Vector Psychometric Group, LLC
References in support of capabilities

Vector Psychometric Group's research, consulting, and publishing experience cover a range of topics focused on advancing psychometric methods and practice. We believe psychometrically sound PRO development, evaluation, and validation requires an in depth understanding of standard and advanced item factor models (factor analysis, structural equation models, and item response theory), estimation methods used to obtain model parameters, tests of model assumptions and fit, understanding of how to model IRT-based scores, experiences writing results for a diverse audience, and the ability to collaborate with a wide range of researchers. While you can obtain a complete list of publications by request, we offer a few selected readings for each of the topics we believe are most important.

Standard and advanced item factor models:

Bollen, K.A., Bauer, D.J., Christ, S.L., & Edwards, M.C. (2010). Overview of structural equation models and recent extensions. In S. Kolenikov, D. Steinley, & L. Thombs (Eds.), *Statistics in the social sciences: Current methodological developments* (pp. 37-79). Hoboken, NJ: Wiley.

Cai, L. (2010c). A two-tier full-information item factor analysis model with applications. Psychometrika, 75, 581–612.

Cai, L., Yang, J. S. & Hansen, M. (2011). Generalized full-information item bifactor analysis. Psychological Methods, 16, 221–248.

Edwards, M.C., Flora, D.B., Thissen, D. (2012). Multi-stage computerized adaptive testing with uniform item exposure. *Applied Measurement in Education, 25*, 118-141.

Edwards, M. C., & Wirth, R. J., Houts, C. R., & Xi, N. (2013). Categorical data in the structural equation modeling framework. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling*. New York: Guilford Press.

MacCallum, R.C., Edwards, M.C., & Cai, L. (2012). Hopes and cautions in implementing Bayesian structural equation modeling. *Psychological Methods, 17*, 340-345.

Thissen, D., Cai, L., & Bock, R. D. (2010). The nominal categories item response model. In M. L. Nering & R. Ostini (Eds.), Handbook of polytomous item response theory models: Development and applications (pp. 43–75). New York, NY: Taylor & Francis.

Estimation methods:

Cai, L. (2008). SEM of another flavor: Two new applications of the supplemented EM algorithm. British Journal of Mathematical and Statistical Psychology, 61, 309–329.

Cai, L. (2010a). High-dimensional exploratory item factor analysis by Metroplis-Hastings Robbins-Monro algorithm. Psychometrika, 75, 33–57.

Cai, L. (2010b). Metropolis-Hastings Robbins-Monro algorithm for confirmatory item factor analysis. Journal of Educational and Behavioral Statistics, 35, 307–335.

Edwards, M.C. (2010). A Markov chain Monte Carlo approach to confirmatory item factor analysis. *Psychometrika, 75*, 474-497.

Moustaki, I., & Cai, L. (in press). Estimation methods in latent variable models for categorical outcome variables. In P. Irwing, T. Booth & D. Hughes (Eds.), The Wiley-Blackwell Handbook of Psychometric Testing. West Sussex, UK: John Wiley & Sons, Ltd.

Paek, I., & Cai, L. (2014). A comparison of item parameter standard error estimation procedures for unidimensional and multidimensional IRT modeling. Educational and Psychological Measurement, 74, 58–76.

Wirth, R. J., & Edwards, M. C. (2007). Item factor analysis: Current approaches and future directions. *Psychological Methods, 12,* 58 – 79.

Tests of model assumptions and fit:

Cai, L., & Hansen, M. (2013). Limited-information goodness-of-fit testing of hierarchical item factor models. British Journal of Mathematical and Statistical Psychology, 66, 245–276

Cai, L., Maydeu-Olivares, A., Coffman, D. L., & Thissen, D. (2006). Limited information goodness-of-fit testing of item response theory models for sparse 2*P* tables. British Journal of Mathematical and Statistical Psychology, 59, 173–194.

Houts, C.R., & Edwards, M.C. (2013). The performance of local dependence measures with psychological data. *Applied Psychological Measurement, 37*, 541-562.

Maydeu-Olivares, A., Cai, L., & Hernandez, A. (2011). Comparing the fit of IRT and factor analysis models. Structural Equation Modeling, 18, 333–356.

Woods, C. M., Cai, L., & Wang, M. (2013). The Langer-improved Wald test for DIF testing with multiple groups: Evaluation and comparison to two-group IRT. Educational and Psychological Measurement, 73, 532–547.

Modeling IRT-based scores:

Edwards, M. C., & Wirth, R. J. (2009). Measurement and the study of change. *Research in Human Development, 6,* 74 – 96.

Edwards, M.C., & Wirth, R.J. (2012). Valid measurement without factorial invariance: A longitudinal example. In J.R. Harring & G.R. Hancock (Eds.), *Advances in longitudinal methods in the social and behavioral sciences* (pp. 289-311). Charlotte, NC: Information Age Publishing.

Hussong, A. M., Wirth, R. J., Edwards, M. C., Curran, P. J., Zucker, R. A., & Chassin, L. A. (2007). Externalizing symptoms among children of alcoholic parents: Entry points for an antisocial pathway to alcoholism. *Journal of Abnormal Psychology, 116,* 529 – 542.

Willoughby, M. T., Wirth, R. J., Blair, C. B., & the Family Life Project Investigators (2012). Executive functioning in early childhood: Longitudinal measurement invariance and developmental change. *Psychological Assessment, 24, 418 - 431.*

Experiences writing results for a diverse audience & collaborating with a wide range of researchers:

Carle, A. C., Cella, D., Cai, L., Choi, S. W., Crane, P. K., Curtis, S. M., Gruhl, J., Lai, J., Mukherjee, S., Reise, S., Teresi, J., Thissen, D., Wu, E. J., & Hays, R. (2011). Advancing PROMIS's methodology: Results of the third PROMIS Psychometric Summit. Expert Review of Pharmacoeconomics & Outcomes Research, 11, 677–684.

Cole, D. A., Cai, L., Martin, N. C., Findling, R. L., Youngstrom, E. A., Garber, J., Curry, J. F., Hyde, J. S., Essex, M. J., Compas, B. E., Goodyer, I. M., Rohde, P., Stark, K. D., Slattery, M. J., & Forehand, R. (2011). Structure and measurement of depression in youth: Applying item response theory to clinical data. Psychological Assessment, 23, 819-33.

Edelen, M. O., Tucker, J. S., Shadel, W. G., Stucky, B. D., & Cai, L. (2012). Toward a more systematic assessment of smoking: Development of a smoking module for PROMIS. Addictive Behaviors, 37, 1278–1284.

Edwards, M.C., Cheavens, J.S., Heiy, J.E., & Cukrowicz, K.C. (2010). A reexamination of the factor structure of the Center for Epidemiologic Studies Depression Scale: Is a one-factor model plausible? *Psychological Assessment, 22*, 711-715.

Ennett, S. T., Bauman, K. E., Hussong, A., Faris, R., Foshee, V. A., DuRant, R., & Cai, L. (2006). The peer context of adolescent substance use: Findings from social network analysis. Journal of Research on Adolescence, 16, 159–186.

Norris, M., Lecavalier, L., & Edwards, M.C. (2012). The structure of autism symptoms as measured by the Autism Diagnostic Observation Schedule. *Journal of Autism and Developmental Disorders, 42*, 1075-1086.

Reise, S., Preston, K., & Cai, L., & Hays, R. D. (2011). Using the nominal response model to evaluate response category discrimination in the PROMIS emotional distress item pools. Educational and Psychological Measurement, 71, 523–550.

Swartz, R. J., Schwartz, C., Basch, E., Cai, L., Fairclough, D. L., McLeod, L., Mendoza, T., & Rapkin, B. (2011). The King's Foot of patient-reported outcomes: Current practices and new developments for the measurement of change. Quality of Life Research, 20, 1159–1167.

Additional Pedagogical Papers:

Cai, L. (2013). Factor analysis of tests and items. In Geisinger, K. F. (Ed.), APA Handbook of Testing and Assessment in Psychology. Washington, DC: American Psychological Association.

Edwards, M.C. (2009). An introduction to item response theory using the Need for Cognition scale. *Social and Personality Compass, 3*, 507-529.

Edwards, M.C., & Edelen, M.O. (2009). Special topics in item response theory. In R.E. Millsap and A. Maydeu-Olivares (Eds.), *The SAGE handbook of quantitative methods in psychology* (pp. 178-198). New York, NY: Sage Publications.