



FRANK L. GREITZER, PhD
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CONSULTING IN COGNITIVE SYSTEMS ANALYTICS

Counterintelligence/Insider Threat Research
Cybersecurity/Cyber Situation Awareness Research
Cognitive Engineering and Cognitive Science
Human Information Analysis/Human-Computer Interaction
Performance Support Tools/Knowledge-Based Systems
Training and learning research and technology
Research Methods//Performance Evaluation

EDUCATION

PhD University of California, Los Angeles (1975) Mathematical Psychology
MA University of California, Los Angeles (1970) Experimental Psychology
BS Harvey Mudd College, Claremont CA (1968) Mathematics

EMPLOYMENT

Independent Consultant – *PsyberAnalytix LLC* (2012-present) <http://www.PsyberAnalytix.com>

Owner, PRINCIPAL SCIENTIST. Consulting in cognitive/behavioral/social sciences R&D applied to human decision making and performance in cybersecurity, intelligence analysis, counterintelligence, and electric power grid/control systems operations. Most recent research and consulting activities have focused on cybersecurity and secure power systems expertise and insider threat modeling and analysis. Click here for [representative projects](#).

Battelle Pacific Northwest National Laboratory (1992-2012)

CHIEF SCIENTIST (*Cognitive Informatics R&D Area*), *National Security Directorate*. Conduct applied research in human-information interaction, human decision making/naturalistic decision making and cognitive engineering. Provide project management, concept development, proposal development, and technical oversight for projects to design and develop new and innovative methods for enhancing systems effectiveness. Mentoring of research staff (e.g., developing and running Publication Workshop to foster increased scientific publications) and supervising student interns. Representative R&D projects in three major applied research areas:

Human/information interaction, decision/information processing support: Research on predictive modeling for insider threat mitigation, socio-cultural modeling for threat anticipation, power grid operator decision making, and methods/metrics for evaluation of information analysis/decision support tools. Applications: insider threat, intelligence analysis, power grid operations.

Cognitive approaches to training and learning: Research in advanced technologies and active learning concepts for enhancing human-system performance. Proposed, managed, and delivered diverse training products, including: *ESTHER*, a web-based guided-discovery learning application on understanding human error precursors for US DOE security incident inquiry officials; *CAISI* e-Learning system, a US Army web-based application to train Army personnel in setting up and maintaining logistics communications; *Enhanced Observational Skills* for IAEA nuclear safeguards inspectors; training on random testing methods for FAA drug and alcohol abatement inspectors; and *ErgoEASER*, a DOE occupational ergonomic analysis/training tool.

Predictive Analytics/System Modeling and Prognostics: Principal Investigator on REDI-PRO (Real-time Engine Diagnostics-Prognostics) prototype health monitoring system for the gas turbine engine on the army M1-Abrams tank; and internal R&D aimed at developing a general methodology for predicting the remaining useful life of mechanical systems.

Washington State University, Tri-Cities Campus. (2004-2010)

ADJUNCT PROFESSOR. Computer Science Department and Psychology Department. Taught courses on user interface design (CPTS-443) and human factors (PSYCH-307) at the WSU Tri-Cities campus.



Previous Work:

- McDonnell Douglas Training Systems, Aurora, CO (1989-1992). *TECHNICAL SPECIALIST*. Advanced Technology Group.
- Martin Marietta Corporation, Denver, CO (1986-1989). *STAFF ENGINEER*. Intelligent Man-Machine Interface R&D, Artificial Intelligence Section.
- Navy Personnel Research and Development Center, San Diego, CA (1979-1986). *RESEARCH PSYCHOLOGIST*. Human Factors (Code 71).
- Academic appointments (taught graduate and undergraduate courses in experimental psychology and statistics):
 - California School of Professional Psychology, San Diego (1979-1980).
 - California State College, San Bernardino (1976-1978).
 - California State University, Long Beach (1975-1976).
 - University of California, Los Angeles (1975-1976).
- Graduate student at UCLA, 1969-1975.
- McDonnell-Douglas Corporation, Santa Monica CA (1968-1969). *ASSOCIATE INDUSTRIAL ENGINEER*.

SYNERGISTIC ACTIVITIES AND EXPERIENCE

- 6 patents (see list below)
- Co-Chair, *2016 IEEE S&P Workshop on Research for Insider Threat (WRIT)*
- Program Committee member, *2014 Learning from Authoritative Security Experiment Results (LASER) Workshop*.
- Program Committee member, *2013 IEEE S&P Workshop on Research for Insider Threat (WRIT)*.
- Program Committee member/reviewer, *Hawaii International Conference on System Sciences (HICSS)*—various years including HICSS-46 (2013), HICSS-45 (2012), HICSS-39 (2006), and HICSS-38 (2005).
- Member of Editorial Board, *International Journal of Cognitive Informatics and Natural Intelligence*.
- Member, International Editorial Advisory Board, *Advances in Cognitive Informatics and Natural Intelligence Book Series*
- Invited Provocateur/Facilitator. *National Academies Workshop on Usability, Security & Privacy*. Washington D.C., July 21-23, 2009.
- Invited speaker, *ODNI-Private Sector Engagement on Insider Threat*. Washington, D.C., May 30, 2007.
- Member of Executive Board and ACI Ambassador, *Augmented Cognition International Society*. Member of Editorial Committee, *Augmented Cognition International Conference*, Beijing, China, July 2007. Co-Chair, Operational Processes and Adaptive Measures Session; and Member of Editorial Committee, *Augmented Cognition International Conference*, San Francisco, CA, October 2006. Co-Chair, Human-Machine Symbiosis Session; and Member of Editorial Committee, *Augmented Cognition International Conference*, Las Vegas, NV, July 2005.
- Invited Presentation/Panelist at the *Inaugural Military Aviation Careers Consortium Workshop*, Washington D.C. July 28-29, 2005.
- Program Committee member, *First International Conference on Intelligence Analysis Methods and Tools*, McLean, VA, May 2005.

PATENTS AND INTELLECTUAL PROPERTY

U.S. Patent No. 9,111,216 (March 3, 2014) and **U.S. Patent No. 9,424,522** (August 23, 2016): INFORMATION PROCESSING SYSTEMS, REASONING MODULES, AND REASONING SYSTEM DESIGN METHODS

U.S. Patent No. 8,561,189 (October 15, 2013): METHOD AND APPARATUS FOR DISTRIBUTED INTRUSION PROTECTION SYSTEM FOR ULTRA HIGH BANDWIDTH NETWORKS.

U.S. Patent No. 7,457,785 (November 25, 2008): Method and Apparatus to Predict the Remaining Service Life of an Operating System

U.S. Patent No. 6,662,091 (December 9, 2003) and **U.S. Patent No. 6,941,2002** (September 6, 2005): Diagnostics/prognostics using wireless links.

SPECIAL DISTINCTIONS/AWARDS

Runner-Up to Best Paper Award, [STIDS 2016](#) Conference, Washington, DC, Nov 15-16, 2016.

R&D 100 Award, 2015, for CHAMPION Reasoning Software



Federal Laboratory Consortium (FLC) Award, 2016, for CHAMPION Reasoning Software
Software Creator Award, PNNL Recognition & Rewards program, 2013, for "Graphical Contingency Analysis Tool 1.0."
Outstanding Performance Awards, 2011, 2002-2006. PNNL
Certificate of Appreciation, for superior accomplishment and valuable service, presented by the Office of the Director of National Intelligence, May, 2007.
Exceptional Performance Award, December 2006, recognition for efforts in leading "Modeling Human Performance in Cyberspace" project and in growing Cognitive Informatics R&D area.
Patent Award, PNNL Recognition & Rewards Program, 2005. Patent Award bestowed for Patent 6,662,091: "Diagnostics/prognostics using wireless links."
Outstanding Performance Awards, PNNL: 2002, 2003, 2004, 2005, 2006, 2011.
Outstanding Team Performance Award, June 2003. Awarded for Glass Box Analysis Prototype Implementation and Deployment, Information Systems Engineering, PNNL.
Key Contributor Award, PNNL Recognition & Rewards Program, 2002: Licensing of radio frequency tags technology for heavy vehicle monitoring.
Key Contributor Award, PNNL Recognition & Rewards program, 1999: Licensing of ErgoEASER software.
Software Creator Award, PNNL Recognition & Rewards program, 1998: Copyright granted to ErgoEASER software.
Visual Basic "Fast Track" for MIS Professionals, course by Strategix, Inc. (1995)
Washington State University C&I Continuing Education course: *Object-Oriented Software Development Method* (1992)
Local Panelist, User Interface Strategies '91 Teleconference produced by the University of Maryland. Local session held at the University of Colorado at Boulder, December 5, 1990.
Performance Award (Bonus), McDonnell Douglas Training Systems (1991).
Local Panelist, User Interface Strategies '88 Teleconference produced by the University of Maryland. Local session held at the University of Colorado at Boulder, October 5 and 12, 1988.
NPRDC Outstanding Performance Award (1984); Sustained Superior Performance Award (1983,1984, 1985); Quality Salary Increase (1983)
Advanced Engineering Short Noncredit Courses, George Washington University: *An Applications-oriented Approach to Artificial Intelligence* (1982); *Command, Control, and Communications* (1979).
Navy Tactical Data System Utilization course, Fleet Combat Training Center, Pacific. (1980, *with distinction*)
Graduate Student Patent Fund Grant for Dissertation Research, UCLA (1975). NSF Summer Traineeship for Graduate Teaching Assistants, UCLA (1971). California State Scholarship for Graduate Study, UCLA (1970).
BS degree *with distinction*, Harvey Mudd College. (1968)

PAPERS IN PRESS OR SUBMITTED FOR PUBLICATION

PUBLICATIONS

Cybersecurity/Counterintelligence/Insider Threat:

- Greitzer, FL, J Purl, YM Leong, & DE Becker. (2018, in press). SOFIT: Sociotechnical and Organizational Factors for Insider Threat. *IEEE S&P Symposium, Workshop on Research for Insider Threat (WRIT)*. San Francisco, CA, May 24, 2018.
- Greitzer, FL, M Imran, J Purl, ET Axelrad, YM Leong, DE Becker, KB Laskey, and PJ Sticha. (2016). "Developing an ontology for individual and organizational sociotechnical indicators of insider threat risk." *The Eleventh International Conference on Semantic Technology for Intelligence, Defense, and Security (STIDS 2016)*, Fairfax, VA, November



15-16, 2016. Paper available at: http://ceur-ws.org/Vol-1788/STIDS_2016_T03_Greitzer_etal.pdf Presentation available at: http://stids.c4i.gmu.edu/papers/STIDSPresentations/STIDS2016_T03_presentation_GreitzerEtAl.pdf

- Cowley, J, and FL Greitzer. 2015. "Organizational impacts to cybersecurity expertise development and maintenance: A qualitative research study." *Human Factors and Ergonomics Society (HFES) International Annual Meeting*, Los Angeles, CA, October 26-30, 2015. <http://pro.sagepub.com/content/59/1/1187.short>
- Cowley, J, FL Greitzer, and B Woods. 2015. "Effect of network infrastructure factors on information system risk assessment." *Computers & Security*, 52, 142-158. doi:10.1016/j.cose.2015.04.011
- Cowley, J, FL Greitzer, and B Woods. (2015). "Factors influencing network risk judgments: A conceptual inquiry and exploratory analysis." *Security Informatics*, 4(1). <http://link.springer.com/article/10.1186/s13388-015-0016-x#page-1>
- Carroll, TE, FL Greitzer, and A Roberts. 2014. "Security informatics research challenges for mitigating cyber friendly fire." *Security Informatics*, 3:13 (25 September 2014). <http://www.security-informatics.com/content/3/1/13>
- Greitzer, FL, J Strozer, S Cohen, A Moore, D Mundie, and J Cowley. 2014. "Analysis of unintentional insider threats deriving from social engineering exploits." *IEEE Security and Privacy Workshop on Research for Insider Threat (WRIT)*, San Jose, CA, May 17-18, 2014. <http://www.ieee-security.org/TC/SPW2014/papers/5103a236.PDF>
- Greitzer, FL, J Strozer, S Cohen, J Bergey, J Cowley, A Moore, and D Mundie. 2014. "Unintentional insider threat: contributing factors, observables, and mitigation strategies." *47th Hawaii International Conference on Systems Sciences (HICSS-47)*, Big Island, Hawaii. http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6758854&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxppls%2Fabs_all.jsp%3Farnumber%3D6758854
- Brown C, FL Greitzer, and A Watkins. 2013. "Toward the Development of a Psycholinguistic-based Measure of Insider Threat Risk Focusing on Core Word Categories Used in Social Media." *Proceedings of the Nineteenth Americas Conference on Information Systems*, Chicago, Illinois, August 15-17, 2013. <http://aisel.aisnet.org/amcis2013/ISSecurity/GeneralPresentations/4/> .
- Greitzer, FL, LJ Kangas, CF Noonan, CR Brown and T Ferryman. (2013). Psychosocial modeling of insider threat risk based on behavioral and word use analysis. *e-Service Journal*, 9(1), 106-138. <http://www.jstor.org/stable/10.2979/eservicej.9.1.106>
- Greitzer, FL, and T Ferryman. 2013. Methods and Metrics for Evaluating Analytic Insider Threat Tools. *IEEE Security and Privacy Workshop on Research for Insider Threat (WRIT)*, San Francisco, CA, May 24, 2013, 90-97. <http://www.ieee-security.org/TC/SPW2013/papers/data/5017a090.pdf>
- Greitzer FL, TE Carroll and AD Roberts. 2013. "Cyber friendly fire: Research challenges for security informatics." *IEEE International Conference on Intelligence and Security Informatics*. Seattle, WA, June 4-7, 2013.
- Brown C, A Watkins and FL Greitzer. 2013. "Predicting insider threat risks through linguistic analysis of electronic communication.," in *46th Hawaii International Conference on Systems Sciences (HICSS-46)*, Wailea, Maui, Hawaii, pp.1849-1858. DOI: [10.1109/HICSS.2013.453](https://doi.org/10.1109/HICSS.2013.453).
- Greitzer FL, LJ Kangas, CF Noonan, AC Dalton, and RE Hohimer. 2012. Identifying at-risk employees: A behavioral model for predicting potential insider threats. In *45th Hawaii International Conference on System Sciences (HICSS-45)*, Wailea, Maui, Hawaii, pp. 2392-2401. <http://origin-www.computer.org/csdl/proceedings/hicss/2012/4525/00/4525c392.pdf>
- Lu, N, P Du, FL Greitzer, X Guo, RE Hohimer, and YG Pomiak. 2012. A multi-layer, data-driven advanced reasoning tool for intelligent data mining and analysis for smart grids. *IEEE Power and Energy Society General Meeting*.
- Carroll, TE, D Manz, T Edgar, and FL Greitzer. 2012. Realizing scientific methods for cybersecurity. *Proceedings of the 2012 Workshop on Learning from Authoritative Security Experiment Results (LASER)*. New York: ACM. Pages 19-24. ISBN: 978-1-4503-1195-3. <http://dl.acm.org/citation.cfm?id=2379619>
- Hohimer RE, FL Greitzer, CF Noonan, and JD Strasburg. 2011. "CHAMPION: Intelligent Hierarchical Reasoning Agents for Enhanced Decision Support." In *Semantic Technology for Intelligence, Defense, and Security (STIDS 2011)*. 36-



43 http://ceur-ws.org/Vol-808/STIDS2011_CR_T5_HohimerEtAl.pdf

Greitzer FL, and RE Hohimer. 2011. "Modeling Human Behavior to Anticipate Insider Attacks." *Journal of Strategic Security* 4(2):25-48. <http://scholarcommons.usf.edu/jss/vol4/iss2/>

Greitzer FL, DA Frincke, and MM Zabriskie. 2011. "Social/Ethical Issues in Predictive Insider Threat Monitoring." In: MJ Dark (Ed.), *Information Assurance and Security Ethics in Complex Systems: Interdisciplinary Perspectives*. Hershey, Pennsylvania: IGI Global. Chapter 7, pp.132-161. <http://www.irma-international.org/viewtitle/46344/>

Bishop M, SJ Engle, DA Frincke, C Gates, FL Greitzer, S Peisert, and S Whalen. 2010. "A Risk Management Approach to the "Insider Threat"." Chapter 6 in *Insider Threats in Cyber Security, Advances in Information Security*, vol. 49, ed. C Probst, J Hunker, M Bishop, pp. 115-137. Springer, New York, NY. <http://www.cs.ucdavis.edu/~peisert/research/insidertthreat-chapter-final-prepress.pdf>

Greitzer FL, and DA Frincke. 2010. "Combining Traditional Cyber Security Audit Data with Psychosocial Data: Towards Predictive Modeling for Insider Threat Mitigation." In *Insider Threats in Cyber Security*, ed. CW Probst, J Hunter, D Gollmann & M Bishop, pp. 85-113. Springer, New York. http://dx.doi.org/10.1007/978-1-4419-7133-3_5.

Bishop M, C Gates, DA Frincke, and FL Greitzer. 2009. "AZALIA: an A to Z Assessment of the Likelihood of Insider Attack." In *2009 IEEE International Conference on Technologies for Homeland Security*. IEEE, Piscataway, NJ. <http://dx.doi.org/10.1109/THS.2009.5168063>

Greitzer FL, AP Moore, DM Cappelli, DH Andrews, L Carroll, and TD Hull. 2008. "Combating the Insider Cyber Threat." *IEEE Security & Privacy* 6(1):61-64. <http://dx.doi.org/10.1109/MSP.2008.8>

Greitzer, F. L., & Endicott-Popovsky, B. (2008). Security and privacy in an expanding cyber world. Panel Session, *24th Annual Computer Security Applications Conference (ACSAC)*, Anaheim, CA. Dec 11, 2008. PNNL-SA-60992.

Greitzer FL, PR Paulson, LJ Kangas, TW Edgar, MM Zabriskie, LR Franklin & DA Frincke. 2008. *Predictive Modeling for Insider Threat Mitigation*. Pacific Northwest National Laboratory, Richland, WA. PNNL-SA-65204. <http://www.pnl.gov/coginformatics/media/pdf/TR-PACMAN-65204.pdf>

Power Grid/Smart Grid Operational Decision Making:

Lu, N, P Du, X Guo, and FL Greitzer, "Smart Meter Data Analysis," *IEEE Transmission and Distribution Conference and Exposition 2012*, Orlando, FL, USA, 2012. <http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=6267012>

Lu, N, P Du, FL Greitzer, X Guo, RE Hohimer, and YG Pomiak, "A Multi-layer, Data-driven Advanced Reasoning Tool for Intelligent Data Mining and Analysis for Smart Grids," *2012 IEEE PES General Meeting*, San Diego, CA, USA, 2012. <http://www.ieee-pes.org/images/pes-ws/gm2012/slides/pesgm2012p-001099.pdf>

Lu, N, P Du, Y Sun, X Guo, and FL Greitzer, "Data Mining for Residential Smart Meter Data," *IEEE Trans. on Smart Grid*, 2011.

Lu N, P Du, PR Paulson, FL Greitzer, X Guo, and MD Hadley. 2011. "The Development of a Smart Distribution Grid Testbed for Integrated Information Management Systems ." In *2011 IEEE PES General Meeting*, Anaheim, CA. PNNL-SA-77213, Pacific Northwest National Laboratory, Richland, WA. http://www.researchgate.net/profile/Ning_Lu4/publication/250305390_2011_general_meeting_The_development_of_a_smart_distribution_grid_testbed_for_IIMS/links/0046351e97e43a1f74000000.pdf

Lu N, P. Du, P.R. Paulson, F.L. Greitzer, X. Guo, and M. Hadley, "A Multi-layer, Hierarchical Information Management System for the Smart Grid." In 2011 IEEE Power & Energy Society General Meeting, Detroit, MI, July 24–29, 2011. [10.1109/PES.2011.6039214](http://dx.doi.org/10.1109/PES.2011.6039214)

Huang, Z., Y Chen, F.L. Greitzer, & R. Eubank. 2011. Contingency visualization for real-time decision support in grid operation. *IEEE Power and Energy Society General Meeting*, Detroit, MI. 10. DOI: [10.1109/PES.2011.6039887](http://dx.doi.org/10.1109/PES.2011.6039887)

Greitzer, F.L. 2010. "Wide-area situation awareness in electric power grid." Keynote Address and paper, *SPIE Defense*,



Security and Sensing, Proceedings. SPIE 7709A (Cyber Security, Situation Management, and Impact Assessment II), Keynote. DOI:10.1117/12.855674. <http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=1345109>

Chen, Y, Z Huang, PC Wong, P Mackey, C Allwardt, J Ma, and FL Greitzer.(2010). "An Advanced Visual Analytic Decision Support Tool for Electricity Infrastructure Operations." *The Fourth Annual IFIP WG 11.10 International Conference on Critical Infrastructure Protection, Washington, DC, March 15-17, 2010*. Also published in: *Critical Infrastructure Protection IV: IFIP Advances in Information and Communication Technology*, Volume 342, 2010, Chapter 17, pp 245-260. <http://dl.ifip.org/db/conf/ifip11-10/iccip2010/ChenHWMAMG10.pdf>

Greitzer, F. L., Podmore, R., Robinson, M., & Ey, P. (2010). Naturalistic Decision Making For Power System Operators. *International Journal of Human Computer Interaction (special issue on Naturalistic Decision Making with Computers)*, 26(2), 278-291. PNNL-SA-64674 http://www.bcs.org/upload/pdf/ewic_ndm09_s1paper2.pdf

Huang Z, PC Wong, PS Mackey, Y Chen, J Ma, KP Schneider, and FL Greitzer. (2008). Managing Complex Network Operation with Predictive Analytics. In *Proceedings of AAAI Spring Symposium on Technosocial Predictive Analytics*. AAAI Sprint Symposium Technical Report SS-09-09, 59-65. (ISBN: 978-1-57735-416-1) <http://www.aaai.org/Papers/Symposia/Spring/2009/SS-09-09/SS09-09-012.pdf> [PNNL-SA-63337]

Huang,Z., PC Wong, P Mackey, Y Chen, J Ma, K Schneider, and FL Greitzer. (2010). "Managing Complex Network Operations with Visual Analytical Techniques." In *Proceedings of the AAAI Spring Symposium on Technosocial Predictive Analytics, San Francisco, CA, March 22-25, 2009*.

Huang, Z., Wong, P. C., Mackey, P. S., Chen, Y., Ma, J., Schneider, K. P., & Greitzer, F. L. (2009). Managing Complex Network Operation with Predictive Analytics. *Proceedings of AAAI Spring Symposium on Technosocial Predictive Analytics*. PNNL-SA-63337 <http://www.aaai.org/Papers/Symposia/Spring/2009/SS-09-09/SS09-09-012.pdf>

Greitzer, F. L., A Schur, M Paget, & RT Guttromson. A Sensemaking Perspective on Situation Awareness in Power Grid Operations. *IEEE Power & Energy Society Annual Meeting—Conversion and Delivery of Electrical Energy in the 21st Century*, 20-24 July 2008, Pittsburgh, PA. Piscataway, NJ: IEEE, pp. 1-6. PNNL-SA-58145 DOI: [10.1109/PES.2008.4596285](http://dx.doi.org/10.1109/PES.2008.4596285)

Human Factors/Cognitive Engineering/Naturalistic Decision Making:

Greitzer, F. L., & DH Andrews. 2010. Training strategies to mitigate expectancy-induced response bias in combat identification: A research agenda. Chapter 11 in D.H. Andrews, R.P. Herz, and M. B. Wolf (Eds), *Human factors issues in combat identification*, Don Harris, Neville Stanton, and Eduardo Salas (Series Eds.) *Human factors in defence*. Surrey: Ashgate. 173-190. PNNL-SA-64673
Book: <http://www.ashgate.com/default.aspx?page=637&calcTitle=1&isbn=9780754677673&lang=cy-GB>
Chapter: http://www.pnnl.gov/cogInformatix/media/pdf/Greitzer-Andrews_CID_Chapter.pdf

Greitzer, F. L., Podmore, R., Robinson, M., & Ey, P. 2010. Naturalistic Decision Making For Power System Operators. *International Journal of Human Computer Interaction (special issue on Naturalistic Decision Making with Computers)*, 26(2), 278-291. PNNL-SA-64674 Also presented at *Naturalistic Decision Making Conference*, June 2009. PNNL-SA-62694 <http://dx.doi.org/10.1080/10447310903499070>

Griffith, D. & FL Greitzer (2008). Neo-Symbiosis: The next stage in the evolution of human information interaction. In Wang, Y. (Ed.), *Novel Approaches in Cognitive Informatics and Natural Intelligence*. Hershey, NY: Information Science Reference (IGI Global), expected December 2008. PNNL-SA-61688
<http://www.pnnl.gov/cogInformatix/media/pdf/Griffith-Greitzer-IJCINI-paper03.pdf>

Greitzer, F. L. 2008. Methodology, Methods and Metrics for Testing and Evaluating Augmented Cognition Systems. Chapter 6 in D. Schmorow & K. Stanney (Eds.) *Augmented Cognition: A Practitioner's Guide*. Santa Monica, CA: Human Factors Society, pp. 144-174. PNNL-SA-53145

Greitzer, F. L., & DH Andrews. 2008. Training strategies to mitigate expectancy-induced response bias in combat identification: A research agenda. Keynote Address and Invited Paper, *Human Factors in Combat ID Workshop*, May 2008, Mesa, AZ. PNNL-SA-59942. <http://cerici.org/workshop/2008Workshops/Greitzer-Andrews%20CID%20Chapter%20FINAL.pdf>



- Griffith, D. & FL Greitzer. 2008. Neo-Symbiosis: The next stage in the evolution of human information interaction. In Sugumaran, V. (Ed.) (2008) *Intelligent Information Technologies: Concepts, Methodologies, Tools, and Applications*. Hershey, NY: Information Science Reference (IGI Global), Vol. III, Section 8 (Emerging Trends), Ch. 8.19, pp. 2383-2396. PNNL-SA-57736
- Griffith, D. & FL Greitzer. (2007) Neo-Symbiosis: The next stage in the evolution of human information interaction. *International Journal of Cognitive Informatics and Natural Intelligence*, 1(1), 39-52. PNNL-SA-47192. <http://www.igi-global.com/article/neo-symbiosis-next-stage-evolution/1528>
- Greitzer, F.L. & Griffith, D. (2006). A Human-Information Interaction Perspective on Augmented Cognition. In D. D. Schmorrow, K. M. Stanney, & L. M. Reeves (Eds.), *Foundations of Augmented Cognition, 2nd Edition*. Arlington, VA: Strategic Analysis, Inc. and Augmented Cognition International Society. Pp. 261-267. Presented at the 2006 *Augmented Cognition International Conference*, San Francisco, CA. October 2006. PNNL-SA-49667.
- Greitzer, F. L. (2005) Extending the reach of augmented cognition to real-world decision making tasks. *Augmented Cognition International Conference*, Las Vegas, NV. http://www.researchgate.net/profile/Frank_Greitzer/publication/228629203_Extending_the_reach_of_augmented_cognition_to_real-world_decision_making_tasks/links/09e41510ff39447a86000000.pdf
- Greitzer, F. L. (2005) Toward the development of cognitive task difficulty metrics to support intelligence analysis research. *IEEE International Conference on Cognitive Informatics*, Irvine, CA. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1532647
- Pond, D. J., and FL Greitzer. (2005) Error-based accidents and security incidents in nuclear materials management. *Institute of Nuclear Materials Management 46th Annual Meeting*, Phoenix, AZ. <http://www.osti.gov/scitech/biblio/966022>
- Greitzer, F. L., and K Allwein. (2005) Metrics and measures for intelligence analysis task difficulty. Panel Session, 2005 *International Conference on Intelligence Analysis*, McLean, VA.
- Badalamente, R. V., and FL Greitzer. (2005) Top ten needs for intelligence analysis tool development. *2005 International Conference on Intelligence Analysis*, McLean, VA. https://www.pnl.gov/coginformatics/media/pdf/top10_paper.pdf
- Elm, W.C., MJ Cook, FL Greitzer, RR Hoffman, B Moon, and SG Hutchins. (2004) Designing Support for Intelligence Analysis. *Proceedings, Human Factors and Ergonomics Society 48th Annual Meeting*. New Orleans, LA. <http://pro.sagepub.com/content/48/3/406.short>
- Sanquist, T., FL Greitzer, A Slavich, R Littlefield, J Littlefield, and P Cowley. (2004) Cognitive Tasks in information analysis: Use of event dwell time to characterize component activities. *Proceedings, Human Factors & Ergonomics Society 48th Annual Meeting*. New Orleans, LA.

Training Technology/Advanced Interactive Computer-Based Learning:

- Greitzer, F.L., O.A. Kuchar, & K. Huston. (2007) Cognitive science implications for enhancing training effectiveness in a serious gaming context. *ACM Journal on Educational Resources in Computing (JERIC)*, 7 (3). Article 2 (August 2007) PNNL-SA-50293. <http://dl.acm.org/citation.cfm?id=1281322>
- Greitzer, F. L., DM Rice, SL Eaton, & MC Perkins. (2005) Learning to pull the thread: Application of guided-discovery principles to the inquiry process. *Proceedings, Interservice/Industry Training, Simulation, and Education Conference (IITSEC)*, December 2005. https://www.researchgate.net/profile/Frank_Greitzer/publication/228804244_Learning_to_Pull_the_Thread_Application_of_Guided_Discovery_Principles_to_the_Inquiry_Process/links/09e41510ff392dcbc4000000.pdf
- Greitzer, F. L., and DJ Pond. (2005) A novel approach to training on human errors underlying security incidents. *Human Performance Improvement Workshop*, Oak Ridge National Laboratory, September 2005. <http://www.osti.gov/scitech/biblio/965618>
- Pond, D. J., and FL Greitzer. (2005) Advanced approaches to incident investigation and prevention. *2005 ASIS International Emerging Trends in Security Technology*, Las Vegas, NV.
- Greitzer, F.L., DJ Pond, and M Jannotta. (2004) Scenario-Based Training on Human Errors Contributing to Security Incidents. *Proceedings, Interservice/Industry Training, Simulation, and Education Conference (IITSEC)*. https://www.researchgate.net/profile/Frank_Greitzer/publication/228918406_Scenario-



based_training_on_human_errors_contributing_to_security_incidents/links/09e41510ff392260f8000000.pdf

- Greitzer, F.L., MD Merrill, DM Rice, and DS Curtis. (2004) Representing Instructional Material for Scenario-Based Guided-Discovery Courseware. Proceedings, *Interservice/Industry Training, Simulation, and Education Conference (IITSEC)*. http://www.researchgate.net/profile/Frank_Greitzer/publication/242693278_Representing_Instructional_Material_for_Scenario-Based_Guided-Discovery_Courseware/links/53ecea1b0cf2981ada110190.pdf
- Greitzer, F. L., DM Rice, S Eaton, MC Perkins, RT Scott, and JR Burnette, and SR Robertson. (2003) A Cognitive Approach to e-Learning. Proceedings, *Interservice/Industry Training, Simulation, and Education Conference (IITSEC)*, December 2003. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.131.6932&rep=rep1&type=pdf>
- Greitzer, F. L. (2002) A Cognitive Approach to Student-Centered e-Learning. Proceedings, *Human Factors & Ergonomics Society 46th Annual Meeting*, October 2002. <http://pro.sagepub.com/content/46/25/2064.short>

Advanced Predictive Maintenance/Engine Prognostics:

- Ferryman, T. A., BD Matzke, JE Wilson, J Sharp, FL Greitzer, and E Hilferty. (2005) Engine Removal Projection Tool. *ASNE Intelligent Ship Symposium VI*, June 1-2, 2005, Villanova, PA.
- Greitzer, F. L. and RA Pawlowski. (2002) Embedded Prognostics Health Monitoring. *48th International Instrumentation Symposium, Engine Health Monitoring Workshop*, May 7-9, 2002. San Diego, California.
- Greitzer, F.L., CJ Hostick, RE Rhoads, and M Keeney. (2001) Determining *How to do Prognostics*, and then determining *What to do with it*. *AUTOTESTCON 2001*, August 20-23, 2001, Valley Forge, Pennsylvania.
- Greitzer, F. L. and TA Ferryman. (2001) Predicting Remaining Life of Mechanical Systems. *ASNE Intelligent Ship Symposium IV*, April 2-3, 2001, Philadelphia, Pennsylvania.
- Greitzer, F. L., LJ Kangas, KM Terrones, MA Maynard, BW Wilson, RA Pawlowski, DR Sisk, and NB Brown. (1999) Gas Turbine Engine Health Monitoring and Prognostics. *SOLE '99 Symposium*, August 31- September 2, 1999, Las Vegas, Nevada.
- Greitzer, F. L., EJ Stahlman, TA Ferryman, BW Wilson, LJ Kangas, and DR Sisk. (1999) Development of a Framework for Predicting Life of Mechanical Systems: Life Extension Analysis and Prognostics (LEAP). *SOLE '99 Symposium*, August 31-September 2, 1999, Las Vegas, Nevada.
- Wilson, B. W., NH Hansen, CL Shepard, TJ Peters, and FL Greitzer. (1999) Development of a Modular In-Situ Oil Analysis Prognostic System. *SOLE '99 Symposium*, August 31- September 2, 1999, Las Vegas, Nevada.
- Greitzer, F. L., LJ Kangas, and LTC M Melius. (1997) An automated health monitoring system for the Army M1A1/A2 main battle tank AGT-1500 gas turbine engine. *USAF Inaugural Engine Condition Monitoring (ECM) Workshop*, San Diego, CA.
- Kangas, L. J., FL Greitzer, and OJ Illi, Jr. (1994) TEDANN: Turbine Engine Diagnostic Artificial Neural Network. In *Proceedings of the American Defense Preparedness Association (ADPA) National Symposium & Exhibition on Advanced Information Systems and Technology for Acquisition, Logistics and Personnel Applications*, Williamsburg, VA.
- Illi, O. J, Jr, FL Greitzer, LJ Kangas, and T Reeve. (1994) An Artificial Neural Network System for Diagnosing Gas Turbine Engine Fuel Faults. In *Advanced Materials and Process Technology for Mechanical Failure Prevention: Proceedings, Mechanical Failures Prevention Group Conference (April 19-21, 1994)*. Wakefield, MA: Vibration Institute, 359-367.

Productivity Enhancement/Human-System Integration:

- Greitzer, F.L., BW Brown, JA Dorsey, and EA Raney. (1995) Pollution Prevention Electronic Design Guideline: A Tool for Identifying Pollution Prevention in Facility Design. *4th Annual Air Force Worldwide Pollution Prevention Conference and Exhibition*, San Antonio, TX.
- Greitzer, F.L., BW Brown, JA Dorsey, and EA Raney. (1995) A Tool for Identifying Pollution Prevention in Facility Design, *American Defense Preparedness Association 21st Environmental Symposium and Exhibition*, San Diego, CA, April 18-21, 1995.
- Greitzer, F. L., BW Brown, JA Dorsey, EA Raney, and J Stitzel. (1995) An electronic design guideline for incorporating pollution prevention into U.S. Department of Energy design projects. In *Proceedings, First International Plant Operations and Design Conference, Volume 3: Plant Equipment and Design*. American Institute of Chemical Engineers 1995 Spring National Meeting, Houston, TX, 5-13.



- Carson, M. L., TG Beaumariage, and FL Greitzer. (1993) Automation of constrained-value business forms. *Proceedings of the Second Industrial Engineering Research Conference*, Los Angeles, CA, 878-882.
- Greitzer, F. L., D Wunderlich, and M Weinberg. (1993) Hypermedia-based rapid interface prototyping. *Journal of the Society for Information Display*, 1(1), 111-119.
- Greitzer, F. L., and NJ Spalding. (1992) Maintaining stasis: Why user acceptance of advanced technology is so hard to get (and what to do about it). *Proceedings of the Human Factors Society 36th Annual Meeting*, Atlanta, GA, 384-388.
- Greitzer, F. L. (1991) Use of hypermedia tools for user interface rapid prototyping. *Society for Information Display International Symposium Digest of Technical Papers*, 22, 373-376.
- Greitzer, F. L. (1989) Prototyping a simulation-based intelligent tutoring system. Work-in-Progress poster session, *Human Factors Society Annual Meeting*, Denver, CO.
- Greitzer, F. L. (1986) Intelligent interface design and evaluation. *Proceedings, Conference on Artificial Intelligence for Space Applications*, Huntsville, Alabama, November 13-15, 1986, 491-498.
- Greitzer, F. L., RL Hershman, and J Kaiwi. (1985) Intelligent interfaces for C² operability. *Proceedings of the 1985 IEEE Conference on Systems, Man, and Cybernetics*, 1985, 782-786.
- Greitzer, F. L., and RL Hershman. (1984) Modeling decision making strategies in simulated AAW operations. *Proceedings of the 7th MIT/ONR Workshop on C³ Systems*, 1984, 145-150.
- Greitzer, F. L., and RL Hershman. (1983) Decision and display analysis in a simple surveillance problem. *Proceedings of the 6th MIT/ONR Workshop on C³ Systems*, 1983, 91-95.
- Hershman, R. L., and FL Greitzer. (1982) Detecting a change in target location: A comparison of human and optimal performance. *Proceedings of the 5th MIT/ONR Workshop on C³ Systems*, 1982, 133-138.
- Greitzer, F. L., RT Kelly, and RL Hershman. (1982) Human memory limitations in multi-object tracking. *Proceedings of the 5th MIT/ONR Workshop on C³ Systems*, 1982, 127-132.
- Greitzer, F. L., RL Hershman, and RT Kelly. (1981) The air defense game: A microcomputer program for research in human performance. *Behavior Research Methods and Instrumentation*, **13**, 57-59

Human Learning and Memory Research:

- Greitzer, F. L. (1976) Intracategory rehearsal in list learning. *Journal of Verbal Learning and Verbal Behavior*, 1976, **15**, 641-654.
- Wickens, T. D., and FL Greitzer. (1975) Second responses in paired- associate learning. *Journal of Mathematical Psychology*, 1975, **12**, 225-261.
- Greitzer, F. L. (1975) Retrieval processes during acquisition. Some interpretations of organizational processes in categorized recall. Doctoral Dissertation, UCLA, 1975.
- Friedman, M. P., and FL Greitzer. (1972) Organization and study time in learning from reading. *Journal of Educational Psychology*, **63**, 609-616.

WORKSHOPS AND INVITED LECTURES

- Greitzer, FL. (2018). Unintentional insider threats. Presented at *2018 Security Awareness Special Interest Group (SASIG) Workshop*, Richland, WA, April 9-12, 2018.
- Greitzer, F.L. (2011). "A Hierarchical Reasoning Framework for Threat Analysis and Anticipation." Workshop Invited Talk, *Computational Cybersecurity in Compromised Environments (C3E)* [Sponsored by ODNI and NSA], Keystone, CO, September 26, 2011. PNNL-SA-82902.
- Greitzer, F.L. (2010). "Wide-area situation awareness in electric power grid." Keynote Address and paper, *SPIE Defense, Security and Sensing*, Proceedings. SPIE 7709A (Cyber Security, Situation Management, and Impact Assessment II), Keynote.
- Greitzer, F. L., and Andrews, D. H. (2008). Training strategies to mitigate expectancy-induced response bias in combat identification: A research agenda. Keynote Address and Invited Paper, *Human Factors in Combat ID Workshop*, May 2008, Mesa, AZ., April 2008.



- Greitzer, F. L. (2007). Insider Threat Predictive Modeling. ODNI-Private Sector Engagement on Insider Threat. Washington, D.C., May 30, 2007.
- Greitzer, F. L. (2005) "Ingredients of Effective and Engaging Online Learning (or... Musings of a cognitive/e-Learning Evangelist)." *InterLab 2005*. Richland, WA. December 14, 2005.
- Pond, DJ, S Mace, and FL Greitzer. (2005) Assessing, Reporting, and Eliminating Error-Based Security Incidents. Workshop presented at the *2005 DOE Computer Security Group Conference*. Denver, CO. April 18, 2005.
- Greitzer, F. L. (2003) "A Cognitive Approach to e-Learning." *Learning and Training Week 2003 Conference and Exposition*, Washington D.C.
- Greitzer, F. L. (1999) "Gas Turbine Engine Health Monitoring and Prognostics." Invited presentation, TACOM/Industry Logistics Data Symposium '99, Troy, MI.
- Greitzer, F.L. (1997) "P2 EDGE: A Pollution Prevention Environmental Design Guide for Engineers." Invited Lecture and demonstration presented to Federal Agency Environmental Roundtable, February 20, 1997, Washington DC.

SELECTED TECHNICAL REPORTS

- LR O'Neil, FL Greitzer, TJ Conway, AC Dalton, DH Tobey, & PK Pusey. (2014). *Secure Power Systems Professional Phase III Final Report: Recruiting, Selecting and Developing Secure Power Systems Professionals*. Technical Report PNNL-23583. Richland, WA: US Dept of Energy/Pacific Northwest National Laboratory. https://www.controlsroadmap.net/ieRoadmap%20Documents/SPSP_Phase3.pdf
- Greitzer FL, TE Carroll, and AD Roberts. 2011. *Cyber Friendly Fire*. PNNL-20821, Pacific Northwest National Laboratory, Richland, WA. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20821.pdf
- Greitzer, FL, PM Dauenhauer, TG Wierks, R Podmore, and A Dalton, "Experimental Evaluation of Electric Power Grid Visualization Tools in the EIOC," Pacific Northwest National Laboratory, Richland, WA, Rep. PNNL-19103, 2010.
- Greitzer, F. L., P. R. Paulson, L. J. Kangas, L. R. Franklin, T. W. Edgar, & D. A. Frincke. 2009. *Predictive modeling for insider threat mitigation*. Technical Report PNNL-SA-65204. Richland, WA: PNNL.
- Greitzer, F. L., & Podmore, R. (2008). *Naturalistic Decision Making in Power Grid Operations: Implications for Dispatcher Training*. Pacific Northwest National Laboratory: Report PNNL-18040. November 2008
- Guttromson, R.T., A Schur, FL Greitzer, & M Paget (2007). Human factors for situation awareness in power grid operations. Pacific Northwest National Laboratory: Report PNNL-167803. August, 2007.
- Greitzer, F. L., LJ Kangas, T Edgar, AJ Brothers, & P Paulson (2007). Predictive Adaptive Classification Model for Analysis and Notification: Insider Threat (PACMAN:IT). Pacific Northwest National Laboratory: Report PNNL-16713. July, 2007.
- Greitzer, F. L., AJ Brothers, JD Fluckiger, CA Goranson, RE Mahan, LM Martucci, & JB Packard. Modeling Human Behavior in Cyberspace: The Insider Threat. Final Report. Pacific Northwest National Laboratory: Report PNNL-15948. September, 2006. [FOR OFFICIAL USE ONLY]
- Greitzer, F. L. Methodology, Metrics and Measures for Testing and Evaluation of Intelligence Analysis Tools. Battelle, Pacific Northwest Division Technical Report PNWD-3550, March 2005.
- Greitzer, F. L. Data Collection Requirements for the Initial Glass Box Releases. Battelle, Pacific Northwest Division Technical Report PNWD-3214, November 2002.
- Greitzer, F. L., RV Badalamente, and TS Stewart. Collaborative Human-Machine Nuclear Non-Proliferation Analysis. Pacific Northwest Laboratory: Technical Report PNL-8922, 1993.
- Greitzer, F. L. Prototyping a Prototype with HyperCard/SuperCard. (MDC Report K4595). Denver: McDonnell Douglas Corporation, November 1989.
- Greitzer, F. L., BB Doehr, and BW Griffin. Artificial intelligence for manufacturing in the Electronics Manufacturing Facility (Final Report, ESO Task 55195). Denver: Martin Marietta Astronautics Group, December 1987.
- Greitzer, F. L., and DW Pachura. Phoenix User-Interface Rapid Prototyping System (Final Report, ESO Task 55007). Denver: Martin Marietta Astronautics Group, December 1987.
- Greitzer, F. L. Ada Workstation user interface design and implementation. (Report No. D87-46789-001). Denver: Martin



Marietta Denver Aerospace, Space Station Program, July 1987.

- Funk, K. H. II, and FL Greitzer. Computer-aided tactical situation assessment: Progress report and annotated bibliography. (HFOSL Technical Note 71-86-14). San Diego: Navy Personnel Research and Development Center, June 1986.
- Greitzer, F. L., and RL Hershman. Inferring threat assessment strategies in simulated antiair warfare (AAW) operations. (NPRDC TR 84-47). San Diego: Navy Personnel Research and Development Center, July 1984.
- Funk, K., FL Greitzer, and SG Hutchins. Prototype intelligent tactical assistant (ITA): I. Conceptual design and initial implementation. (NPRDC TR 84-38). San Diego: Navy Personnel Research and Development Center, March 1984.
- Greitzer, F. L., SG Hutchins, and RT Kelly. Dual-task performance in a simulated antiair warfare (AAW) problem. (NPRDC TR 84-39). San Diego: Navy Personnel Research and Development Center, March 1984.
- Greitzer, F. L., RT Kelly, and RL Hershman. Interactive simulation of mine countermeasures operations. (NPRDC SR 83-49). San Diego: Navy Personnel Research and Development Center, August 1983.
- Hershman, R. L., and FL Greitzer. A prototype man-machine interface for subsystem integration in undersea surveillance. (NPRDC SR 83-22). San Diego: Navy Personnel Research and Development Center, March 1983. (SECRET)
- Greitzer, F. L., RT Kelly, and RL Hershman. Human memory limitations in multi-object tracking. (NPRDC TR 82-48). San Diego: Navy Personnel Research and Development Center, June 1982.
- Hershman, R. L., and FL Greitzer. An improved air defense simulation for the Tektronix 4054. (NPRDC TN 82-26). San Diego: Navy Personnel Research and Development Center, August 1982.
- Kelly, R. T., and FL Greitzer. Effects of track load on decision performance in simulated command and control operations. (NPRDC TR82-21). San Diego: Navy Personnel Research and Development Center, January 1982.
- Kelly, R. T., FL Greitzer, and RL Hershman. Air defense: A computer game for research in human performance. (NPRDC TR 81-15). San Diego: Navy Personnel Research and Development Center, July 1981.

INVENTION REPORTS

- “Columnar Hierarchical Auto-associative Memory Processing In Ontological Networks (CHAMPION).” Patent application. RE Hohimer, FL Greitzer, S. Hampton (submitted March 21, 2011).
- “Method for Incorporating Cultural Factors into Threat Scenario Assessment.” IDR 2523. FL Greitzer, B Esmailzadeh, PR Paulson, HJ Lester, LJ Kangas. (May 2008).
- “Predictive Classification and Reasoning Methods for Insider Threat Mitigation.” IDR 2503. FL Greitzer, PR Paulson, LJ Kangas, TW Edgar, MM Zabriskie, L Franklin, JR Burnette (April 2008)
- “Predictive Insider Cyber Threat Detection.” Invention Report 15194-E/ IDR 1737. FL Greitzer, JR Burnette, BH McMillan (May 2006)
- “Method Underlying Prediction of Cyber Behavior.” Invention Report 15194-E/ IDR 1736. FL Greitzer, AJ Brothers, CA Goranson, JD Fluckiger, JB Packard, LM Martucci (May 2006)
- “Use of Brain Monitoring Technology to Support Predictive Insider Threat Detection.” Invention Report 15240-E/ IDR 1771. FL Greitzer (May 2006)
- “SORT: Scenario-based Operations, Recruitment and Training.” FL Greitzer. (May 2005)
- “A Distributed Intrusion Protection System for Ultra High Bandwidth Networks.” (PNNL 14307-E) CA Goranson, JR Burnette, FL Greitzer, and BH McMillan. (January 2004).
- “Automated Development Tools for Guided Discovery/Scenario-Based Learning and Intelligent Performance Support.” (PNL-14318). FL Greitzer, DM Rice, DS Curtis (January 2004)
- “Implementing Learning Content ‘Pedigree’ for Automatic Updating of Course Content.” (PNL 14314-E). FL Greitzer, DM Rice, DS Curtis, CR Younkin, KL Morris. (January 2004)
- “Transparent Communications Analysis Tools.” JR Burnette, CA Goranson, FL Greitzer (Aug 2003)
- “On-Board Diagnostics and Prognostics Apparatus for Reciprocating Engines.” (PNNL 13458-E). FL Greitzer and RL Pawlowski. (January 2002).
- “Multimedia Interaction Elements for Scenario-Based Distribution Learning.” (PNNL 13789-E) FL Greitzer, DM Rice, RT Scott, MC Perkins, SL Eaton, and JR Burnette. (September 2002).