image: Daniel Simons



<https://www.psychologytoday.com>





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By Kay Cordtz
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Brookhaven Lab Training Course 'Most Important' for IAEA Inspectors

July 8, 2014



IAEA inspectors search for clues that might indicate a clandestine weapons program in "Freedonia."

[+ENLARGE](#)

7 | Safeguards Research at SNL

1. Visual Inspection
2. Wayfinding
3. Knowledge Transfer





Seal/Container	Seal/Container	Seal/Container	Seal/Container	Seal/Container	Seal/Container	Seal/Container	Seal/Container
845432 EF-36	892115 LM-79	822459 TY-05	863497 HK-21			845432 EF-36	892115 LM-79
885214 VZ-52	835983 EF-34	878626 AB-46	876826 LM-78			885214 VZ-52	835983 EF-34
883173 NP-20	835893 EF-38	827614 NP-12	863479 VZ-96			883173 NP-20	835893 EF-38
864413 VZ-97	826167 VZ-56	831349 HK-25	843608 HK-30			864413 NP-19	826167 VZ-56
864704 LM-80	870694 RS-69	813349 VZ-94	825213 EF-31			864704 LM-80	870694 RS-69
847186 GI-82	821045 NP-14	858592 NP-09	864325 HK-22			847168 GI-82	821045 VZ-95
884277 EF-39	881092 GI-89	853673 GI-81	878348 HK-29			884277 EF-39	881092 GI-89
812914 RS-93	854267 HK-24	811491 LM-67	899508 VZ-55			812914 TY-08	852467 HK-24
897936 TY-07	894320 AB-41	814835 HK-28	879316 VZ-99			897936 TY-07	832326 VZ-58
							842752 RS-63
							879316 VZ-99

Seal present,
correct container

Seal present,
incorrect container



Seal missing

Other issue

Column 1

Column 2

Column 3

Column 4

Inspection Complete

Color Change

Visual List Inspection

Inspector List

Seal Cont.

287367 GI-97

270754 TY-11

271919 HK-40

239851 EF-43

239851 EF-43

Facility List

Seal Cont.

287367 GI-97

270754 HK-45

???

238951 EF-43

239851 EF-43

238951 EF-43

Item Condition

Match (18)

Wrong container (4)

Missing (2)

Transposed (4)

Transposed/Match (8)

Visual List Inspection

<u>Seal/Container</u>	<u>Seal/Container</u>	<u>Seal/Container</u>	<u>Seal/Container</u>
953479 TY-14	984789 EF-32	985231 LM-76	983246 VZ-60
968722 LM-74	939885 VZ-51	929681 TY-02	956284 AB-43
979744 VZ-92	967524 RS-62	970123 LM-75	935623 RS-67
910246 AB-97	977856 VZ-98	935263 GI-84	996321 VZ-57
934328 VZ-59	990086 NP-11	991546 AB-42	997840 EF-33
946972 RS-70	961527 LM-72	915709 EF-40	927992 TY-10
987569 LM-73	956248 VZ-91	957453 RS-22	923440 LM-71
949672 AB-50	941538 GI-85	919724 VZ-93	914581 EF-35
973221 EF-37	942896 TY-04	968401 GI-90	976524 TY-01

Inspection Complete

Color Change

<u>Seal/Container</u>	<u>Seal/Container</u>	<u>Seal/Container</u>	<u>Seal/Container</u>
968722 LM-74	939885 LM-12	987569 LM-73	991546 EF-81
910246 AB-97	917509 EF-40	977856 GI-30	953479 TY-14
919724 VZ-93	984789 EF-32	946972 RS-70	940574 NP-81
961527 LM-72	956284 AB-43	957453 RS-22	985231 LM-76

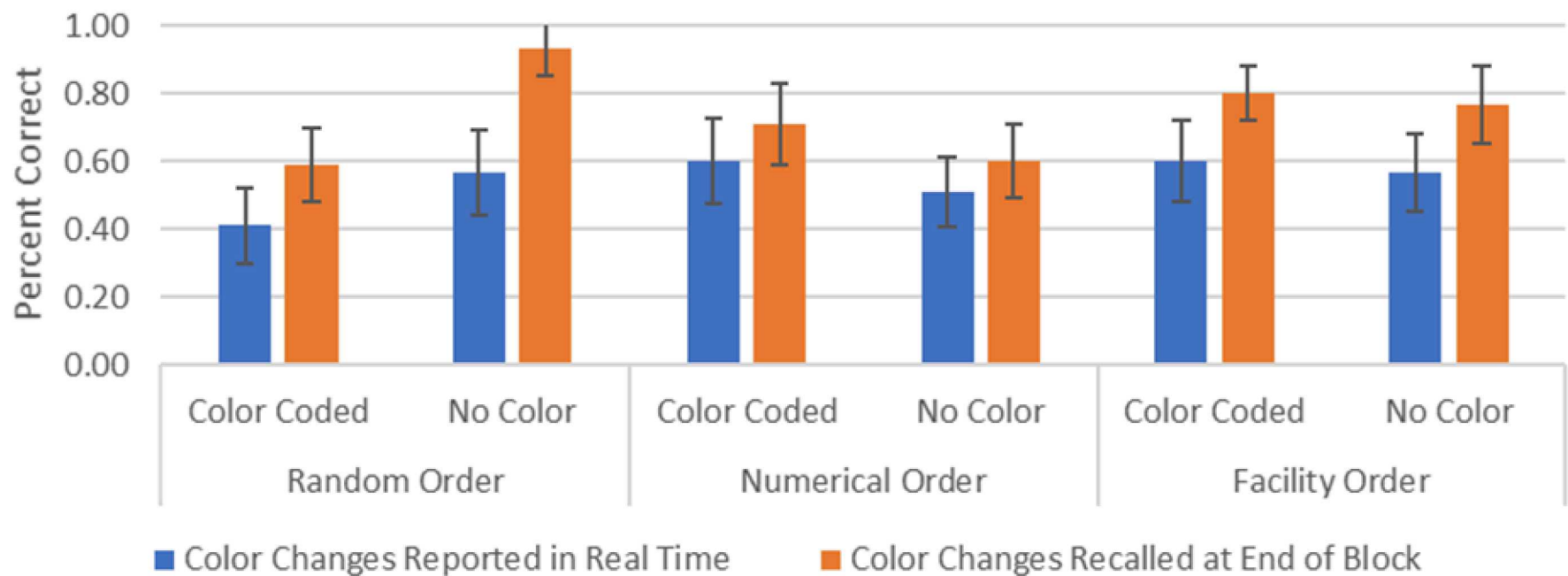
<u>Seal/Container</u>	<u>Seal/Container</u>	<u>Seal/Container</u>	<u>Seal/Container</u>
953479 TY-14	984789 EF-32	985231 LM-76	983246 VZ-60
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973221 EF-37	942896 TY-04	968401 GI-90	976524 TY-01

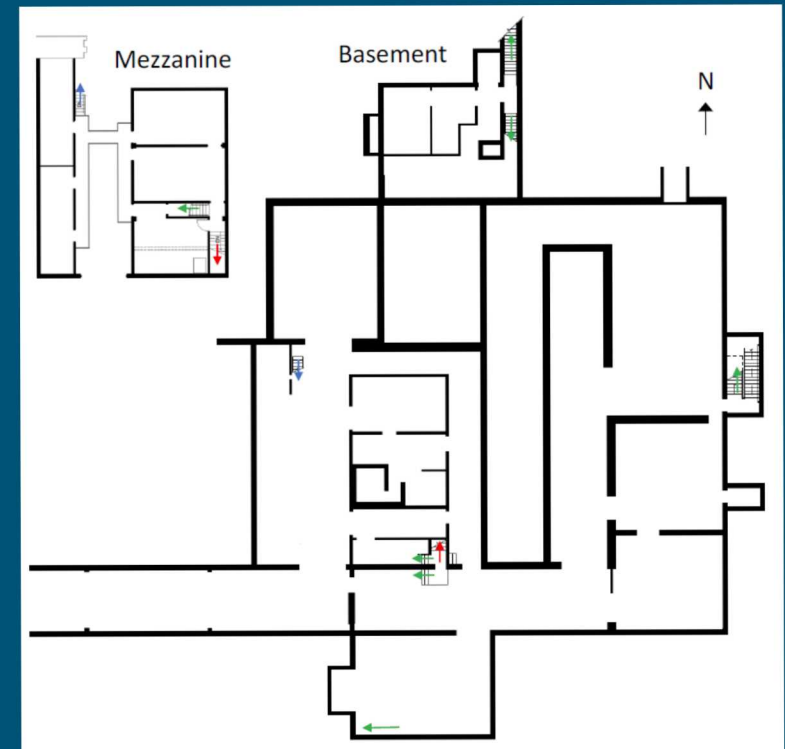
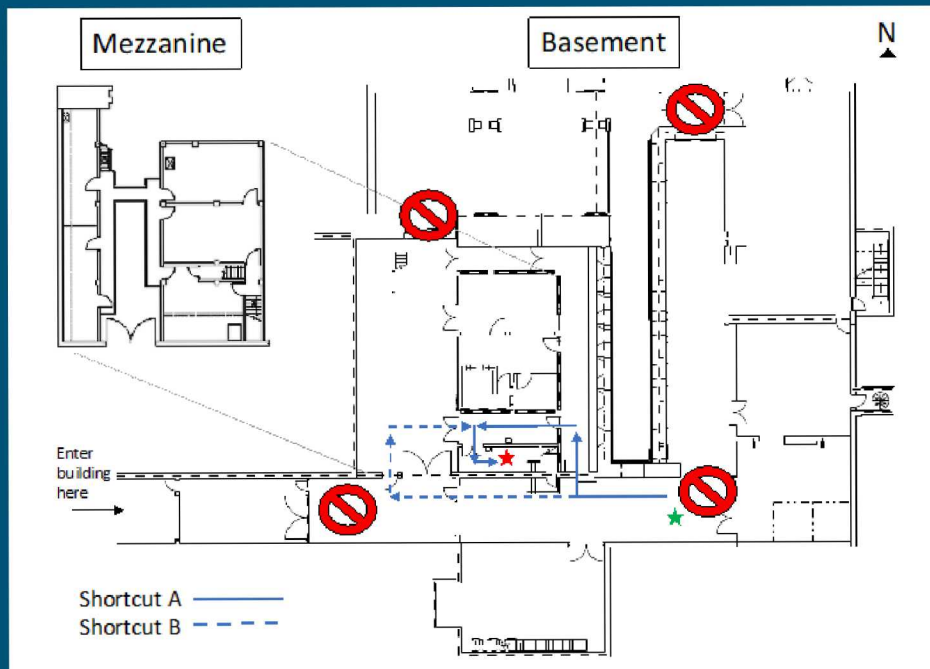
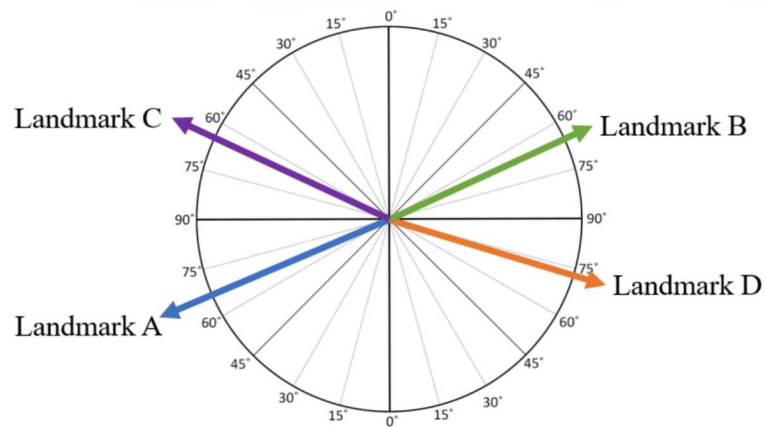
Inspection Complete

Color Change

<u>Seal/Container</u>	<u>Seal/Container</u>	<u>Seal/Container</u>	<u>Seal/Container</u>
968722 LM-74	939885 LM-12	987569 LM-73	991546 EF-81
910246 AB-97	917509 EF-40	977856 GI-30	953479 TY-14
919724 VZ-93	984789 EF-32	946972 RS-70	940574 NP-81
961527 LM-72	956284 AB-43	957453 RS-22	985231 LM-76
990086 NP-11	935263 GI-84	967524 RS-62	956248 VZ-91
942896 TY-04	934328 VZ-59	973221 EF-37	923440 VZ-24
933734 HK-99	927992 TY-10	929861 TY-02	949672 AB-50
976524 TY-01	935623 RS-67	941538 GI-85	996321 VZ-57
986401 GI-90	983246 VZ-60	970123 LM-75	914581 EF-35

Color Change Detection

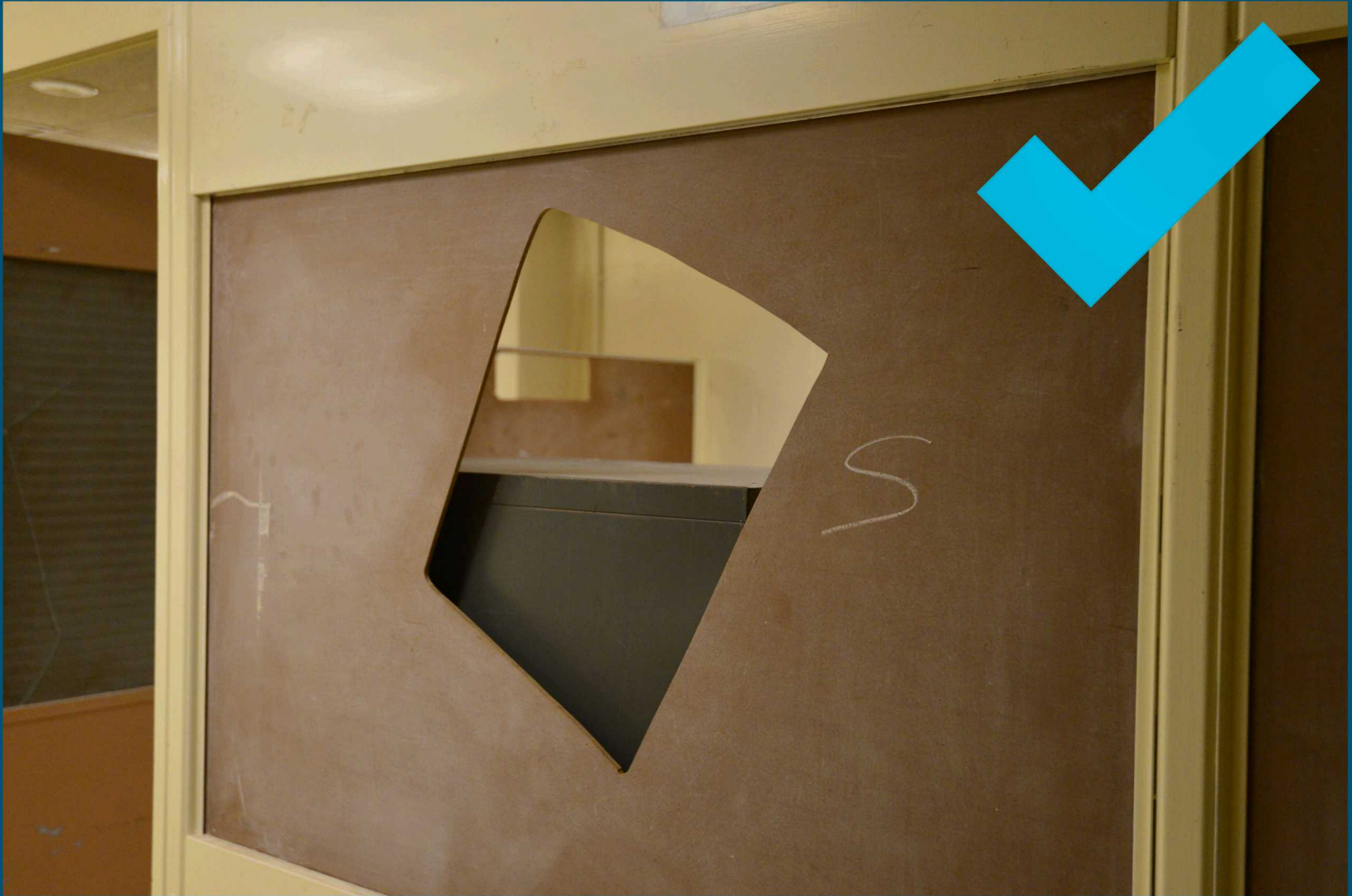








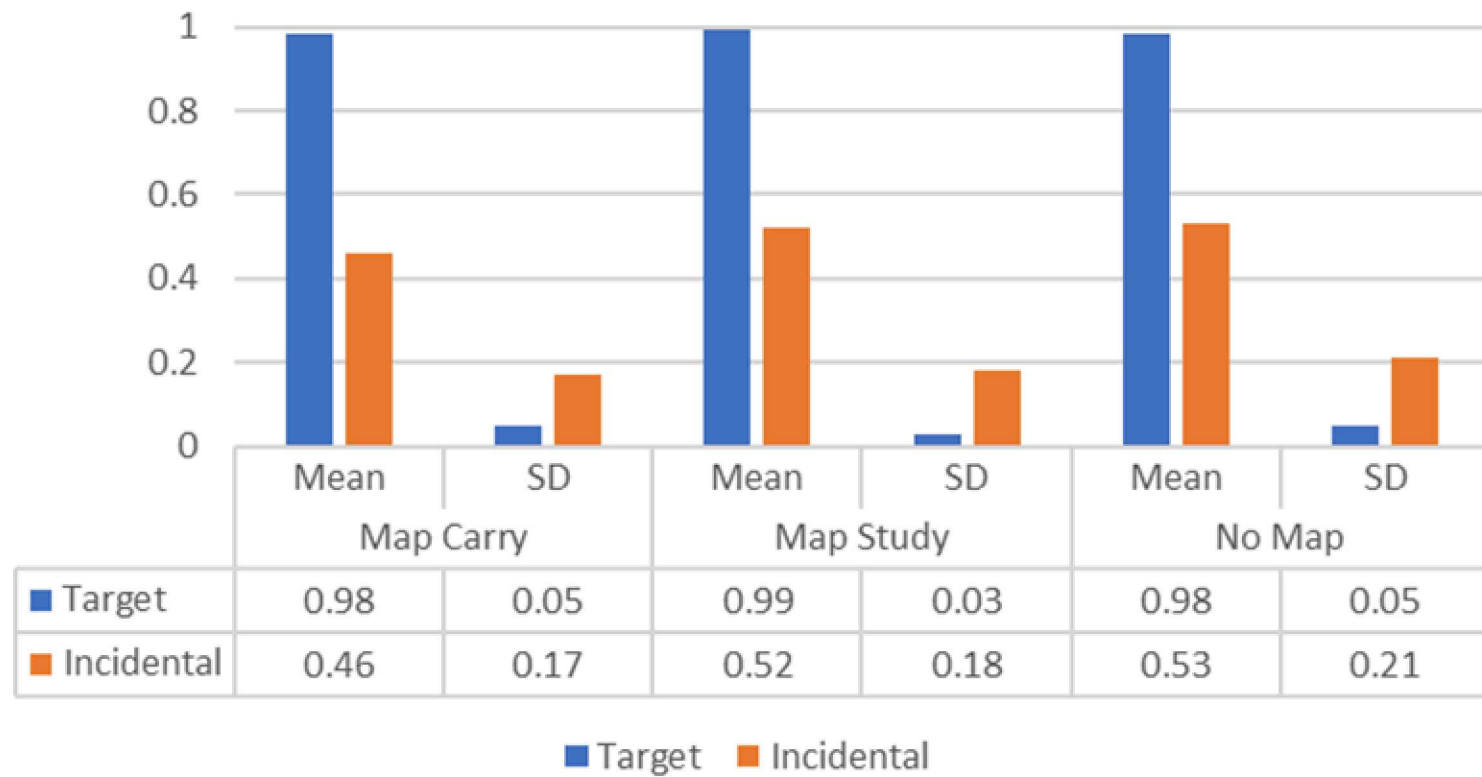


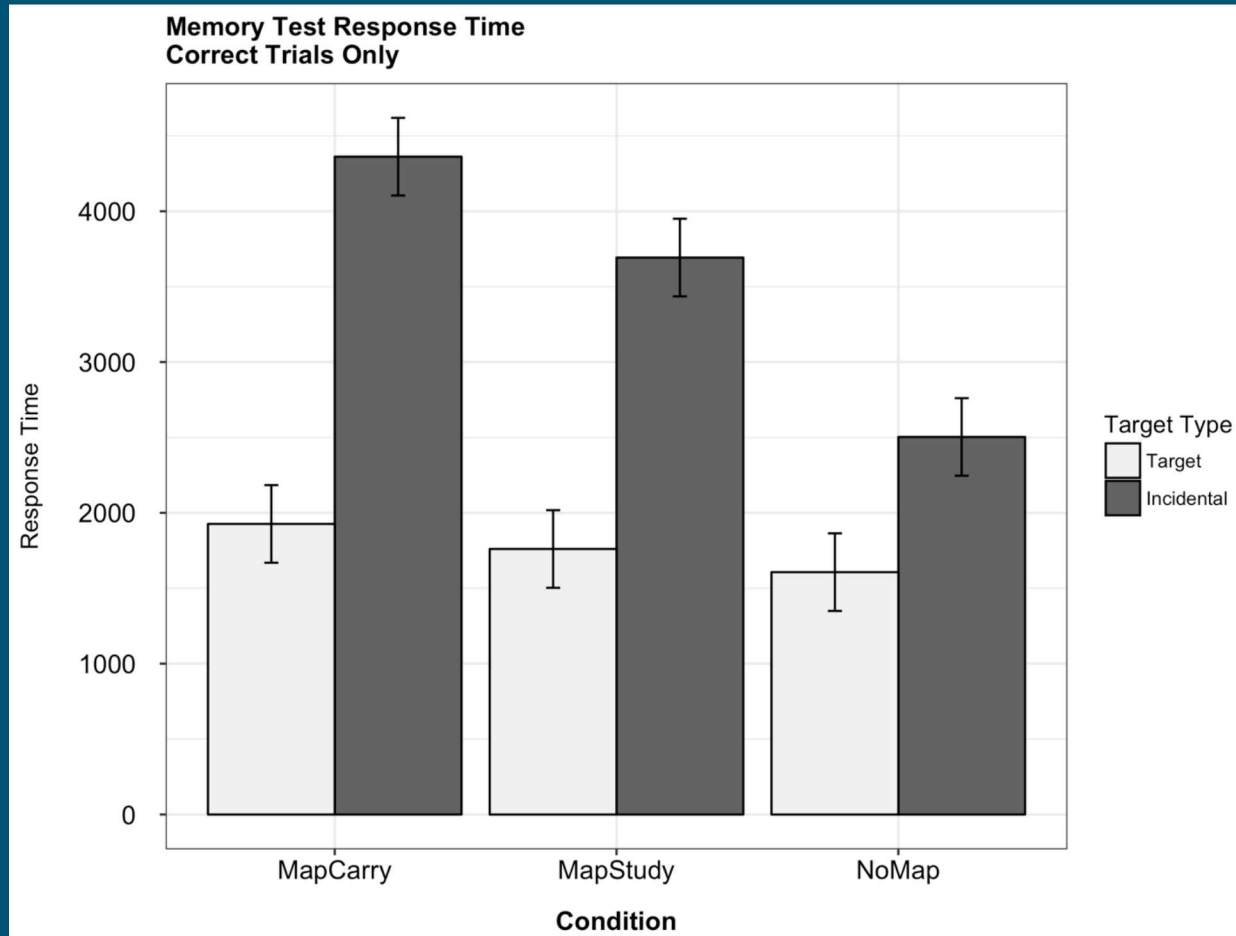


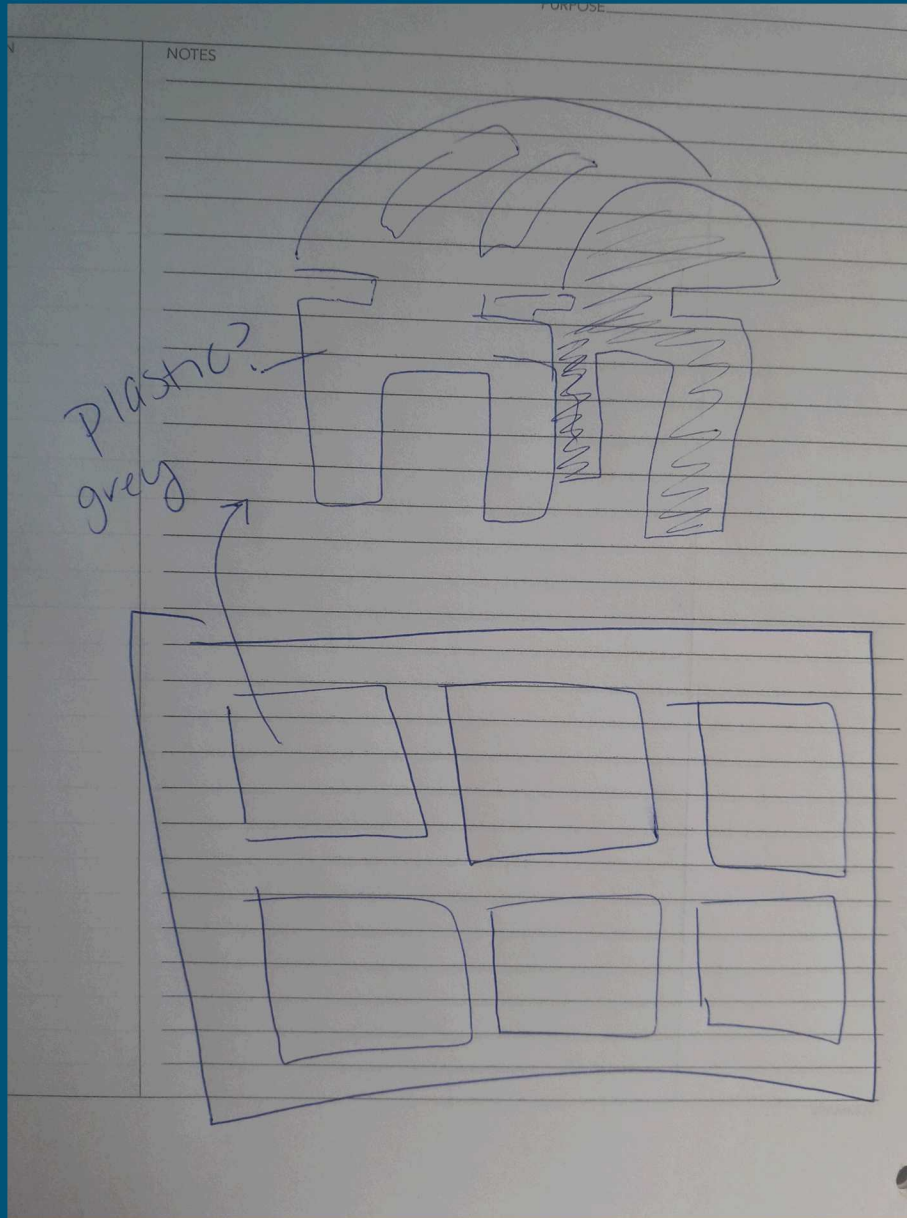


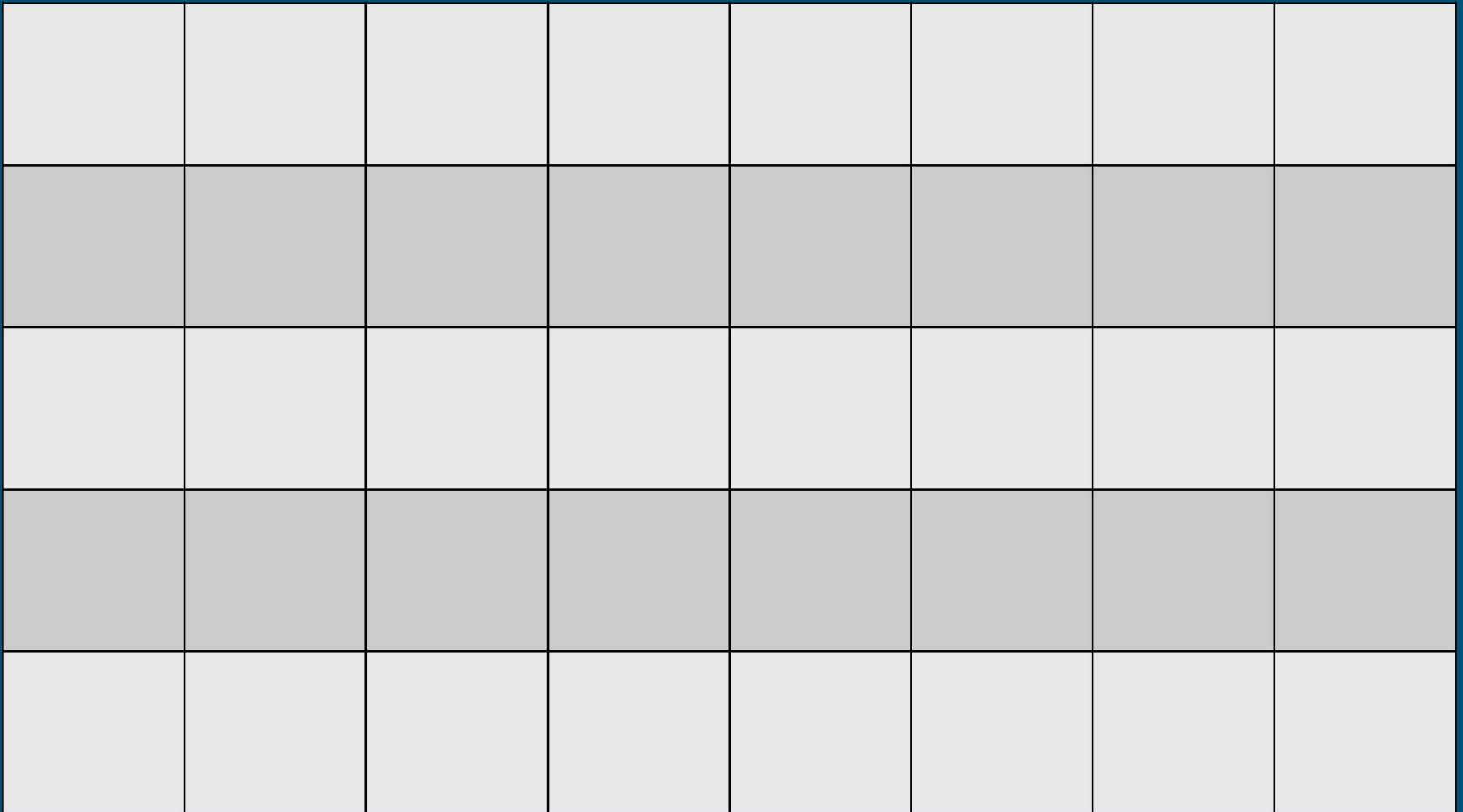


Memory Task Hit Rate

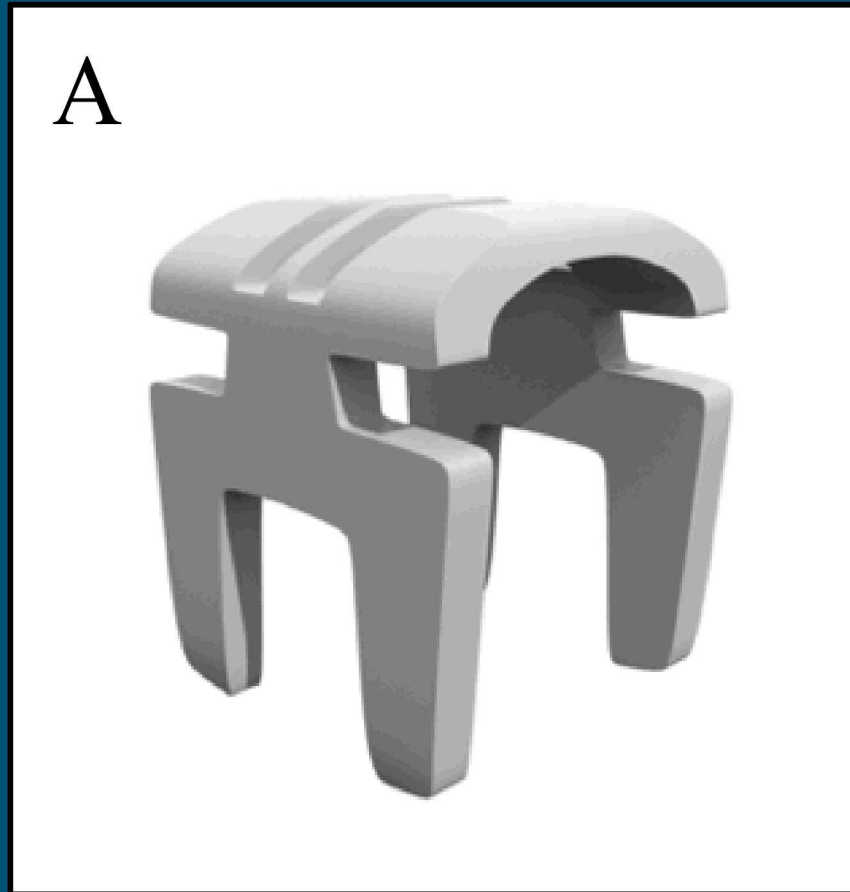








40 images x 4 test boards = 160 original images



Courtesy: IARPA MICrONS project



20 changes per board: orientation, material, new object, location change
Individuals view 216 unique images in the course of the experiment

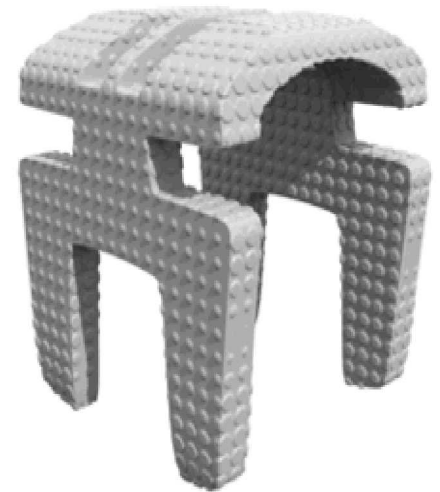
A



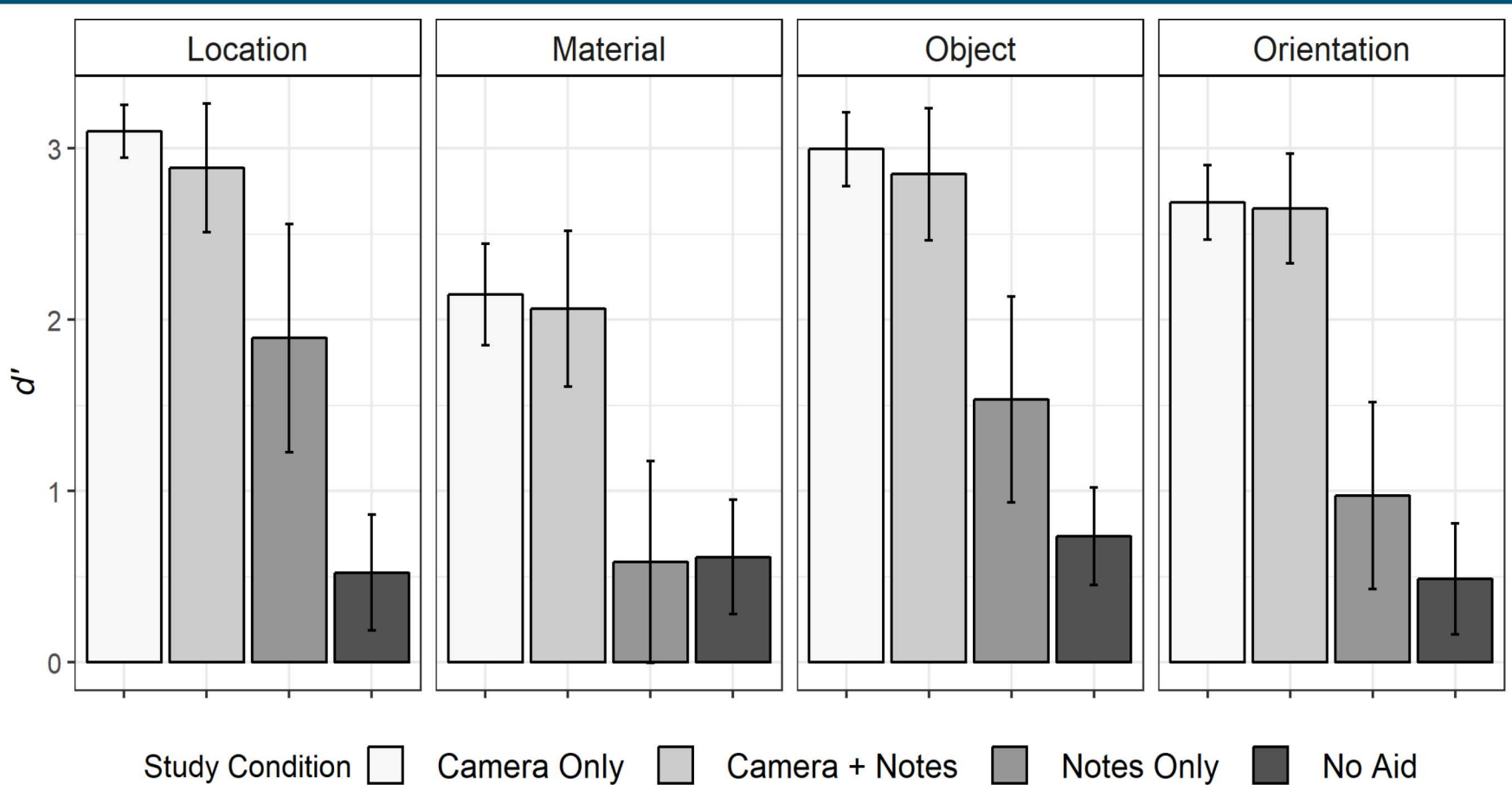
B



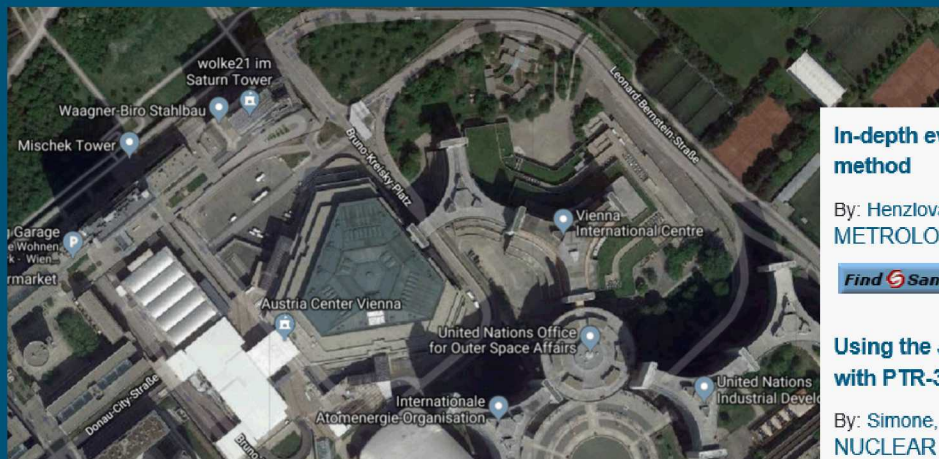
C



Courtesy: IARPA MICrONS project



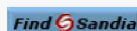
Bars show the d' score for each study condition and item change type. Error bars represent 95% confidence intervals around the mean.



In-depth evaluation of Cf-252 absolute calibration by passive neutron correlation counting method

By: Henzlova, Daniela; Favalli, Andrea; Croft, Stephen

METROLOGIA Volume: 56 Issue: 1 Article Number: 015017 Published: FEB 2019



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Using the JCC-71 neutron coincidence collar as a benchmark for detector characterization with PTR-32 list mode data acquisition

By: Simone, A. T.; Croft, S.; Hayward, J. P.; et al.

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ELECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT Volume: 908 Pages: 24-34

Published: NOV 11 2018



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For isotope safeguards techniques (MIST): Analysis and visualization of gas centrifuge enrichment plant process data using the MSTAR model

Shephard, Adam M.; Thomas, Benjamin R.; Coble, Jamie B.; et al.

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ELECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT Volume: 890 Pages: 79-83

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Financing the Fork detector for quantitative spent nuclear fuel verification

Vaccaro, S.; Gauld, I. C.; Hu, J.; et al.

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ELECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT Volume: 888 Pages: 202-217

Published: APR 21 2018





Approach/Overview:

- Testing Human Performance in Simulated In-Field Safeguards Information Environments. Gastelum, Matzen, Smartt, Horak, Solodov, Moyer, St. Pierre. Proceedings of the INMM Annual Meeting, July 2017.
- Brain Science and International Nuclear Safeguards: Implications from Cognitive Science and Human Factors Research on the Provision and Use of Safeguards-Relevant Information in the Field. Gastelum, Matzen, Smartt, Horak, Moyer, St. Pierre. ESARDA Bulletin, No. 54, June 2017.
- Human Performance Testing for Cognitive Science-Informed Information Provision for International Nuclear Safeguards Inspectors. Gastelum, Matzen, Smartt, Stites. IAEA Safeguards Symposium, November 2018.

Visual Inspection:

- Cognitive Science Evaluation of Safeguards Inspector List Comparison Activities Using Human Performance Testing. Gastelum, Matzen, Stites, Smartt. Proceedings of the INMM Annual Meeting, July 2018.
- The Impact of Information Presentation on Visual inspection Performance in the International Nuclear Safeguards Domain. Matzen, Stites, Smartt, Gastelum. (forthcoming) Proceedings of HCI International, July 2019

Wayfinding:

- The Role of Maps in Site Knowledge and Wayfinding: A Human Performance Evaluation for International Nuclear Safeguards Inspections. Gastelum, Stites, Matzen, Smartt. (forthcoming) Proceedings of the ESARDA Symposium, May 2019.

Knowledge Transfer:

- Human Performance Testing on Observation Capture Methods for International Nuclear Safeguards Inspections: Transferring Knowledge from the Field to Headquarters and Back. Gastelum, Matzen, Stites, Smartt. (forthcoming) Proceedings of the INMM Annual Meeting, July 2019.
- Effects of Note-Taking Method on Knowledge Transfer in Inspection Tasks. Stites, Matzen, Smartt, Gastelum. (forthcoming) Proceedings of HCI International, July 2019