

Richard Border
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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 interests include:

1. Polygenic estimators under nonrandom mating and other forms of population structure
2. Efficient numerical methods for the analysis and simulation of genome-wide data.
3. Metascience, model misspecification, 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 work 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

- **Border, R.**, Athanasiadis, G., Build, A., Schork, A., Cai, N., Young, A., Werge, T., Flint, J., Kendler, K., Sankararaman, S., Dahl, A., Zaitlen, N.. “Cross-trait assortative mating is widespread and inflates genetic correlation estimates.” doi.org/10.1101/2022.03.21.485215
- 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 doi.org/10.1101/2022.03.21.485215
- Dahl, A., ..., **Border, R.**, ..., Cai, N.. “Phenotype integration improves power and preserves specificity in biobank-based genetic studies of MDD” doi.org/10.1101/2022.08.15.503980

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.” *Nature Communications*. [10.1038/s41467-022-28294-9](https://doi.org/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.” *Translational Psychiatry*. doi.org/10.1038/s41398-021-01480-x
- 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*. doi.org/10.1186/s12859-019-2978-z
- **Border, R.**, Johnson, E.C., Evans, L.M., Berley, N., Sullivan, 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

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., Sullivan, P.F., Keller, M.C. (2018). “Quantitative reconciliation of GWAS and candidate gene findings: measurement error, nonlinearity, and artifactual results”. Paper presentation *accepted* for the 48th 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., Sullivan, P.F., Keller, M.C. (2018). “Examining the relevance of canonical candidate genes for major depression”. Poster *accepted* for the 48th 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., Sullivan, P.F., Keller, M.C. (2017). “Discrepancies between candidate gene and genome-wide studies of complex traits and endophenotypes.” Poster presented at the 25th 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 4th 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”. Poster presented at the 45th annual meeting of the Behavior Genetics Association in San Diego, CA.

Honors and awards

2021	Charles J. Epstein Research Semifinalist Award <i>American Society for Human Genetics</i>	
	National Institutes of Health Postdoctoral Trainee <i>Semel Institute for Neuroscience and Human Behavior, University of California, Los Angeles</i>	T32NS048004
2020	Dosier Muenzinger Award for Outstanding Contribution to Basic Research <i>Department of Psychology and Neuroscience, University of Colorado Boulder</i>	
2016–2019	National Institutes of Health Predoctoral Trainee <i>Selected by faculty training committee thrice consecutively (maximum number of times awarded to any graduate student), Institute for Behavioral Genetics, University of Colorado Boulder</i>	T32MH016880
2018	Behavior Genetics Association Travel Award <i>Behavior Genetics Association</i>	
	Departmental Travel Grant <i>Department of Psychology and Neuroscience, University of Colorado Boulder</i>	
2017	United Government of Graduate Students Individual Travel Award <i>University of Colorado Boulder Graduate School</i>	
2015–2019	Predoctoral Fellowship <i>Institute for Behavioral Genetics, University of Colorado Boulder</i>	

Education

2019	Doctor of Philosophy <i>Behavioral, Psychiatric, and Statistical Genetics</i> <i>Advised by Matthew C. Keller</i> <i>Department of Psychology and Neuroscience, University of Colorado Boulder</i>
2018	Master of Science <i>Applied Mathematics</i> <i>Advised by Stephen Becker</i> <i>Department of Applied Mathematics, University of Colorado Boulder</i>

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

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

Peer review

I have served as a special topic guest editor for *Frontiers in Genetics*. Additionally, I have refereed for the following journals:

- *Alcoholism: Clinical and Experimental Research*
- *American Journal of Medical Genetics Part*
- *American Journal of Psychiatry*
- *Bioscience Reports*
- *BMC Bioinformatics*
- *BMC Psychiatry*
- *eLife*
- *Frontiers in Public Health*
- *Genes, Brain and Behavior*
- *JAMA Psychiatry*
- *Journal of Clinical Medicine*
- *Journal of Psychiatric Research*
- *Molecular Psychiatry*
- *Nature Human Behavior*
- *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.

Guest lectures

- Mapping genes for complex traits (2019). *Physiological Genetics and Genomics, Department of Integrative Physiology.*
- Randomized algorithms for genomic variance components analyses (2019). *Randomized Algorithms, Department of Applied Mathematics.*
- Statistical power (2016). *Introduction to Statistics, Department of Psychology and Neuroscience.*
- Functional programming concepts in R (2015). *Statistical Programming with R, Department of Psychology and Neuroscience.*
- Methods for reproducible research in R (2015). *Statistical Programming with R. Department of Psychology and Neuroscience.*