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INNOVATIVE ASSESSMENT OF COLLABORATION 2014



Meeting Program

November 3–4, 2014
Arlington, Virginia

November 3rd - November 4th, 2014
DoubleTree by Hilton – Crystal City
300 Army Navy Drive
Arlington, VA
USA

The rapidly growing literature on teamwork and collaborative problem solving suggests that these skills are becoming increasingly important in today's organizations. However, significant developments in the evaluation of these skills are occurring within different research communities, often independently of one another.

Educational Testing Service (ETS) is hosting a two-day working meeting organized around five thematic panels that will bring together researchers in organizational teaming, educational collaboration, tutoring, simulation, gaming, and statistical and psychometric process modeling. Practitioners and researchers who approach teamwork and collaborative problem solving from different perspectives will come together to share insights and contribute to the development of reliable and valid collaborative assessment.

Alina A. Von Davier

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Educational Testing Service

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Meeting Agenda

<i>Time</i>	<i>Day 1: Collaborative Tasks</i>
8:30 a.m. – 9:50 a.m.	Registration & Breakfast
9:50 a.m. – 10:00 a.m.	Welcome Alina von Davier (Educational Testing Service)
10:00 a.m. – 10:20 a.m.	Opening Remarks Gerald Goodwin (US Army Research Institute)
10:20 a.m. – 12:00 p.m.	Panel 1: Organizations (Moderator: Patrick Kyllonen) Eduardo Salas (University of Central Florida) Leslie DeChurch (Georgia Institute of Technology) Noshir Contractor (Northwestern University) Stephen Fiore (University of Central Florida)
12:00 p.m. – 1:30 p.m.	Lunch
1:30 p.m. – 3:10 p.m.	Panel 2: Interactive Learning Environments (Moderator: Alina von Davier) Art Graesser (University of Memphis) Carolyn Penstein Rosé (Carnegie Mellon University) Vincent Aleven (Carnegie Mellon University) & Nikol Rummel (Ruhr-Universität Bochum & Carnegie Mellon University) Saad Khan (Educational Testing Service)
3:10 p.m. – 3:30 p.m.	Break
3:30 p.m. – 5:10 p.m.	Panel 3: Education (Moderator: Art Graesser) Patrick Griffin (University of Melbourne) Paul Borysewicz & Eric Steinhauer (Educational Testing Service) Alina von Davier (Educational Testing Service) Patrick Kyllonen (Educational Testing Service)
5:10 p.m. – 5:30 p.m.	Summary of Day 1 Patrick Kyllonen (Educational Testing Service)
7:00 p.m.	Panelist Dinner (Madison Room)
<i>Time</i>	<i>Day 2: Modeling Methods</i>
8:00 a.m. – 8:30 a.m.	Breakfast
8:30 a.m. – 8:40 a.m.	Welcome to the Second Day Alina von Davier (Educational Testing Service)
8:40 a.m. – 10:20 a.m.	Panel 4: Statistical Models for Process Data (Moderator: Patrick Kyllonen) Peter Halpin (New York University) Ronald Stevens (University of California, Los Angeles) Yoav Bergner (Educational Testing Service) Jiangang Hao (Educational Testing Service)
10:20 a.m. – 10:40 a.m.	Break
10:40 a.m. – 12:00 p.m.	Panel 5: Statistical Models for Collaboration and Group Dynamics (Moderator: Alina von Davier) Sy-Miin Chow (Pennsylvania State University) Tracy Sweet (University of Maryland, College Park) Mengxiao Zhu (Educational Testing Service)
12:00 p.m. – 12:20 p.m.	Closing Remarks Scott Paris (Educational Testing Service)
12:20 p.m. – 12:30 p.m.	Summary Patrick Kyllonen (Educational Testing Service)
12:30 p.m. – 1:30 p.m.	Lunch

Panel I:
Evaluation of Team Performance in Organizations

This panel will discuss methods and findings for evaluating collective performance in organizational settings. Presenters include:

- **Eduardo Salas** (University of Central Florida), who is an expert on teamwork, team training, advanced training technology, decision-making under stress, learning methodologies, and performance assessment.
- **Leslie DeChurch** (Georgia Institute of Technology), who studies leadership and teamwork in organizations with a special focus on leadership networks and multi-team systems.
- **Noshir Contractor** (Northwestern University), who investigates factors that lead to the formation, maintenance, and dissolution of dynamically linked social and knowledge networks in various types of teams in both real-world and virtual-world teams.
- **Stephen Fiore** (University of Central Florida), who conducts interdisciplinary research that incorporates the cognitive, social, organizational, and computational sciences in the investigation of learning and performance in individuals and teams.



The Measurement of Collectives: Some Observations After Three Decades of Research and Practice

Eduardo Salas

During the last three decades we have seen significant progress in the assessment and measurement of groups, teams, units, and collectives. There are better tools and approaches to capture the complexities of group phenomena. However, after 30 years of conducting research across a number of different types of collectives and using these tools in practice, a few challenges remain. In this brief presentation, I will outline ten observations on the measurement of collectives. These will serve as food-for-thought in order to continue the forward movement in this important domain.

Confluent and Countervailing Forces Within and Between Teams

Leslie DeChurch

Some processes that enable teams to function well have unintended consequences when teams collaborate as part of tightly-coupled systems of teams (i.e., multiteam systems; MTSs). This talk will explain these paradoxes teams face using the conceptual notion of countervailing forces. After presenting four idealized situations wherein the activities needed for a team to function internally are at odds with those needed for system effectiveness, I will present an empirical study that applies the framework finding support for countervailance arising from team internal communication networks. The talk concludes with a discussion of the implications of countervailing forces for building collaborative organizational systems.

Some Assembly Required: Organizing in the 21st century

Noshir Contractor

Recent technological advances provide comprehensive digital traces of social actions, interactions, and transactions. These data provide an unprecedented exploratorium to model the socio-technical motivations for creating, maintaining, dissolving, and reconstituting into teams. Using examples from research on collaboration in science, software development and massively multiplayer online games, Contractor will argue that Network Science serves as the foundation for the development of social network theories and methods to help advance our ability to understand the emergence of effective teams. More importantly, he will argue that these insights will also enable effective teams by building a new generation of recommender systems that leverage our research insights on the socio-technical motivations for creating ties.



From Neurons to Networks: Examining Interactions between Brains and Bodies over Time and Space

Stephen M. Fiore

One of the pressing issues for understanding team cognition is development of interdisciplinary teams capable of synthesizing theory and methods with new theory and new technologies. The study of teams is becoming increasingly sophisticated and it is an important time for research that crosses levels and disciplines in the study of interaction. We are having introduced to us many new concepts and methods helping us study the world of interaction within and across multiple levels of analysis. For example, neuroscientists are helping us to understand, at the micro-level, the neurobiological underpinnings of social-cognitive processes. Researchers in the computational and social sciences are creating a fascinating blend of disciplines to study meso-level patterns of interaction. At the more macro-level, researchers in network science are studying broad patterns of interaction across multiple time scales. This represents a small sample of research emerging at varied levels of analysis of team cognition. My goal with this presentation is to discuss how we can leverage complementary capabilities to reap the intellectual rewards through development of new theories that transcend disciplines and provide a fuller understanding of teams.



***Panel II:
Evaluation of Students Working Together in Tutoring Environments,
Games, and Simulations***

This panel will focus on interactive learning environments, such as intelligent tutors, games, and simulations. Presenters include:

- **Art Graesser** (University of Memphis), who designed, developed, and tested software that integrates psychological sciences with learning, language, and discourse technologies.
- **Carolyn Penstein Rosé** (Carnegie Mellon University), who studies the approaches from computational discourse analysis and text mining, conversational agents, and computer supported collaborative learning.
- **Vincent Aleven** (Carnegie Mellon University) and **Nikol Rummel** (Ruhr-Universität Bochum and Carnegie Mellon University), who develop novel technologies for instruction, in particular for creating intelligent tutoring systems.
- **Saad Khan** (Educational Testing Service), who has expertise in developing computer vision and human machine interaction algorithms.



Collaboration through Dialogues and Trialogues with Conversational Agents

Art Grasser

Recent advances in computational linguistics and discourse processing have made it possible to analyze naturalistic texts and conversation on multiple levels of language and discourse. These advances are influencing the world of assessments of reading, writing, mathematics, science, reasoning, problem solving, and other competencies. This presentation reports research conducted in the Institute for Intelligent Systems on *conversational agents* that interact with the human in natural language. For example, *AutoTutor* is an agent that helps students learn by holding a collaborative dialogue in natural language. The agent and tutor co-construct answers to questions, solutions to problems, explanations, and complex content through a variety of speech acts: short feedback, pumps for information, hints, prompts for specific words, corrections, assertions, summaries, requests for summaries, and fragments of missing information. *Trialogues* are conversations between the human students and two computer agents that play different roles (e.g., student, tutor). Trialogues can model interactions (between the student agent and tutor agent) and elicit information from the human student following systematic conversational patterns. Trialogues have been developed for the Internet in serious games on scientific reasoning (*Operation ARA*), in assessments with Educational Testing Service, and in a Center for the Study of Adult Literacy for struggling adult readers. The conversational patterns of these agents are based on extensive empirical analyses of human tutoring in addition to ideal theoretical strategies of collaboration.

Assessment of Learning in Collaborative Tasks

Carolyn Penstein Rosé

In this panel talk I will discuss the role of conversation in collaborative learning and how operationalizations of the related constructs can be used to rate how beneficial for learning a conversational interaction has been. I will compare how conversational processes have been operationalized using constructs from the Learning Sciences as well as Linguistics, with an emphasis on Systemic Functional Linguistics. I will then describe an integrated perspective and discuss work towards automation of relevant constructs using machine learning and text mining technology. I will highlight findings from quantitative analyses that point to the importance of these constructs in discussion for learning in threaded discussion, synchronous chat, and face to face discussion.



Using Tutor Log Data and Dual Eye Tracking to Study Learning With a Collaborative Intelligent Tutoring System

Vincent Alevan, Nikol Rummel, Jennifer Olsen, Daniel Belenky, & Michael Ringenberg

Collaborative learning has been shown to be beneficial for older students, but there has not been much research that investigates how best to support effective collaborative learning among elementary school students. In our research project, we use a collaborative Intelligent Tutoring Systems (ITS) for 4th and 5th grade fractions learning as a platform to investigate the relative strengths of collaborative and individual learning, so as to (eventually) combine them effectively.

We conducted a study in a school with 84 4th and 5th grade students, each working with our ITS for a single session on fraction equivalence. Students either worked individually or collaboratively, and worked either on problems targeting procedural knowledge or conceptual knowledge. The collaborative groups had the same learning gains as the individual groups although with fewer problems in the same amount of time. Analysis of tutor log data shows learning of key fractions knowledge components. We expand upon a new methodology, dual eye-tracking, to understand how collaborators' joint visual attention (measured as gaze convergence) may impact learning. Analysis of eye tracking data revealed a surprising correlation between joint visual attention and conceptual learning on problems targeting procedural knowledge.

This work indicates that by embedding collaboration scripts in ITSs, collaborative learning can be an effective instructional method even with young children. These results may inform the design of future learning technologies, and illustrate the utility of using tutor log data as well as dual eye-tracking to study collaboration.

Behavioral Analytics in Intelligent Training Systems

Saad Khan

As the boundary blurs between what is real and what is virtual in today's learning environments, there is a growing need for new assessment tools that capture behavioral aspects key to evaluating skills like problem solving, communication, and collaboration. This talk presents an approach for developing interactive training systems that capture and analyze trainee/s behavior at multiple levels of abstraction for automated performance assessment. A key challenge considered here is to capture and understand human behavior at fidelity sufficient to estimate cognitive and affective state as manifests through multiple mediums including speech, body pose, gestures, gaze, etc. However, analyzing each of these modalities in isolation may result in incongruities. In addition, the affective states of a person show significant variations in time. To address these issues we model the temporal dynamics and integration of multiple data modalities using conditional random fields (CRFs) on observable data. We demonstrate our approach in the context of simulated intelligent tutoring systems where a detailed understanding of human/trainee behavior is used to customize and drive the flow of training scenarios.



***Panel III:
Evaluation of Collaborative Problem Solving Performance in Educational
Settings***

This panel will discuss students working collaboratively in educational settings, such as problem solving. It includes:

- **Patrick Griffin** (University of Melbourne), who is an expert on broad topics in assessment and evaluation and has developed dozens of online collaborative problem solving tasks that are used in 10 countries.
- **Paul Borysewicz and Eric Steinhauer** (both from Educational Testing Service), who are experts on psychometric methodologies and will discuss the development of the collaborative tasks for PISA 2015.
- **Alina von Davier and Patrick Kyllonen** (both from Educational Testing Service), who are both assessment experts and will discuss the collaborative problem solving projects at ETS.



Challenges of Internet Based Collaborative Problem Solving Assessment

Patrick Griffin

This presentation will examine the challenges experienced in the development of human to human collaborative problem-solving assessment tasks. The challenges included the definition, development of tasks, the delivery, student and school access and real time scoring, calibration dealing with dependencies built into the process, interpretation, and reporting to students and teachers. There were also issues associated with developing teacher skills in using the data to make instructional decisions about improvement of student performance in these areas.

An additional area of challenge was the idea of bringing this to scale, developing and negotiating policy implications, and working with education systems and jurisdictions to influence curriculum.

Among the strategies adopted to meet these challenges was to set assessments within a developmental conceptual framework, developing an online delivery for teacher development, and providing informative feedback procedures for students, teachers and schools. In addition a planned series of publications outlining the conceptualisation of the issues, methodological approaches, and research underpinning the study are planned as a means of addressing the issues and challenges. The presentation of research outcomes via a massive open online course and the formation of a global consortium for research into the C21 skills defined in the ATC21S project.

The PISA 2015 Collaborative Problem Solving Measure: A Large-scale Standardized Assessment of CPS skills

Paul Borysewicz and Eric Steinhauer

This session will provide information about the Collaborative Problem Solving measure that will form part of the PISA test in 2015. The PISA CPS measure is the first large-scale standardized assessment of individual CPS skills. The session will provide a brief overview of the CPS Framework that was used to create the measure. The presenters will then describe some of the major constraints and design decisions that shaped the development of the measure and describe the scenario-based items that form the basis of the measure. The presenters will also discuss preliminary statistical results derived from field tests of the items.



A Research Programme for Collaborative Assessments

Alina von Davier

In this presentation I will describe a comprehensive programme that we put in place at Educational Testing Service for building a collaborative assessment. The main categories of research in this programme are construct, technology in delivery and scoring, assessment and psychometric design, data management, and statistical modeling and data mining. We have started various projects in each of these categories. Some projects are very large and span more than one category. The main message of this talk is that a valid and reliable collaborative assessment results from the appropriate assembly of many (seemingly) independent building blocks. I will give examples of projects and their role in the programme. The focus of the presentation is on psychometric models that account for dependences among items and people

Outline of a Framework and Roadmap for Collaborative Problem Solving Assessment

Patrick C. Kyllonen

Educational Testing Service is engaged in several lines of research intended to lead to a better understanding of collaborative problem solving for K-12, higher education, and the workplace. The emphasis is on exploring strategies for assessing individual and group collaborative problem solving skill. In this talk I will provide a background on why this topic has attracted so much attention, summarize some of the knowns and unknowns, then outline a general research framework. The framework proposes a set of key outcomes at both individual and team levels (content, strategy, collaborative learning, task knowledge, team knowledge, situational awareness), and a set of participant background variables (e.g., cognitive and noncognitive skills), task variables (e.g., well vs. ill-structured, assigned participant roles), and process variables (e.g., personal acknowledgement, turn taking, comprehension monitoring) as predictors for the outcomes. The talk concludes with a discussion of prospects for collaborative assessment in low- and high-stakes settings.



Panel IV:
Statistical Models for Dependent Process Data

In this session, the presenters will discuss several modeling approaches to dependent time series that represent the individuals' actions during a collaborative problem solving task or other form of team interaction. The presenters also may address the integration of the models for process data and outcome data. Presenters include:

- **Peter Halpin** (New York University), who together with Alina Von Davier has proposed a model for studying interactions based on the Hawkes process.
- **Ron Stevens** (University of California, Los Angeles and TLC Inc.), who is using EEG to model team Neurodynamics in settings as diverse as US Navy Submarine Piloting and Navigation and high school problem solving.
- **Yoav Bergner** and **Jiangang Hao** (both from Educational Testing Service), who apply novel techniques, such as cluster analysis and editing distance, in analyzing process data.



Modeling Collaboration Using Point Processes

Peter Haplin, Alina von Davier, Jiengang Hao, & Lei Lui

In this paper we elaborate the uses of point processes and related methods for modeling interdependence in multivariate time series data. For example, we may be concerned with how the actions of one student depend on those of one or more other students during a collaborative task. In this case, each univariate margin of the process corresponds to the actions of a single student. Point processes let us model the dependence in timing among students' actions — for instance, do the actions of one student increase the probability of actions by one or more other students in the near future? This provides an intuitive measure of engagement among team members, and we present some initial work on a “collaboration index” to quantify this notion engagement. Point processes also provide a framework for incorporating domain- and task-relevant variables. For example, such variables could represent whether each component of a task was completed “correctly.” This leads us to pose a basic question to the workshop participants: How should information about task mastery be combined with information about team engagement? One option we consider is to report two scores, one for task mastery and one for team engagement, each of which can be provided at the individual level. We illustrate this work with applications to professional basketball and an educational collaborative problem solving task designed by Educational Testing Service.

Measuring the Neurodynamics of Team Organizations

Ron Stevens and Trysha Galloway

Team neurodynamics seeks to describe how social coordination at the neurophysiologic level reflects / influences behavior and performance at the team level. As teams perform complex tasks in naturalistic settings, across-brain synchronizations develop in response to both changing task demands as well as the verbal and non-verbal communication and interaction patterns of team members. Few approaches exist for determining the frequency, magnitude, and duration of these neurophysiologic synchronizations.

Our studies show that EEG power relationships of team members can be converted into symbolic alphabets where each symbol represents the levels of EEG markers of individual team members and the team as a whole. The symbol expression is updated each second as team neurodynamics evolves in parallel with the task providing a unique temporal perspective (and history) of how the team and its members responded to periodic routines and unexpected challenges.

Quantitative estimates of the degree of team synchronization can be made by calculating the Shannon entropy of the symbolic data streams over a moving time window. Fluctuations in the entropy-based data streams have a multi-fractal structure where prolonged (3-5 minutes) fluctuations reflect team synchronizations to major task changes, while shorter (minutes) variations reflect more minor internal and external task perturbations.



These measurements of when teams are neurodynamically ‘in-synch’ are providing new insights into the role of the task (i.e. US Navy navigation vs. high school problem solving) in shaping team neurodynamic profiles, as well as into the cross-level effects between neurophysiological, cognitive, and behavioral levels as a function of the task, team experience, and training.

Dynamical Bayesian Network Analysis of Peer Tutoring Interactions

Yoav Bergner

The ability to automatically distinguish between successful and deleterious patterns in collaborative learning sessions opens doors to improved opportunity for learning in pairs or groups even when a teacher might not be available to facilitate. In this presentation, data from one-time computer-based peer tutoring sessions are modeled using hidden Markov models (HMMs) in two ways. The first model uses an input-output HMM to compare the assistance value of different tutor inputs in helping the tutee correct a mistaken step in solution. This model uses only automatically generated codes based on context and cognitive content of the tutor chat. Its successes and failures are both informative! The second model predicts tutee normalized gains from pre- to post-test in the experimental condition. Both cognitive and affective labels to tutor chats (human-coded) were included as well as tutee (in)correctness, undos, and chats back to the tutor. Performance of the HMM is favorable compared to a “static” logistic regression model using aggregated totals of the same observables. Some of the hidden states are readily interpretable, though deeper comparison between high- and low-gain groups is part of ongoing work.

Assessing CPS in Action: Practical Considerations and Preliminary Results

Jiangang Hao

Collaborative problem-solving skill (CPS) is one the most important 21st skills needed to be assessed rigorously. Educational simulations or games can provide complex digital environments that are very promising for eliciting more collaboration, making them good candidates for assessing CPS. In this talk, I will focus on some practical considerations for implementing an assessment for CPS and will introduce a specific project for assessing the CPS, in which two participants will form a team to complete a simulation task about volcano science. We collected our data from Amazon Mechanical Turk and have collected responses from over 300 dyads to date. I will introduce the task deployment, data management, data collection, log file mining, and our plans for modeling the process data. Some preliminary results based on the early data will be presented.



***Panel V:
Statistical Models for Collaboration and Group Dynamics***

This panel will discuss advanced statistical models used in analyzing collaboration and group dynamics, such as social network models and Bayesian modeling. The presenters include:

- **Sy-Miin Chow** (Pennsylvania State University), who uses Kalman filter approaches and dynamical systems models to represent the dynamics of emotion regulation.
- **Tracy Sweet** (University of Maryland), who has expertise in social networks applied to education.
- **Mengxiao Zhu** (Educational Testing Service), who studies the impact of social networks on team assembly and performance.



Representing Trends, Moment-to-Moment Variability and Non-stationarities in Dyadic and Family Processes Using Dynamic Systems Modeling Techniques

Sy-Miin Chow

Dynamic systems modeling techniques provide a convenient modeling platform for representing systematic trends as well as patterns of intraindividual variability around these trends. Their flexibility in accommodating multivariate processes renders them particularly suited to studying dyadic and family processes that show complex ebbs and flows over time. Using dyadic data collected during the Face-to-Face/Still-Face (FFSF) procedure, examples are provided to illustrate the use of dynamic systems techniques to represent (1) systematic trends that are relatively smooth and slow-varying, (2) transient patterns of intraindividual variability that are manifested on a moment-to-moment basis, and (3) multivariate dynamic processes that show nonstationarities in the form of time-varying coefficients.

Modeling Teacher and Student Social Networks

Tracy Sweet

Experimental and observational studies in education are sometimes focused not on the effects of changing curriculum, teaching and learning materials, or classroom technique, but rather on changes in the way students -- or teachers, teaching coaches, and administrators -- interact with one another (e.g., relationship between transformational leadership and leaders' professional social connections, influence of peer group structure on student behavior and aggression, diffusion of innovation and reform initiatives in schools, advice giving/receiving, social capital among teachers, etc.). Many whole school initiatives encourage some type of social structural change, be it an increase in collaboration, distribution of leadership, or a push toward small learning communities: in short, they encourage changes in the social networks of students and of professionals in school systems.

Social Network Models enable researchers to model and detect the effects of interventions and other covariates on the structure of social networks. In this talk, I will introduce several of these models and describe how they can be used in practice. In addition, I will illustrate two real-world examples using teacher advice-seeking networks and student friendship networks.



Team Assembly and Performance in Large Scale Online Role Playing Games

Mengxiao Zhu

The development in information and communication technology in the contemporary society brings dramatic changes to how teams are assembled and team members work together. Nowadays, many teams are ad hoc and self-organized, assembled for specific tasks and disband upon accomplishing team goals with members across the organizational and geographical boundaries. Some examples include inter-disciplinary and multi-institutional scientific collaboration teams, open source software development teams that collaborate over the Internet, and teams in games, especially in Massively Multiplayer Online Role-playing Games. However, our understanding of self-organizing mechanism and dynamic of project team is very limited. This study investigates the self-assembly mechanisms of ad hoc project teams using a bipartite network perspective. Individuals and projects are modeled as two types of nodes and team membership as relations between them. This approach enables us to investigate factors that impact voluntary team assembly at the individual, dyadic, and team levels simultaneously. This study uses Exponential Random Graph Models (ERGM/p*) to analyze players' combat teams in a Massively Multiplayer Online Role-Playing Game (MMORPG) as a case of self-assembled project teams. Empirical results show that individuals are motivated to join ad hoc teams to complete difficult projects but not projects with long durations. This study also found that individuals tend to collaborate with specific teammates who have complementary skills, those who have similar age or skill level, and those who are affiliated with the same organizational entity. Besides team assembly mechanisms, this study also explores the impact of team member attributes and the social networks of team members on team performance.



Biographies





Vincent Alevén

Associate Professor
Carnegie Mellon University

Vincent Alevén is an Associate Professor in Carnegie Mellon's Human-Computer Interaction Institute. He has over 20 years of research experience in computer-based learning environments based on cognitive and Self-Regulated Learning (SRL) theory, including intelligent tutoring systems, educational games, and collaborative learning environments. Alevén is co-leader of a research thrust on Metacognition and Motivation as part of the Pittsburgh Science of Learning Center (LearnLab). He is the co-editor-in-chief of the *International Journal of Artificial Intelligence in Education*. He is co-editor of the *International Handbook on Metacognition in Computer-Based Learning Environments* (Azevedo & Alevén, 2013). He is or has been PI on 7 major research grants and co-PI on 10 others. He has over 180 publications to his name.



Yoav Bergner

Research Scientist
Educational Testing Service

Yoav Bergner is a Research Scientist in the Center for Advanced Psychometrics at Educational Testing Service (ETS). He studied theoretical physics at Harvard and MIT before turning to the applied side and becoming a sculptor and furniture maker for five years. He spent three years teaching science and math in a NYC public school, which led to a research interest in the potential of digital environments for personalized learning and assessment. His current work bridges educational data mining and psychometric approaches to modeling process data, including online courses and simulation-based tasks, with particular interests in multidimensionality issues, model fit, and collaborative learning and assessment.





Paul Borysewicz

Assessment Specialist
Educational Testing Service

Paul Borysewicz has worked at ETS since 1996. After pursuing a degree in medieval history, he came to ETS to work on the GRE Reasoning test, then moved to the History and Social Sciences Group. In his time with ETS, Paul has worked on a wide range of assessments, including the Advanced Placement exams, the SAT Subject tests, various teacher-licensure and K through 12 tests as well as the Program for International Student Assessment's (PISA) new section on Collaborative Problem Solving.



Sy-Miin Chow

Associate Professor
Pennsylvania State University

Sy-Miin Chow is an Associate Professor in the Department of Human Development and Family Studies at the Pennsylvania State University and the Principal Investigator of the Emotions and Dynamic Systems Lab. Dr. Chow's research focuses on the development and adaptation of modeling and analysis tools that are suited to evaluating linear and nonlinear dynamical systems models, including longitudinal structural equation models and state-space modeling techniques. Her current work involves using Kalman filter approaches and dynamical systems models to represent the dynamics of emotion regulation. Her longer term aim is to develop a broader repertoire of data-driven tools tailored toward analyzing the kinds of longitudinal data typically available in the social and behavioral sciences.





Noshir Contractor

Professor

Northwestern University

Noshir Contractor is the Jane S. & William J. White Professor of Behavioral Sciences in the McCormick School of Engineering & Applied Science, the School of Communication and the Kellogg School of Management at Northwestern University, USA. He is the Director of the Science of Networks in Communities (SONIC) Research Group at Northwestern University. He is investigating factors that lead to the formation, maintenance, and dissolution of dynamically linked social and knowledge networks in a wide variety of contexts including communities of practice in business, translational science and engineering communities, public health networks and virtual worlds. He was elected by a group of his peers to receive the National Communication Association 2014 Distinguished Scholar Award. This award recognizes a lifetime of scholarly achievement in the study of human communication.



Leslie DeChurch

Associate Professor

Georgia Institute of Technology

Leslie DeChurch is an Associate Professor of Industrial & Organizational Psychology at Georgia Tech. Her research examines leadership, teams, multiteam systems, and social networks. Professor DeChurch is the recipient of an NSF CAREER award to support her research on multiteam systems, co-editor of, “Multiteam systems: An organizational form for dynamic and complex environments,” and author of dozens of articles in top journals including PNAS: Proceedings of the National Academy of Science (PNAS), Journal of Applied Psychology, Journal of Management, Organizational Behavior and Human Decision Processes, and the Leadership Quarterly. She currently serves on the editorial boards of the Journal of Applied Psychology, Group & Organization Management, Small Group Research, the Journal of Occupation and Organizational Psychology, and the Journal of Business and Psychology. Professor DeChurch served on the National Academy of Sciences (NAS) committee on the “The Context of Military Environments,” and her research was featured in two recent NAS consensus studies on The Science of Team Science and New Directions in Assessing Individuals & Groups. She serves on the board for the Interdisciplinary Network for Group Research (INGRoup) board, and the advisory committee for Science of Team Science (SciTS).





Stephen M. Fiore

Director of Cognitive Sciences Laboratory
University of Central Florida

Dr. Stephen M. Fiore, is Director, Cognitive Sciences Laboratory, and faculty with the University of Central Florida's Cognitive Sciences Program in the Department of Philosophy and Institute for Simulation & Training. He is President of the Interdisciplinary Network for Group Research and a founding Program Committee member for the annual Science of Team Science Conference. He maintains a multidisciplinary research interest that incorporates aspects of the cognitive, social, organizational, and computational sciences in the investigation of learning and performance in individuals and teams. His primary area of research is the interdisciplinary study of complex collaborative cognition and the understanding of how humans interact socially and with technology. Dr. Fiore has been a visiting scholar for the study of shared and extended cognition at École Normale Supérieure de Lyon in Lyon, France (2010) and he was a member of the expert panel for the Organisation for Economic Co-operation and Development's 2015 Programme for International Student Assessment (PISA), which focuses on collaborative problem solving skills. He has contributed to working groups for the National Academies of Science in understanding and measuring "21st Century Skills" and he is currently a committee member of their "Science of Team Science" consensus study. As Principal Investigator and Co-Principal Investigator he has helped to secure and manage over \$20 million in research funding. He is co-Editor of recent volumes on Shared Cognition (2012), Macrocognition in Teams (2008), Distributed Training (2007), Team Cognition (2004), and he has co-authored over 150 scholarly publications in the area of learning, memory, and problem solving at the individual and the group level.





Gerald F. Goodwin

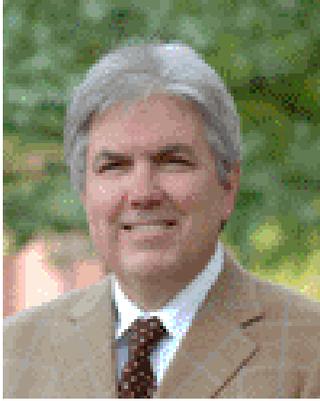
Director of Cognitive Sciences Laboratory
U. S. Army Research Institute

Dr. Gerald F. Goodwin is Chief, Foundational Science Research Unit at the U. S. Army Research Institute for Behavioral and Social Sciences (ARI). In addition to overseeing ARI's basic research program, he is responsible for research teams focused on emerging and developing concepts within the applied research program on topics including unit command climate, unit resilience, assessment of cross-cultural competence, and assessing and developing unit cohesion.

Dr. Goodwin's research expertise is in leadership, team and organizational effectiveness, and cultural factors in Joint, Interagency, and Multinational contexts. He has led or overseen projects investigating shared cognition in command teams, leadership in multi-team systems, team staffing and composition, leader development and training, and cultural factors in interpersonal interactions. He was the program manager for ARI's applied research program 'Teams in Complex Organizations,' served on assignment to ARI's Office of the Director to lead strategic planning for the institute, and was detailed to the Department of Defense Comprehensive Review Working Group as a research analyst and the lead writer the DOD report assessing the impact of repeal of "Don't Ask, Don't Tell." He transitioned to his current position after leading basic research in leader development, team and organizational effectiveness, and cross-cultural issues. He is a scientific advisor to several Multidisciplinary University Research Initiative (MURI) grants investigating cognition in organizations and cultural factors in negotiation and collaboration. He was previously employed at the American Institutes for Research, where his project work included test development, employment litigation support with an emphasis on statistical analysis, training evaluation, and performance modeling.

Dr. Goodwin received his M.S. and Ph.D. in Industrial/Organizational Psychology from the Pennsylvania State University. He is a member of the Society for Industrial and Organizational Psychology, the American Psychological Association (APA), and APA Division 19 (Military Psychology).





Art Graesser

Distinguished University Professor

University of Memphis

Honorary Research Fellow

Center for Educational Assessment at University of Oxford

Art Graesser is a Distinguished University Professor of Interdisciplinary Research in the Department of Psychology and the Institute of Intelligent Systems at the University of Memphis, and is an Honorary Research Fellow in the Oxford University Center for Educational Assessment at the University of Oxford. His primary research interests are in cognitive science, discourse processing, computational linguistics, and the learning sciences. He has developed automated tutoring systems with conversational agents (such as AutoTutor and Operation ARA) and automated text analysis systems (Coh-Metrix, QUAID). He served as editor of the journal *Discourse Processes* (1996–2005) and *Journal of Educational Psychology* (2009–2014). His service in professional societies includes president of the Empirical Studies of Literature, Art, and Media (1989–1992), the Society for Text and Discourse (2007–2010), the International Society for Artificial Intelligence in Education (2007–2009), and the Federation of Associations in the Behavioral and Brain Sciences Foundation (2012–13). He has chaired or been a member of expert panels for the Program for International Student Assessment (PISA) and the Program of International Assessment of Adult Competencies (PIAAC) in addition to consulting for Educational Testing Service and the College Board. He has received major lifetime research achievement awards from the Society for Text and Discourse, the American Psychological Association, and the University of Memphis.





Patrick Griffin

Chair of Education (Assessment)

University of Melbourne

Director

Assessment Research Center

Associate Dean

Melbourne Graduate School of Education

Patrick Griffin holds the Chair of Education (Assessment) at the University of Melbourne and is Director of the Assessment Research Centre. He is the Associate Dean in the Melbourne Graduate School of Education. He has published widely on assessment and evaluation topics that include competency development, language proficiency, industrial literacy, school literacy and numeracy, professional standards and online interactive assessment and calibration.

Professor Griffin is a project team leader for UNESCO in southern Africa and was awarded, in 2005, a UNESCO Research Medal by the Ministers of Education from southern African nations. Professor Griffin is a World Bank consultant in Vietnam, leading national and international teams in studies of literacy and numeracy. He has also addressed major professional associations, and taught and conducted assessment and evaluation research projects in more than 20 countries.

Professor Griffin is the executive Director of the Assessment and Teaching of 21st Century Skills project – a multiyear, multi country Public – Private – Academy Partnership project initially sponsored by Cisco, Intel and Microsoft.





Peter Haplin

Assistant Professor
New York University

Peter F. Halpin is an Assistant Professor of Applied Statistics at Steinhardt School of Culture, Education, and Human Development. In 2010 he received his PhD in Psychology from Simon Fraser University in Vancouver, Canada, and he held a postdoctoral fellowship at the University of Amsterdam through summer 2012. His research focuses on psychometrics (e.g., confirmatory factor analysis, item response theory, latent class analysis, structural equation modeling), as well as dynamical models for human interaction. His work has been published in *Psychometrika*, *Structural Equation Modeling*, and *Multivariate Behavioral Research*, and he has received multi-year awards from the US Department of Education Institute of Education Sciences, Natural Science and Engineering Council of Canada, and the Social Science and Humanities Research Council of Canada.



Jiangang Hao

Research Scientist
Educational Testing Service

Jiangang Hao is a Research Scientist in the Center for Advanced Psychometrics at ETS. Prior to joining ETS, he had been working on modeling and mining Terabyte scale data in physics at Fermi National Accelerator Laboratory after getting his Ph.D. in physics and MA in Statistics from the University of Michigan. He has been working extensively on data standardization, data model schema, data mining, and machine learning techniques for big data. He wrote several widely used packages in Python programming language and C++ for digital image analysis, measurement error corrected Gaussian Mixture Model and probabilistic clustering analysis. Most recently, he developed an automated parsing pipeline to streamline the data reduction for the GlassLab's SimCityEdu game. Jiangang's current research centers on collaborative problem solving, educational data mining, game and simulation based assessment. He is also applying natural language processing techniques to analyze the conversations in collaboration to develop an intelligent (adaptive) facilitating mechanism.





Saad Khan

Senior Research Scientist
Educational Testing Service

Saad Khan is a senior research scientist in the Center for Advanced Psychometrics within the Research and Development division at Educational Testing Service in Princeton, NJ. With expertise in computer vision and machine learning, his interests span a spectrum of multidisciplinary research that includes behavioral analytics, affective computing, multimodal data fusion, and its application to education, assessment, and gaming. Prior to joining ETS, Khan was at SRI where he led design and development of advanced intelligent training/tutoring systems that can adapt to both changing pedagogical objectives and learners' behavior. He led the development and transition of APELL: Automated Performance Evaluation and Lessons Learned, an immersive, interactive, mixed-reality training system that provides real-time sensing and automated analysis of trainee actions in Military Operations on Urban Terrain (MOUT) sites. He also served as principal investigator (PI) on programs in immersive training, human performance assessment, and automated target recognition. His work in automated image-based localization earned an Honorable Mention award at the International Conference of Computer Vision 2005. He has authored over 25 papers and holds two issued patents. Khan received a Ph.D. in computer science from the University of Central Florida in 2008. He is a member of IEEE and chairs the Signal Processing Chapter for the Princeton/Central Jersey Section.





Patrick C. Kyllonen

Senior Research Director
Educational Testing Service

Patrick Kyllonen is Senior Research Director of the Center for Academic and Workforce Readiness and Success at Educational Testing Service (ETS) in Princeton, N.J. Center scientists conduct innovative research on (a) higher education assessment, (b) workforce readiness; (c) international large scale assessment research (e.g., Program for International Student Assessment; PISA); and (d) 21st century skills assessment, such as creativity, collaborative problem solving, and situational interviews. Dr. Kyllonen received his B.A. from St. John's University and Ph.D. from Stanford University and is author of *Generating Items for Cognitive Tests* (with S. Irvine, 2001); *Learning and Individual Differences* (with P. L. Ackerman & R.D. Roberts, 1999); and *Extending Intelligence: Enhancement and New Constructs* (with R. Roberts and L. Stankov, 2008). He is a fellow of the American Psychological Association and the American Educational Research Association, and as a member of the National Academy of Sciences/National Research Council Committee on Defining Deeper Learning and 21st Century Skills co-authored the 2012 report, *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*.





Scott G. Paris

Vice President of Research
Educational Testing Service

As Vice President of Research in the Research & Development division of ETS, Dr. Scott G. Paris is responsible for the overall leadership and direction of research associated with all ETS testing programs; oversees advanced capability development; and provides strategic, tactical and financial oversight of all functional areas within the Research division including Assessment Innovations; Foundational and Validity Research; English Language Learning and Assessment; Center for Academic and Workforce Readiness and Success; Research Coordination and Support; and Learning, Teaching and Cognitive Sciences.

Prior to coming to ETS, Paris led the Centre for Research on Pedagogy and Practice at the National Institute of Education of Singapore. From 1978–2008, he was a member of the Department of Psychology and the School of Education at the University of Michigan. He served as Chair of the Graduate Program in Psychology from 2001–2007, and also has been a visiting professor at universities in New Zealand, Australia, Hawaii and Hong Kong.

Paris earned his bachelor's degree in psychology from the University of Michigan and a doctorate in developmental psychology from Indiana University. His research has focused on cognitive development, reading, assessment, metacognition, learning in museums and self-regulated learning. He has published 12 books and written more than 130 book chapters and research articles. In 2008, he received the Oscar Causey research award from the National Reading Conference and the Albert Harris research award from the International Reading Association, and was recognized by the University of Michigan with awards for outstanding undergraduate teaching in 1993, 1995 and 1997.

Paris is a Fellow of the American Psychological Association, the American Psychological Society, the Society for Research in Child Development and the American Educational Research Association. He currently serves on the editorial boards of *Educational Psychologist* and *Cognition and Instruction*, and was elected to the International Reading Association's Reading Hall of Fame in 2009.





Carolyn Penstein Rosé

Associate Professor
Carnegie Mellon University

Dr. Carolyn Rosé is an Associate Professor of Language Technologies and Human-Computer Interaction in the School of Computer Science at Carnegie Mellon University. Her research program is focused on better understanding the social and pragmatic nature of conversation, and using this understanding to build computational systems that can improve the efficacy of conversation between people, and between people and computers. In order to pursue these goals, she invokes approaches from computational discourse analysis and text mining, conversational agents, and computer supported collaborative learning. She serves on the executive committee of the Pittsburgh Science of Learning Center and the co-leader of its Social and Communicative Factors of Learning research thrust. She also serves as President Elect of the International Society of the Learning Sciences. She serves as Associate Editor of the International Journal of Computer Supported Collaborative Learning and the IEEE Transactions on Learning Technologies.





Nikol Rummel

Professor

Head of Educational Psychology Research Group

Ruhr-Universität Bochum, Germany

Adjunct Professor

Carnegie Mellon University

Dr. Nikol Rummel is a Full Professor and head of the Educational Psychology Research Group at the Institute of Educational Research at the Ruhr-Universität Bochum, Germany, and an Adjunct Professor in the Human-Computer Interaction Institute at Carnegie Mellon University. Dr. Rummel is elected member of the Board of Directors of the International Society of the Learning Sciences (ISLS). She is Associate Editor of the Journal of the Learning Sciences, and Editorial Board member of the International Journal of Computer-Supported Collaborative Learning and of Learning & Instruction. Dr. Rummel has published numerous papers in major research journals, such as the Journal of Educational Psychology or the Journal of the Learning Sciences. She has been or is PI and Co-PI on various research grants funded by different international organizations: the DFG [German Science Foundation], the European Union, the US National Science Foundation (NSF), and the US Institute of Educational Services (IES). Dr. Rummel's research interests center around instructional support for learning in computer-supported and specifically collaborative settings.





Eduardo Salas

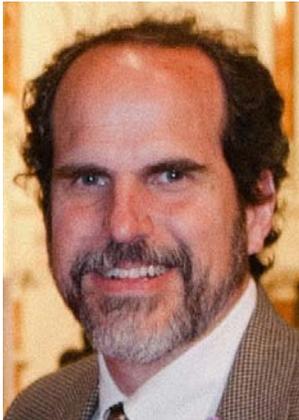
Trustee Chair
Pegasus Professor
University of Central Florida

Eduardo Salas is the Trustee Chair and Pegasus Professor of Psychology at the University of Central Florida (UCF). He also holds an appointment as Program Director for Human Systems Integration Research Department at UCF's Institute for Simulation & Training. Previously, he was a Senior Research Psychologist and Head of the Training Technology Development Branch of NAVAIR-Orlando for 15 years. During this period, Dr. Salas served as a principal investigator for numerous R&D programs focusing on teamwork, team training, simulation-based training, decision-making under stress, learning methodologies and performance assessment.

Dr. Salas has co-authored over 375 journal articles and book chapters and has co-edited over 25 books. Dr. Salas has held numerous positions in the Human Factors and Ergonomics Society (HFES) during the past 15 years. He is the past chair of the Cognitive Engineering and Decision Making Technical Group and of the Training Technical Group, and currently he is the Past President. He is also very active with Society for Industrial and Organizational Psychology (SIOP)—Division 14 of APA. He is Past President of SIOP and past Series Editor of the Organizational Frontier and the Professional Practice Book Series. He received his Ph.D. degree (1984) in industrial and organizational psychology from Old Dominion University.

His expertise includes helping organizations on how to foster teamwork, design and implement team training strategies, facilitate training effectiveness, manage decision making under stress, develop performance measurement tools, and design learning and simulation-based environments. He is currently working on designing tools, instructional strategies and techniques to minimize human errors in medical environments. He has consulted to a variety of corporate, manufacturing, pharmaceutical laboratories, industrial and governmental organizations.





Eric Steinhauer

Principal Assessment Designer
Educational Testing Service

Eric Steinhauer is a Principal Assessment Designer at Educational Testing Service, Princeton, New Jersey. He joined ETS in 1994. He is currently coordinating new test development for PISA 2015 and working on new teacher licensure assessment projects. In his 20 years at ETS, Mr. Steinhauer has managed test development teams for five different high stakes testing programs (GRE, GMAT, SAT, The Praxis Series and the Texas Educator Certification Program) as well as for PISA and ELTeach. His test development and design work has spanned the areas of critical thinking, collaborative problem solving, scientific literacy, high-leverage practices in teaching, verbal reasoning, language proficiency (in English as a foreign language and American Sign Language), and multiple specific subject areas such as audiology to technology education. His work has included assessment innovation at both the test level and at the level of assessment task design. Mr. Steinhauer received his Masters in Philosophy from Princeton University and his Bachelors in Chemistry from Amherst College.



Ron Stevens

Professor
University of California, Los Angeles

Ron Stevens, Ph.D. is Professor, UCLA School of Medicine and a member of the UCLA Brain Research Institute. Dr. Stevens was the former developer and director of the technology-based IMMEX™ problem-authoring and solving project. In his role as the CEO of The Learning Chameleon, Inc., his recent research has focused on using EEG to map synchronized brain activation patterns in US Navy and high school teams. Identifying when teams are neurodynamically ‘in-synch’ will provide new ways of linking neuro-mechanisms with observable team behaviors leading to more detailed, and perhaps predictive models of ‘cross-level’ team interactions.





Tracy M. Sweet

Assistant Professor
University of Maryland

Tracy M. Sweet is an Assistant Professor in the Department of Human Development and Quantitative Methodology, University of Maryland. Dr. Sweet received her PhD in statistics from Carnegie Mellon University. Her research focuses on developing statistical social network models for education applications and she developed the Hierarchical Network Models framework. She has led multiple workshops on social network models for education researchers and has several on-going collaborations with education researchers interested in applying her social network models to their network data.



Alina von Davier

Senior Research Director
Educational Testing Service
Adjunct Professor
Fordham University

Alina von Davier is a Senior Research Director and leader of the Center for Advanced Psychometrics at ETS. She also is an Adjunct Professor at Fordham University. Her Ph.D. in mathematics was earned at the Otto von Guericke University of Magdeburg, Germany, and her M.S. in mathematics is from the University of Bucharest, Romania. At ETS, von Davier is responsible for developing a team of experts and a psychometric research agenda in support of next generation of assessments. She also is responsible for fostering research relationships between ETS and the psychometric field, nationally and internationally. During her tenure at ETS she led the Center for Psychometrics International Tests, where she managed a large group of scientists and was responsible for the scores reported to about a million of test takers annually. She edited a volume on test equating, *Statistical Models for Test Equating, Scaling, and Linking*, which has been selected as the 2013 winner of the Division D Significant Contribution to Educational Measurement and Research Methodology award. She wrote and co-edited four other books and volumes. She is the co-author of the report “Collaborative Problem Solving and the Assessment of Cognitive Skills: Psychometric Considerations.” She serves as an Associate Editor for *Psychometrika* and the *Journal of Educational Measurement*. Prior to joining ETS, she worked in Germany at the Universities of Trier, Magdeburg, Kiel, and Jena, and at the ZUMA in Mannheim, and in Romania, at the Institute of Psychology of the Romanian Academy.





Mengxiao Zhu

Associate Research Scientist
Educational Testing Service

Mengxiao Zhu is an associate research scientist in the Center for Advanced Psychometrics within the Research and Development division at Educational Testing Service in Princeton, NJ. Zhu received a Ph.D. degree in Industrial Engineering and Management Sciences from Northwestern University in 2012. She also holds degrees in Communication (M.A.) from the University of Illinois at Urbana-Champaign, Computer Science (M.E. & B.E.) and Science and English (B.S.) from the University of Science and Technology of China. Prior to joining ETS, she worked as Graduate Research Assistant in the Science of Networks in Communities (SONIC) Research Group at Northwestern University, and as post-doctoral Research Associate in the School of Communication and Information at Rutgers University. She has been involved in several NSF and NIH -funded projects focusing on computer-mediated communication in emergency response teams, and on the development of knowledge networks and the dynamics of collaborations both in real world, such as research institutions, and in virtual worlds, such as Second Life and online role-playing games. Her current research focuses on psychometrics for the new generation of assessments, including psychometric models for collaborative problem solving, data mining techniques applied on assessment data, simulations and games in assessment, and integration of cognitive science with psychometrics.



