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Vision: Guide mathematics learning by making connections between cognition, assessment, and artificial intelligence.

Education

Ph.D. in Cognitive Psychology; Minor in Quantitative Psychology 1992–2000

University of Washington — Seattle, WA

B.A. in Mathematics 1992–2000

University of Washington — Seattle, WA

B.A. in Psychology; Minor in Biological Sciences 1988–1992

Binghamton University — Vestal, NY

Employment History

Founder — Proof-of-Concept Learning LLC — Educational Research Consulting — 2026–present
Lawrenceville, NJ

Senior Research Scientist — ETS (Educational Testing Service) — Division of Research and Development; Research Institute — Princeton, NJ 2020–2025

Research Scientist — ETS (Educational Testing Service) — Division of Research and Development; Research Institute — Princeton, NJ 2004–2020

Associate Research Scientist — ETS (Educational Testing Service) — Division of Research and Development; Research Institute — Princeton, NJ 2001–2004

Research Scientist — University of Washington — Department of Psychology — Seattle, WA 2000–2001

Grants

Principal Investigator — National Science Foundation (NSF) 2021–2025

- *Investigating the Role of Collaboration on the Development of Student Ideas using a Learning Progression for the Function Concept.* Grant #2101393. Budget: \$3,063,630.

Principal Investigator — National Science Foundation (NSF) 2016–2021

- *Development and Empirical Recovery for a Learning Progression-Based Assessment of the Function Concept.* Grant #1621117. Budget: \$3,350,056.

Senior Personnel — Institute of Education Sciences (IES) 2017–2020

- *DAT-CROSS: Developing Assessments and Tools to Support the Teaching and Learning of Science Crosscutting Concepts.* Grant #R305A170634. Budget: \$1,395,722.

Co-Principal Investigator — National Science Foundation (NSF) 2003–2006

- *Adaptive E-Learning for Middle-School Mathematics*. Grant #0313202. Budget: \$399,996.

Teaching and Mentoring Experience

Mentor or Co-Mentor — ETS (Educational Testing Service) 2002–2024

- Supported nine graduate and undergraduate students during various summer internship programs.

Teaching Assistant, Research Methods — Department of Psychology, University of Washington 1994

Teaching Assistant, Statistics — Department of Psychology, University of Washington 1994

Undergraduate Teaching Assistant, Statistical Analysis and Design — Department of Psychology, Binghamton University 1989

Awards

R & D Presidential Team Award — ETS (Educational Testing Service) 2010

- Mathematics content lead at ETS for the Measures of Effective Teaching study, funded by the Gates Foundation.

R & D Presidential Team Award — ETS (Educational Testing Service) 2005

- Member of the Research and Assessment Development Math Team.

Skills

AI in Education: Prompt engineering and evaluation of AI-based mathematical problem solving.

Leadership Skills: Have led major grants with multiple subrecipients; have also led large internal projects.

Mentorship Skills: Have successfully mentored undergraduate students, graduate students, and early-career professionals.

Problem Solving Skills: Use multiple approaches and technologies to find innovative solutions to challenging problems.

Communication Skills: Experienced author and presenter; conversant with mathematicians, learning scientists, psychologists, assessment specialists, psychometricians, software developers, and finance managers alike.

Research Skills: Knowledge of mathematics cognition literature (including learning progressions), research design, automated item generation (AIG), data analysis and statistics, proposal writing.

Statistical Software Skills: R, SPSS.

Assessment Design Skills: Experience designing innovative and engaging mathematics assessment tasks.

Editorships

Guest Editor — Special Issue of the Journal of Mathematical Behavior

Former Consulting Editor — Educational Psychology: An International Journal of Experimental Educational Psychology

Publications

- Graf, E. A., & Flor, M. (in press). Automated generation of mathematics word problems by a symbolically-constrained LLM. In von Davier, A. A. & Yan, D. (Eds.), *Artificial intelligence in educational learning and assessment*.
- Andrews-Todd, J., Lee, J., Cisterna, D., Song, Y., Graf, E. A., & Jiang, Y. (2026). Design and perceptions of a science conversation-based assessment with AI agents. *ICLS Proceedings*, 1378–1382. <https://2026.isls.org/proceedings/>
- Andrews-Todd, J., Jiang, Y., Lai, Y., Graf, E. A., Bennett, A. B., Funk, R., Lamb, C., & Marienau, N. (2026). Examining the impact of human facilitation on collaborative problem solving in mathematics: A mixed methods approach. *International Journal of Computer-Supported Collaborative Learning*. <https://doi.org/10.1007/s11412-026-09482-x>
- Graf, E. A., Shin, H. J., Yan, D., & Von Davier, A. A. (2026). Automated item generation: The promises and the challenges. In *Reference module in social sciences* (B9780443266294002367). Elsevier. <https://doi.org/10.1016/B978-0-443-26629-4.00236-7>
- Nath, S., Graf, E. A., Zhang, L., & Zapata-Rivera, D. (2026). Representation robustness under executable reasoning constraints in large language models for mathematical problem solving. In H. Degen & S. Ntoa (Eds.), *Artificial intelligence in HCI* (pp. 155–171). Springer Nature Switzerland. https://doi.org/10.1007/978-3-032-30860-3_11
- Jiang, Y., Graf, E. A., & Todd, J. A. (2025). Using epistemic network analysis and sequential pattern mining to explore the impacts of human facilitation on collaborative mathematical problem solving. *Proceedings of the 18th International Conference on Computer-Supported Collaborative Learning–CSCL 2025*, 3–11. <https://doi.org/10.22318/cscl2025.352932>
- Jiang, Y., Graf, E. A., & Andrews-Todd, J. A. (2025, July 7). *From wall to bridge: Supporting mathematics learning through collaboration and guided facilitation*. <https://www.ets.org/research/behindthebreakthroughs/walltobridge.html>
- Zhang, L., & Graf, E. A. (2025a). Mathematical computation and reasoning errors by large language models. In J. Wilson, C. Ormerod, & M. Beiting Parrish (Eds.), *Proceedings of the artificial intelligence in measurement and education conference (AIME-con): Full papers* (pp. 417–424). National Council on Measurement in Education (NCME). Retrieved April 30, 2026, from <https://aclanthology.org/2025.aimecon-main.45/>
- Zhang, L., & Graf, E. A. (2025b, August 13). Mathematical computation and reasoning errors by large language models. <https://doi.org/10.48550/arXiv.2508.09932>
- Forsyth, C. M., Zapata-Rivera, D., Graf, E. A., & Jiang, Y. (2024). Complex conversations: LLM vs. knowledge engineering conversation-based assessment (B. Paaßen & C. Demmans Epp, Eds.). <https://doi.org/10.5281/ZENODO.12729976>
- Graf, E. A., Lizano, C. L., Agyapong, F., & van Rijn, P. W. (2024). Evaluating learning progression-based mathematics rubrics for validity and reliability. *ICLS Proceedings*, 1123–1126. <https://doi.org/10.22318/icls2024.322165>
- Zapata-Rivera, D., Forsyth, C., Graf, E. A., & Jiang, Y. (2024). Designing and evaluating evidence-centered design based conversations for assessment with LLMs. *Joint Proceedings of the Human-Centric Explainable AI in Education and the Leveraging Large Language Models for Next Generation Educational Technologies Workshops (HEXED-L3MNGET 2024) co-located with 17th International Conference on Educational Data Mining (EDM 2024)*, 3840. https://ceur-ws.org/Vol-3840/L3MNGET24_paper3.pdf
- Moynihan, B., Wilson, R. T., Wynne, J., McEwan, L., West, M. M., Davis, F. E., Clemens, H., Budzban, G. M., Graf, E. A., Soguero, A., Moses, J. J., Dennis, D. J., Godfrey, L., Shaw, A., Fasanelli, F., Belcher, J., Gillen, J., Ball, D. L., Nettles, M., . . . Cobb, N. (2023). What’s math got to do

- with it?: Bob Moses, algebra, and the movement for civil rights, January 23, 1935–July 25, 2021. *Notices of the American Mathematical Society*, 70(2), 1. <https://doi.org/10.1090/noti2629>
- Eames, C. L., Graf, E. A., van Rijn, P. W., Budzban, G., & Voepel, T. (2021). The finite-to-finite strand of a learning progression for the concept of function: A research synthesis and cognitive analysis [Place: Netherlands]. *The Journal of Mathematical Behavior*, 62. <https://doi.org/10.1016/j.jmathb.2021.100864>
- Graf, E. A., van Rijn, P. W., & Eames, C. L. (2021). A cycle for validating a learning progression illustrated with an example from the concept of function. *The Journal of Mathematical Behavior*, 62, 100836. <https://doi.org/10.1016/j.jmathb.2020.100836>
- Cisterna, D., Liu, L., Chen, S.-K., van Rijn, P., Graf, A., Rehmat, A. P., Housh, K., & Hmelo-Silver, C. E. (2020). Students' ideas about the NGSS crosscutting concept of system and system models: Evidence from parallel assessments. *ICLS Proceedings*. Retrieved October 20, 2025, from <https://repository.isls.org/handle/1/6785>
- Graf, E. A., Peters, S., Fife, J. H., van Rijn, P. W., Arieli-Attali, M., & Marquez, E. (2019). A preliminary validity evaluation of a learning progression for the concept of function. *ETS Research Report Series*, 2019(1), 1–38. <https://doi.org/10.1002/ets2.12257>
- Graf, E. A., Fife, J. H., Howell, H., & Marquez, E. (2018). The development of a quadratic functions learning progression and associated task shells. *ETS Research Report Series*, 2018(1), 1–28. <https://doi.org/10.1002/ets2.12234>
- van Rijn, P., Graf, E. A., Arieli-Attali, M., & Song, Y. (2018). Agreement of teachers on evaluating assessments of learning progressions in English language arts and mathematics. *ETS Research Report Series*, 2018(1), 1–25. <https://doi.org/10.1002/ets2.12199>
- Graf, E. A., & Arieli-Attali, M. (2015). Designing and developing assessments of complex thinking in mathematics for the middle grades. *Theory Into Practice*, 54(3), 195–202. Retrieved July 2, 2025, from <https://www.jstor.org/stable/43893983>
- Graf, E. A., & van Rijn, P. W. (2015). Learning progressions as a guide for design: Recommendations based on observations from a mathematics assessment [Num Pages: 25]. In Lane, S., Raymond, M. R., & Haladyna, T. M. (Eds.), *Handbook of test development* (2nd ed.). Routledge.
- Graf, E. A. (2014). Connecting lines of research on task model variables, automatic item generation, and learning progressions in game-based assessment. *Measurement: Interdisciplinary Research and Perspectives*, 12(1), 42–46. <https://doi.org/10.1080/15366367.2014.921032>
- Roohr, K. C., Graf, E. A., & Liu, O. L. (2014). Assessing quantitative literacy in higher education: An overview of existing research and assessments with recommendations for next-generation assessment. *ETS Research Report Series*, 2014(2), 1–26. <https://doi.org/10.1002/ets2.12024>
- van Rijn, P. W., Graf, E. A., & Deane, P. (2014). Empirical recovery of argumentation learning progressions in scenario-based assessments of English language arts. *Psicología Educativa*, 20(2), 109–115. <https://doi.org/10.1016/j.pse.2014.11.004>
- Song, Y., Deane, P., Graf, E. A., & van Rijn, P. W. (2013). *Using argumentation learning progressions to support teaching and assessments of English language arts*. (R & D Connections No. 22). ETS. Princeton, NJ. Retrieved July 2, 2025, from https://www.researchgate.net/publication/275465074-Using_argumentation_learning_progressions_to_support_teaching_and_assessments_of_English_language_arts
- Graf, E. A., & Fife, J. H. (2012). Difficulty modeling and automatic generation of quantitative items: Recent advances and possible next steps [Num Pages: 22]. In Gierl, M. J. & Haladyna, T. M. (Eds.), *Automatic item generation* (pp. 157–179). Routledge.
- Fife, J. H., Graf, E. A., & Ohls, S. (2011). Constructed-response mathematics tasks study. *ETS Research Report Series*, 2011(2), i–71. <https://doi.org/10.1002/j.2333-8504.2011.tb02271.x>

- Bejar, I. I., & Graf, E. A. (2010). Updating the duplex design for test-based accountability in the twenty-first century. *Measurement: Interdisciplinary Research and Perspectives*, 8(2), 110–129. <https://doi.org/10.1080/15366367.2010.511976>
- Graf, E. A., Harris, K., Marquez, E., Fife, J. H., & Redman, M. (2010). Highlights from the cognitively-based assessment of, for, and as learning (CBAL) project in mathematics. *ETS Research Spotlight*, (3), 19–30. <https://www.ets.org/Media/Research/pdf/SPOTLIGHT3.pdf>
- Graf, E. A. (2009). Defining mathematics competency in the service of cognitively based assessment for grades 6 through 8. *ETS Research Report Series*, 2009(2), i–46. <https://doi.org/10.1002/j.2333-8504.2009.tb02199.x>
- Graf, E. A., Harris, K., Marquez, E., Fife, J. H., & Redman, M. (2009). *Cognitively based assessment of, for, and as learning (CBAL) in mathematics: A design and first steps toward implementation* (ETS Research Memorandum No. RM-09-07). ETS. Princeton, NJ. Retrieved July 2, 2025, from https://www.ets.org/research/policy_research_reports/publications/report/2009/hycf.html
- Fife, J. H., Graf, E. A., Marquez, E., & Ohls, S. (2008). *Identifying common misconceptions—an analysis of MIM data* (Research Memorandum No. RM-08-16). ETS. Princeton, NJ. https://www.ets.org/research/policy_research_reports/publications/report/2008/iblg.html
- Graf, E. A. (2008a). Approaches to the design of diagnostic item models. *ETS Research Report Series*, 2008(1), i–25. <https://doi.org/10.1002/j.2333-8504.2008.tb02093.x>
- Graf, E. A. (2008b). Diagnostic assessment. In G. McCulloch & D. Crook (Eds.), *The routledge international encyclopedia of education* (1st, pp. 168–169). Routledge.
- Deane, P., Graf, E. A., Higgins, D., Futagi, Y., & Lawless, R. (2006). Model analysis and model creation: Capturing the task-model structure of quantitative item domains. *ETS Research Report Series*, 2006(1), i–63. <https://doi.org/10.1002/j.2333-8504.2006.tb02017.x>
- Shute, V. J., Graf, E. A., & Hansen, E. G. (2006). Designing adaptive, diagnostic math assessments for individuals with and without visual disabilities. *ETS Research Report Series*, 2006(1), i–37 (Note: A related publication is available as a book chapter). <https://doi.org/10.1002/j.2333-8504.2006.tb02007.x>
- Graf, E. A., Peterson, S., Steffen, M., & Lawless, R. (2005). Psychometric and cognitive analysis as a basis for the design and revision of quantitative item models. *ETS Research Report Series*, 2005(2), i–33. <https://doi.org/10.1002/j.2333-8504.2005.tb02002.x>
- Shute, V. J., Graf, E. A., & Hansen, E. G. (2005). Designing adaptive, diagnostic math assessments for individuals with and without visual disabilities. In L. M. Pytlikzillig, R. H. Bruning, & M. Bodvarsson (Eds.), *Technology-based education: Bringing researchers and practitioners together* (pp. 169–202). Information Age Publishing (Note: A related publication available as ETS RR-06-01).
- Graf, E. A., Bassok, M., Hunt, E. B., & Minstrell, J. (2004). A computer-based tutorial for algebraic representation: The effects of scaffolding on performance during the tutorial and on a transfer task. *Technology, Instruction, Cognition, and Learning*, 2(1), 135–170.
- Graf, E. A. (2002). Different assessments suit different needs: Considering the roles of assessments in gender fairness and educational opportunity [commentary published with diane halpern’s focus article]. [Issue: 1 Pages: 49 Volume: 8]. *Issues in Education: Contributions from Educational Psychology*, 8(1), 49–53.
- Nelson, T. O., Graf, A., Dunlosky, J., Marlatt, A., Walker, D., & Luce, K. (1999). Effect of acute alcohol intoxication on recall and on judgments of learning during the acquisition of new information [Num Pages: 20]. In G. Mazzoni (Ed.), *Metacognition and cognitive neuropsychology*. Psychology Press.
- Narens, L., Graf, A., & Nelson, T. O. (1996). Metacognitive aspects of implicit/explicit memory [Num Pages: 34]. In L. M. Reder (Ed.), *Implicit memory and metacognition*. Psychology Press.

- Schaffner, A., Graf, E. A., Madigan, D., Minstrell, J., Hunt, E., & Nason, M. (1996). Benchmark lessons and the world wide web: Tools for teaching statistics. *Proceedings of the 1996 international conference on Learning sciences*, 480–485. Retrieved October 20, 2025, from <https://dl.acm.org/doi/10.5555/1161135.1161206>
- Nelson, T. O., Dunlosky, J., Graf, A., & Narens, L. (1994). Utilization of metacognitive judgments in the allocation of study during multitrial learning. *Psychological Science*, 5(4), 207–213. <https://doi.org/10.1111/j.1467-9280.1994.tb00502.x>

Presentations

- Andrews-Todd, J., Lee, J., Cisterna, D., Song, Y., Graf, E. A., & Jiang, Y. (2026, June). *Design and perceptions of a science conversation-based assessment with AI agents* [Annual meeting of the International Society of the Learning Sciences].
- Andrews-Todd, J., Lai, Y., Jiang, Y., Graf, E. A., & Bennett, A. B. (2026, April). *Facilitating disciplinary reasoning in online collaborative problem solving: A mixed methods study* [Annual Meeting of the American Educational Research Association (AERA)].
- Graf, E. A. (2026, August). *An evaluation of LLM proof proficiency* [Mathematical Association of America’s Annual MathFest 2026].
- Nath, S., Graf, E. A., Zhang, L., & Zapata-Rivera, D. (2026). *Representation robustness under executable reasoning constraints in large language models for mathematical problem solving* [HCI International 2026, 28th International Conference on Human-Computer Interaction].
- Andrews-Todd, J., Cisterna-Albuquerque, D., Graf, E. A., Song, Y., & Lee, J. (2025, April). *Features and perceptions of an interdisciplinary STEM performance task for classroom assessment* [Annual meeting of the American Educational Research Association in Denver, CO].
- Andrews-Todd, J., Graf, E. A., Forsyth, C., Cisterna-Albuquerque, D., Song, Y., & Lee, J. (2025, April). *Showcasing a STEM conversation-based assessment with AI agents* [Innovation Demonstration at the annual meeting of the National Council on Measurement in Education in Denver, CO].
- Graf, E. A., van Rijn, P. W., Lizano, C. L., Andrews-Todd, J., Jiang, Y., & Lee, J. (2025, December). *The role of rich mathematical conversations in learning trajectory research* (Online keynote presentation) [Conference on Learning Trajectories and its Implications for Curriculum and Instructional Reform] [Online keynote presentation].
- Graf, E. A., Forsyth, C., Ruiz Diaz, S., Yan, D., & Jiang, Y. (2025, April). *Mathematical explorations in an LLM* [In E. A. Graf (Chair), Applications of Generative AI to Mathematics Education: Opportunities and Challenges, paper available on request. Annual meeting of the National Council on Measurement in Education (NCME) in Denver, CO].
- Graf, E. A., van Rijn, P. W., Lizano, C. L., Andrews-Todd, J., & Jiang, Y. (2025, June). *Investigating the role of collaboration on the development of student ideas using a learning progression for the function concept* [Poster presented at the biannual NSF DRK-12 PI Meeting in Arlington, VA].
- Jiang, Y., Graf, E. A., & Andrews-Todd, J. (2025, June). *Using epistemic network analysis and sequential pattern mining to explore the impacts of social facilitation on collaborative mathematical problem solving* [International Conference on Computer-Supported Collaborative Learning (CSCL) in Helsinki, Finland].
- Stacho, L., Graf, E. A., & Zapata-Rivera, D. (2025, April). *Explorations in using student solution pathways and large language models for enhanced mathematical learning* [In E. A. Graf (Chair), Applications of Generative AI to Mathematics Education: Opportunities and Challenges, paper available on request. Annual meeting of the National Council on Measurement in Education in Denver, CO].

- Zapata-Rivera, D., Graf, E. A., Confrey, J., Ruiz Diaz, S., & Stacho, L. (2025, April). *Enhancing AI-math conversations with learning progressions* [In E. A. Graf (Chair), Applications of Generative AI to Mathematics Education: Opportunities and Challenges. Annual meeting of the National Council on Measurement in Education in Denver, CO].
- Zhang, L., & Graf, E. A. (2025, October). *Mathematical computation and reasoning errors by large language models* [Artificial Intelligence in Measurement and Education Conference (AIME-Con)].
- Cisterna, D., Andrews-Todd, J., Graf, E. A., Song, Y., Lee, J., & Rice, J. (2024, September). *Practices for designing STEM performance assessments: The weather task* [International Association for Educational Assessment Conference in Philadelphia, PA].
- Gaston, A., & Graf, E. A. (2024, April). *Exploring chat data through the lens of facilitation* [In E. A. Graf (Chair), Advancing Equity in Assessment Through Small-Team Collaboration in Mathematics. Annual meeting of the American Educational Research Association in Philadelphia, PA].
- Graf, E. A., Lizano, C. L., Agyapong, F., & van Rijn, P. W. (2024, June). *Evaluating learning progression-based mathematics rubrics for validity and reliability* [Annual meeting of the International Society of the Learning Sciences in Buffalo, NY].
- Graf, E. A., & Lizano, C. L. (2024, April). *Exploring student response and chat data through the lens of the function concept learning progression* [In E. A. Graf (Chair), Advancing Equity in Assessment Through Small-Team Collaboration in Mathematics. Annual meeting of the American Educational Research Association in Philadelphia, PA].
- Graf, E. A., Lizano, C. L., van Rijn, P. W., & Crombie, W. O. (2024, April). *Designing learning progressions to advance equity in assessment and learning* [Training Session at the annual meeting of the National Council on Measurement in Education in Philadelphia, PA].
- Andrews-Todd, J., Graf, E. A., & Pinto Jr., W. (2023, March). *A collaborative problem-solving platform to measure understanding on a mathematics learning progression* [In A. Zilberberg (Chair), Platforms and Strategies to Enhance Learning. Annual meeting of the National Council on Measurement in Education (Virtual Session)].
- Graf, E. A. (2023, June). *Co-designing learning progression-aligned mathematics activities that support collaborative discourse* [Working session presented at the biannual NSF DRK-12 PI Meeting in Arlington, VA].
- Graf, E. A., & Confrey, J. (2023, April). *Assessment in support of equity and student agency* [Organized Discussion, Transforming K-12 Assessments: Providing Valid Data for Instructional Decisions, Equity, and Accountability, led by Charlotte Gilbar. Annual meeting of the National Council on Measurement in Education in Chicago, Illinois].
- Graf, E. A., Lizano, C. L., Gaston, A., Andrews-Todd, J., & Voepel, T. (2023, June). *Investigating the role of collaboration on the development of student ideas using a learning progression for the function concept* [Poster presented at the Biannual NSF DRK-12 PI Meeting in Arlington, VA].
- Graf, E. A., & Andrews-Todd, J. (2022, July). *A usability study for collaborative problem solving in mathematics* [We the People—Math Literacy for All & Algebra Project National Conference (Virtual Session)].
- Graf, E. A., Milner, C., Eames, C. L., & van Rijn, P. W. (2021, June). *Development and empirical recovery for a learning progression-based assessment of the function concept* [Poster presented at the biannual NSF DRK-12 PI Meeting (Virtual Session)].
- Graf, E. A. (2020, January). *Geometric transformations as functions: A qualitative analysis of student responses* [In G. Budzban (Chair), Experiencing Geometric Transformations and Evaluating Learning Progressions: Celebrating the Work of David W. Henderson. MAA Invited session given at the Joint Mathematics Meetings in Denver, CO].
- Graf, E. A., Milner, C., Eames, C. L., & van Rijn, P. W. (2020, August). *Steps in the design and validation of the assessment: An overview* [In E. A. Graf (Chair), Development and Empirical

- Recovery of a Learning Progression that Incorporates Student Voice. Annual meeting of the National Council on Measurement in Education (Virtual Session)].
- The Algebra Project, ETS, Southern Illinois University Edwardsville, & The Young People's Project. (2020, May). *Practitioner's use of the 5-step curricular process*. <https://multiplex.videohall.com/presentations/1898.html>
- van Rijn, P. W., & Graf, E. A. (2020, August). *Psychometric results for two strands of a learning progression for the concept of function* [In E. A. Graf (Chair), Development and Empirical Recovery of a Learning Progression that Incorporates Student Voice. Annual meeting of the National Council on Measurement in Education (Virtual Session)].
- Briars, D., Graf, E. A., Hauk, S., Nabors-Olah, L., & Steele, M. (2019, March). *Panel 7: How can organizations and CIME participants work together?* [Panel Presentation given at the 2019 Annual Conference on Critical Issues in Mathematics Education at MSRI (Mathematical Modeling in K-16: Community and Cultural Contexts) in Berkeley, CA].
- Foster, K., Graf, E. A., & Ohls, S. (2019, June). *Cognitive interview protocol development* [In C. L. Eames, & J. H. Fife (Chairs), Cognitive interview data as validity evidence for a learning progression-based assessment of the function concept. Symposium conducted at the 49th Annual Meeting of the Jean Piaget Society in Portland, OR].
- Graf, E. A. (2019, August). *Development and critique of a learning progression-based assessment for the function concept* [In E. A. Graf (Chair), The Use of Learning Progression-Based Assessments with Students and Teachers. Organized session at the 2019 NCME Special Conference on Classroom Assessment (Classroom Assessment as a Learning Experience) in Boulder, CO].
- Graf, E. A., Ohls, S., & Eames, C. L. (2019, June). *Assessment of the function concept* [In C. L. Eames, & J. H. Fife (Chairs), Cognitive interview data as validity evidence for a learning progression-based assessment of the function concept. Symposium conducted at the 49th Annual Meeting of the Jean Piaget Society in Portland, OR].
- Graf, E. A., & van Rijn, P. W. (2019a, April). *Cycle for validating a learning progression* [In L. Ketterlin Geller (Chair), Validating Theories of Learning for Classroom Assessment Design: Sources of Evidence. Annual meeting of the American Educational Research Association in Toronto, ON].
- Graf, E. A., & van Rijn, P. W. (2019b, August). *Development and empirical recovery for a learning progression-based assessment of the function concept* [In E. A. Graf (Chair), The Use of Learning Progression-Based Assessments with Students and Teachers. Roundtable discussion at the 2019 NCME Special Conference on Classroom Assessment (Classroom Assessment as a Learning Experience) in Boulder, CO].
- Graf, E. A., & van Rijn, P. W. (2019c, April). *Patterns of response times for different student strategies: Implications for psychometric modeling* [Electronic Board Presentation given at the annual meeting of the National Council on Measurement in Education in Toronto, ON].
- Graf, E. A., Moses, R. P., Budzban, G., Milner, C., Crombie, W. O., & van Rijn, P. W. (2019, May). *Concept of function learning progression*. <https://multiplex.videohall.com/presentations/1613.html>
- van Rijn, P. W., & Graf, E. A. (2019, April). *Fitting models for accuracy and speed for classification into learning progression levels* [Electronic Board Presentation given at the annual meeting of the National Council on Measurement in Education in Toronto, ON].
- Confrey, J., Ketterlin-Geller, L., Carney, M., Graf, E. A., & Christiansen, J. (2018, September). *Why purpose and grain-size matters in the design of learning trajectories/progressions-based classroom assessment* [Panel Presentation given at the 2018 NCME Special Conference on Classroom Assessment (Assessment in the Disciplines) in Lawrence, Kansas].
- Graf, E. A. (2018, April). *A learning progression for the function concept as a basis for assessment : Traditional strand* [In E. A. Graf (Chair), A Learning Progression for the Function Concept as a

- Basis for Assessment. Annual National Council of Teachers of Mathematics (NCTM) Research Conference in Washington, DC].
- Graf, E. A., Henderson, D. W., Ohls, S., & Milner, C. (2018, June). *Incorporating the student voice into the design of a mathematics assessment* [ETS Research Forum in Washington, DC].
- Graf, E. A., Milner, C., Budzban, G., Cobb, N., Crombie, W. O., Davis, F. E., & van Rijn, P. W. (2018, June). *Development and empirical recovery for a learning progression-based assessment of the function concept: Incorporating the voices of students in the bottom quartile* [Poster presented at the NSF DRK-12 PI Meeting].
- Graf, E. A., Ohls, S., & Budzban, G. (2018, April). *Student voices and understanding the most important mathematical concepts* [Washington Teachers' Union Shared Vision Conference in Washington, DC].
- Graf, E. A., & van Rijn, P. W. (2018, April). *The interpretation of learning progressions: Do teachers and other subject-matter experts agree?* [Annual meeting of the National Council on Measurement in Education (NCME) in New York, NY].
- Peters, S., Graf, E. A., & Fife, J. H. (2018, April). *A preliminary validity evaluation of a learning progression for the concept of function* [Electronic Board Presentation given at the annual meeting of the National Council on Measurement in Education (NCME) in New York, NY].
- van Rijn, P. W., Graf, E. A., & Christiansen, J. (2018, July). *Using item responses and response times for classification into levels of a learning progression* [In D. Molenaar (Chair), The Value of Item Response Times in Psychometric Test Practice. The 11th Conference of the International Test Commission (ITC) in Montreal, CA].
- Graf, E. A., van Rijn, P. W., & McCaffrey, D. (2017, April). *Agreement between human and model-based classification probabilities for a learning progression* [Annual meeting of the National Council on Measurement in Education (NCME) in San Antonio, TX].
- Graf, E. A., Ohls, S., Bejar, I. I., Kaltman, M., Chen, J., & Saldivia, L. (2016, April). *An item difficulty model for quantitative reasoning* [In I. I. Bejar (Chair), Item Difficulty Modeling: From Theory to Practice. Annual meeting of the National Council on Measurement in Education (NCME) in Washington, DC].
- Graf, E. A., & van Rijn, P. W. (2016, April). *Cognitive analysis of responses scored using a learning progression for proportional reasoning* [Electronic Board Presentation given at the annual meeting of the National Council on Measurement in Education (NCME) in Washington, DC].
- Graf, E. A., & van Rijn, P. W. (2015, April). *Holistic scoring and IRT-based classification for evaluating learning progressions* [In J. Lin (Chair), Methods for Investigating Threats to Validity. Annual meeting of the National Council on Measurement in Education (NCME) in Chicago, IL].
- Graf, E. A., Gestwicki, P., & Arieli-Attali, M. (2014, April). *Designing a cryptography game to assess student understanding with respect to a learning progression for mathematical functions* [In D. Zapata-Rivera (Chair), Designing Game-Based Assessment Around Learning Progressions. Annual meeting of the American Educational Research Association (AERA) in Philadelphia, PA].
- Graf, E. A., van Rijn, P. W., & Arieli-Attali, M. (2014, April). *Empirical recovery of a CBAL learning progression for linear functions* [In R. E. Bennett (Chair), Scoring Issues for Next-Generation Performance Assessments: An Example from CBAL. Annual meeting of the National Council on Measurement in Education (NCME) in Philadelphia, PA].
- Graf, E. A., & van Rijn, P. W. (2013, April). *Recovery of CBAL learning progressions: Theory, results, challenges, and next steps* [In R. E. Bennett (Chair), Validation of Next-Generation, Technology-Based, Performance Assessments: An Example From CBAL. Annual meeting of the National Council on Measurement in Education (NCME) in San Francisco, CA].
- Graf, E. A. (2012, April). *Designing, developing, and validating assessments of complex thinking in mathematics for the middle grades* [In K. Ercikan (Chair), Assessment of Complex Thinking

- in Mathematics, Reading, Science and History. Annual meeting of the American Educational Research Association (AERA) in Vancouver, BC].
- Graf, E. A., Harris, K., Marquez, E., & Almond, R. (2008, April). *A cognitively based assessment system for mathematics competency* [Annual meeting of the American Educational Research Association (AERA) in New York, NY].
- Trader, K., & Graf, E. A. (2008, April). *Investigating the effect of content specific terminology on the difficulty of an extended mathematics task* [Poster presented at the annual meeting of the American Educational Research Association (AERA) in New York, NY].
- Graf, E. A. (2007, August). *A cognitively-based approach to the development of mathematics assessment for grades 6 through 8* [Annual meeting of the American Psychological Association in San Francisco, CA].
- Robin, F., Banerjee, B., & Graf, E. A. (2006a, April). *Developing quantitative item models that support diagnostic assessment* [In R. R. Lawless (Chair), Policies, Methods, and Capabilities to Support Continuous, Diagnostic Assessment. Annual meeting of the American Educational Research Association in San Francisco, CA].
- Robin, F., Banerjee, B., & Graf, E. A. (2006b, October). *Impact of using small samples to pretest test items* [Annual meeting of the Northeastern Educational Research Association in Kerhonkson, NY].
- Hansen, E. G., Landau, S., Shute, V. J., & Graf, E. A. (2005, April). *Audio-tactile graphics in an adaptive delivery system for math tests and instruction* [Poster presented at the GAMA Summit: Goals for Achieving Math Accessibility, National Federation of the Blind (NFB) Jernigan Institute in Baltimore, MD].
- Shute, V. J., Hansen, E. G., & Graf, E. A. (2005, December). *ACED: Adaptive content with evidence-based diagnoses* [Poster presented at the National Science Foundation in Arlington, VA].
- Graf, E. A., Steffen, M., & Lawless, R. (2004, June). *Statistical and cognitive analysis of quantitative item models* [In R. R. Lawless (Chair), Item modeling and facet-based assessment in math and science: Applications to high-stakes and formative assessments. 30th annual conference of the International Association for Educational Assessment (IAEA)].
- Graf, E. A., Steffen, M., Peterson, S., Saldivia, L., & Wang, S. (2004, October). *Designing and revising quantitative item models* [Fourth Spearman Conference in Philadelphia, PA].

Professional Memberships

National Council of Teachers of Mathematics (NCTM) —	2003–Present
National Council on Measurement in Education (NCME) —	2019–Present
American Educational Research Association (AERA) —	2005–Present
Mathematical Association of America (MAA) —	2025–Present
Northeastern Educational Research Association (NERA) —	2025–Present