Richard Border
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Department of Neurology
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Research statement

I study problems at the intersections of human genetics, statistical inference, quantitative psychology, and applied mathematics. My primary research foci include:

1. Genomic variance/covariance component estimators in structured populations.
2. Efficient numerical methods for the analysis and simulation of genome-wide data.
3. Metascience, falsifiability, and the identification of spurious findings.

My research is supervised by Noah Zaitlen at the UCLA David Geffen School of Medicine Neurology Department and Sriram Sankararaman in the UCLA Computer Science Department. I also colloborate with the Price Lab at the Harvard T. H. Chan School of Public Health Department of Epidemiology, which I joined as a visiting scientist in 2021.

Preprints

- Jami, J.S., ..., **Border**, **R**., ..., Middeldorp, C.M.. "Genome-wide meta-analysis of internalising symptoms in 64,641 children and adolescents repeatedly measured between age 3 and age 18." doi.org/10.1101/2020.09.11.20175026

Peer-reviewed publications

- **Border**, **R**., O'Rourke, S., de Candia, T., Goddard, M. E., Visscher, P. M., Yengo, L., Jones, M., Keller, M. C. (2022). "Assortative mating biases marker-based heritability estimates." *In press* at *Nature Communications.* 10.1038/s41467-022-28294-9
- Ip, H.F., ..., **Border**, **R**., ..., Boomsma, D. (2021). "Genetic association study of childhood aggression across raters, instruments and age." *In press* at *Translational Psychiatry.* doi.org/10.1101/854927
- Adjangba, C., **Border, R**., Romero, Villela P.N., Ehringer, M.A., Evans, L.M. (2021). Little evidence of modified genetic effect of rs16969968 on heavy smoking based on age of onset of smoking. *Nicotine and Tobacco Research.* doi.org/10.1101/2020.04.22.20071407
- **Border**, **R**. and Becker, S. (2019). Stochastic Lanczos estimation of genomic variance components for linear mixed-effects models. *BMC Bioinformatics* (2019). doi.org/10.1186/s12859-019-2978-z
- **Border**, **R**., Johnson, E.C., Evans, L.M., Berley, N., Sullvan, P.F., Keller, M.C. (2019). No support for historic candidate gene or candidate gene-by-interaction hypotheses for major depression across multiple large samples. *American Journal of Psychiatry.* doi.org/10.1176/appi.ajp.2018.18070881
- **Border**, **R**., Johnson, E.C., Evans, L.M., Keller, M.C. (2019). Measurement error cannot account for failed replications of historic candidate gene-by-environment hypotheses: response to Vrshek-Schallhorn et al.. *American Journal of Psychiatry.* doi.org/10.1176/appi.ajp.2019.19040374r

- **Border, R.**, Smolen, A., Corley, R., Stallings, M., Brown, S., Conger, R., Derringer, J., Donnellan, B., Haberstick, B., Hewitt, J., Hopfer, C., Krauter, K., McQueen, M., Wall, T., Keller, M., Evans, L. (2019). Imputation of behavioral candidate gene repeat polymorphisms in 486,551 publicly-available UK Biobank individuals. *European Journal of Human Genetics.* doi.org/10.1038/s41431-019-0349-x

- **Border**, **R**., Corley, R.C., Brown, S.A., Hewitt, J.K., Hopfer, C.J., Williams, S.K., Rhea, S., Shriver, C.L., Stallings, M.C., Wall, T.L., Woodward, K.E., Rhee, S.H. (2018). "Independent predictors of mortality in adolescents ascertained for conduct disorder and substance use problems, their siblings, and community controls." *Addiction.* doi.org/10.1111/add.14366

- **Border**, **R**., Corley, R.C., Brown, S.A., Hewitt, J.K., Hopfer, C.J., Stallings, M.C., Wall, T.L., Young, S.E., Rhee, S.H. (2018). "Predictors of adult outcomes in clinically- and legally-referred youth with antisocial behavior." *PLOS ONE.* doi.org/10.1371/journal.pone.0206442

- Johnson, E.C., **Border**, **R**., Melroy-Greif, W.E., de Leeuw, C., Ehringer, M.A., Keller, M.C. (2017). "No evidence that schizophrenia candidate genes are more associated with schizophrenia than non-candidate genes." *Biological Psychiatry.* doi.org/10.1016/j.biopsych.2017.06.033

- **Border**, **R**. and Keller, M.C. (2017). "Fundamental problems with candidate gene-by-environment interaction studies." *Journal of Child Psychology and Psychiatry.* doi.org/10.1111/jcpp.12669

Dissertation and master's thesis

- **Border**, **R**.. "Topics in the quantitative analysis of complex trait genetic architectures". Psychology and Neuroscience Graduate Theses & Dissertations. scholar.colorado.edu/concern/articles/vd66w090s

- **Border**, **R**.. "Stochastic Lanczos likelihood estimation of genomic variance components". Applied Mathematics Graduate Theses & Dissertations. 120. scholar.colorado.edu/appm_gradetds/120

Presentations

- **Border**, **R**., Athanasiadis, G., Buil Demur, A., Schork, A., Werge, T., Kendler, K., Flint, J., Dahl, A., Zaitlen, N. (2021). "Widespread evidence of systematic bias in estimates of genetic correlation due to cross-trait assortative mating ". Plenary talk presented at the 2021 annual meeting of *American Society of Human Genetics*.

- **Border**, **R**., Becker, S. (2019). "Randomized algorithms for genomic variance components estimation in mixed models". Poster presented at the 2019 *International Workshop on Statistical Genetic Methods for Human Complex Traits*, Boulder, CO.

- **Border**, **R**., Johnson, E.C., Evans, L.M., Berley, N., Sullvan, P.F., Keller, M.C. 2018). "Quantitative reconcilliation of GWAS and candidate gene findings: measurement error, nonlinearity, and artifactual results". Paper presentation *accepted* for the 48*th* meeting of the Behavior Genetics Association in Boston, MA. (Talk delivered by M.C. Keller due to illness)

- **Border**, **R**., Johnson, E.C., Berley, N., Medland, S.E., Sullvan, P.F., Keller, M.C. (2018). "Examining the relevance of canonical candidate genes for major depression". Poster *accepted* for the 48*th* meeting of the Behavior Genetics Association in Boston, MA.

- Evans, L.M., **Border, R.**, du Pont, A., Friedman, N.P., Johnson, E., Yang, J., Visscher, P., Keller, M.C. (2018). "Exploring the genetic architecture of psychiatric disorders using partitioned heritability approaches". Symposium presented by Luke Evans at the *World Congress of Psychiatric Genetics*, October 2018, Glasgow, Scotland.
- **Border**, **R**., Johnson, E.C., Berley, N., Sullvan, P.F., Keller, M.C. (2017). "Discrepancies between candidate gene and genome-wide studies of complex traits and endophenotypes." Poster presented at the 25*th* annual meeting of the World Congress of Psychiatric Genetics, Orlando, Florida, October 13-17, 2017
- Park, A. L., Tsai, K. H., Guan, K., **Border, R.**, and Chorpita, B. F. (2017). "Unintended consequences of evidence-based treatment policy reform." In *Use of Evidence in Mental Health Treatment and Clinical Decision-Making.* Symposium held at the 4*th* Biennial Society for Implementation Research Collaboration Conference, Seattle, WA.
- Johnson, E.C., Melroy-Greif, W.E., **Border**, **R**., Keller, M.C., Ehringer, M.A. (2016). "Examining 25 classic schizophrenia candidate genes in the context of GWAS data: evidence for relevance?". Poster presented at the 2016 meeting of the American Society of Human Genetics in Vancouver, British Colombia.
- **Border**, **R**., Sawaya, S., Huggett, S., Brown, S.A., Wall, T.L., and Stallings, M.C. (2015). "Sensitivity of random forests algorithm to population stratification in GWAS data". Postter presented at the 45*th* annual meeting of the Behavior Genetics Association in San Diego, CA.

Education

2019 Doctor of Philosophy
Behavioral, Psychiatric, and Statistical Genetics
Advised by Matthew C. Keller
Department of Psychology and Neuroscience, University of Colorado Boulder

2018 Master of Science
Applied Mathematics
Advised by Stephen Becker
Department of Applied Mathematics, University of Colorado Boulder

Master of Arts
Behavioral, Psychiatric, and Statistical Genetics
Advised by Soo Hyun Rhee
Department of Psychology and Neuroscience, University of Colorado Boulder

2011 Bachelor of Arts
Japanese Language and Literature
Advised by Terry Kawashima
Department of East Asian Studies, Wesleyan University

Honors and awards

2021 Charles J. Epstein Research Semifinalist Award
American Society for Human Genetics

National Institutes of Health Postdoctoral Trainee *T32NS048004*
Semel Institute for Neuroscience and Human Behavior, University of California, Los Angeles

2020 Dosier Muenzinger Award for Outstanding Contribution to Basic Research
Department of Psychology and Neuroscience, University of Colorado Boulder

2016–2019 National Institutes of Health Predoctoral Trainee *T32MH016880*
Selected by faculty training committee thrice consecutively (maximum number of times awarded to any graduate student), Institute for Behavioral Genetics, University of Colorado Boulder

2018 Behavior Genetics Association Travel Award
Behavior Genetics Association

Departmental Travel Grant
Department of Psychology and Neuroscience, University of Colorado Boulder

2017 United Government of Graduate Students Individual Travel Award
University of Colorado Boulder Graduate School

2015–2019 Predoctoral Fellowship
Institute for Behavioral Genetics, University of Colorado Boulder

Peer review

I have refereed for the following journals:

- *Alcoholism: Clinical and Experimental Research*
- *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics*
- *American Journal of Psychiatry*
- *Bioscience Reports*
- *BMC Bioinformatics*
- *BMC Psychiatry*
- *Genes, Brain and Behavior*
- *JAMA Psychiatry*
- *Journal of Psychiatric Research*
- *Molecular Psychiatry*
- *Psychiatry Research*
- *Psychological Bulletin*
- *Psychoneuroendocrinology*

Teaching positions

2019 Statistical Methods and Applications II (Combined Undergraduate and Graduate Sections)
Course Assistant, Department of Applied Mathematics.

2018 Mathematical Statistics (Combined Undergraduate and Graduate Sections)
Course Assistant, Department of Applied Mathematics.

Statistical Methods (Combined Undergraduate and Graduate Sections)
Course Assistant, Department of Applied Mathematics.

2016 Statistical Programming with R (Graduate)
Teaching Assistant, Department of Psychology and Neuroscience.

Statistics II (Graduate)
Teaching Assistant, Department of Psychology and Neuroscience.

2015 Introduction to Statistics (Undergraduate)
Teaching Assistant, Department of Psychology and Neuroscience.

Statistical Programming with R (Graduate)
Teaching Assistant, Department of Psychology and Neuroscience.

Lectures

- Mapping genes for complex traits. *Physiological Genetics and Genomics, Department of Integrative Physiology.*
- Randomized algorithms for genomic variance components analyses. *Randomized Algorithms, Department of Applied Mathematics.*
- Statistical power. *Introduction to Statistics, Department of Psychology and Neuroscience.*
- Functional programming concepts in R. *Statistical Programming with R, Department of Psychology and Neuroscience.*
- Methods for reproducible research in R. *Statistical Programming with R. Department of Psychology and Neuroscience.*