# Lucy D'Agostino McGowan

www.lucymcgowan.com

♠ LucyMcGowan y LucyStats
♠ 0000-0001-7297-9359

# **EDUCATION**

PhD in Biostatistics, May 2018, GPA 3.95

VANDERBILT UNIVERSITY

Thesis: Improving Modern Techniques of Causal Inference: Finite Sample Performance of ATM and ATO Doubly Robust Estimators, Variance Estimation for ATO Estimators, and Contextualized Tipping Point Sensitivity Analyses for Unmeasured Confounding

MS in Biostatistics, December 2013, GPA 3.88

WASHINGTON UNIVERSITY SCHOOL OF MEDICINE

Thesis: Quantitative Assessment of the Community Research Fellows Training Program

**BA** with Distinction and Highest Honors

University of North Carolina at Chapel Hill

Religious Studies: GPA 3.92 Romance Languages: GPA 3.86

# RESEARCH EXPERIENCE

2019-present	Wake Forest University Assistant Professor, Department of Mathematics and Statistics
2018-2019	Johns Hopkins Bloomberg School of Public Health Postdoctoral fellow with Jeffrey Leek
2017 March-August	RStudio Internship under Jenny Bryan developing the 'googledrive' R package
2016-2017	Vanderbilt University NIH Big Data to Knowledge Training Fellow
2015-2016, 2017-2018	Vanderbilt University Research Assistant, Department of Biostatistics and VA Tennessee Valley
2015 Summer	Cleveland Clinic Summer Graduate Fellow, Department of Quantitative Health Sciences
2013 Summer	Graham Colditz Laboratory Summer Intern, Washington University School of Medicine
2012-2014	Washington University School of Medicine Research Assistant, Gutmann Research Laboratory, Department of Neurology
2012-2014	Washington University School of Medicine Statistical Data Analyst, Department of Surgery, Division of Public Health Science

# Computing

Expert: R, Shiny, Git/GitHub, LATEX, HTML/CSS, SAS

Familiar: Python, Stata, ArcGIS

# AWARDS

2020	JupyterCon Invited Keynote Speaker
2019	Winning team, ASA Leadership Challenge
2018	Vanderbilt Biostatistics Travel Award (ENAR)
2017	NASA Datanauts, Class of 2017
2017	useR!2017 Young Academic Scholarship
2017	Caucus for Women in Statistics Travel Award
2016	First Place, GSS Student Data Challenge, ASA Joint Statistical Meeting
2016	Second Place, SPAAC Poster Competition, ASA Joint Statistical Meeting
2016	Southern Startup Internship Program in Data Science (South BDHub)
2016	Vanderbilt Commodore Award in Biostatistics
2015	First Place, GSS Student Data Challenge, ASA Joint Statistical Meeting
2015	Prezi Student Ambassador
2014	SAS Student Scholar, PharmaSUG
2014	SAS Student Ambassador, SAS Global Forum 2014
2013	First Place, Student Research Competition, 141st APHA Annual Meeting
2013	Ellis R. Ott Scholarship: ASQ Statistics Division
2013	Best Contributed Paper in the Statistics and Data Analysis Section at SAS Global Forum
2013	SAS Student Scholar, NESUG
2013	SAS Student Ambassador, SAS Global Forum 2013
2012	Gertrude M. Cox Scholarship for Women in Statistics Honorable Mention
2012	NIAF Jim Cantalupo Scholarship
2011-2012	National Society of Leadership and Success
2011	Dunlevie Honors Undergraduate Research Award
2010	Programma Ponte Scholarship
2010	Newman Scholar
2009-2012	UNC Dean's List
2008-2012	UNC Public Service Scholar

# OUTREACH

2019-2021 Casual Inference Podcast co-host, sponsored by the American Journal of Epidemiology 2017-2018 President, Vanderbilt Biostatistics Graduate Student Association 2017-2018 Abstract reviewer, R-Ladies Global 2016-2019 Co-founder, Co-organizer, R-Ladies Nashville 2016-2017 President, Vanderbilt Graduate Student Council 2016-2017 Vice President, Vanderbilt Biostatistics Graduate Student Association useR Student Volunteer 2015-2016 Tutor, Tennessee Office of Refugees Scholar, Scholarship of Teaching and Learning

2014-2015 Vice President of Social Affairs, Vanderbilt Graduate Student Council

# Professional Activities

#### **Internal Service**

2020-2021	Peer Learning Community Facilitator, WFU Center for Advancement of Teaching
2020-2021	Wake Forest College Covid-19 Steering Committee Working Group
2020-2021	Statistics Hiring Committee Member
2020-2021	Committee member, Postdoc Hiring Committee
2020	Math Club Faculty Co-Chair
2019-2020	Faculty advisor, Wake Forest University ASA Student Chapter
2019-2020	Founding committee member, DataFest
2019-2020	Committee member, Statistics Curriculum Committee
2019-2020	Founder, Reynolda Data Science Lab

#### **Professional Service**

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2020-2021	Committee member, ENAR Program Committee
2020-2021	Member, ENAR Regional Advisory Board
2020-2021	Committee of Presidents of Statistical Societies (COPSS) Communications Officer
2020	Vice-chair, Chair-elect, ASA Committee on Women in Statistics
2020	Chair, ASA Committee on Women in Statistics
2019-2021	ASA Council of Sections Representative, Section on Statistical Computing
2019-2021	Associate Editor (Social Media), The American Journal of Epidemiology
2019-2021	Committee member, ASA Computing and Graphics Student Paper Award Selection Commit-

2019	Committee member, ASA Committee on Women in Statistics
2019	Interim Program Chair, ASA Statistics Communication Interest Group
2018	Committee member, Women in Statistics and Data Science Service Project
2017-2018	President, Nashville ASA Student Chapter
2017	Panelist, Inaugural ASA Student Chapter Workshop
2016-2017	Vice President, Co-founder, Nashville ASA Student Chapter
2014	Abstract reviewer, Applied Public Health Statistics, American Public Health Association

#### Referee

Biostatistics, The American Statistician, BMJ Open, rOpenSci, American Journal of Epidemiology, Statistics in Medicine, Journal of the Royal Statistical Society, Nature Biotechnology and PLOS One

# **FUNDING**

2020	Leadership and Character Course Redesign Grant
	Internal Grant. Amount: \$1000

2019 A study of various methods to teach R programming

Wake Forest University Center for the Advancement of Teaching SoTL Seed Grant Fund. Role: PI. WFU Amount: \$940

# TEACHING EXPERIENCE

#### Wake Forest University

- (Spring) STA 363: Statistical Learning (2020)
- (Fall) STA 312: Linear Models (2020)
- (Fall) STA 212: Statistical Modeling (2019)

# Vanderbilt University

- Frank Harrell's Regression Modeling Strategies (2017)
- Statistical Collaboration in Health Sciences Teaching Assistant (2015)
- Modern Regression Analysis Teaching Assistant (2015)
- Principles of Modern Biostatistics Teaching Assistant (2015)

# Washington University in St. Louis

- Introduction to SAS Teaching Assistant (2013)
- Introduction to Clinical Epidemiology Teaching Assistant (2013)
- $\bullet\,$  Randomized Controlled Trials Teaching Assistant (2013)

#### **Online Courses**

- Creating dynamic dashboards with the shinydashboard R package (2019)
- Understanding data and statistics in the medical literature (2019)
- ggplot2 in 2: Learn the ggplot2 R package in 2 hours (2019)

# STUDENT ENGAGEMENT

## **Undergraduate Theses**

- Jonathan Trattner, Tools for Designing Online Randomized Trials Using the Shiny Framework (2020-2021)
- Nuri Park, Best Practices for Teaching R: A Randomized Controlled Trial (2020-2021)
- Hannah Mendoza, The Impact of Disclosing Uncertainty on Decision Making: A Randomized Controlled Trial (2020)

# Independent Studies

- Iris Liu, Building a Dashboard and Gaining Insight into Reynolda Museum Data, URECA Wake Forest Research Fellowship (Funded Research) (Summer 2020)
- Sofia Blankenship, Independent Study Building a Shiny Application (Course Credit) (Fall 2019)
- Sophia Fang, Understanding Statistics and Data in The Medical Literature Course Update (2020)
- Hannah Luebbering, Studies on Teaching Programming: A Literature Review (2020)

# Invited Presentations

ENAR 2020 Oral Presentation

Lucy D'Agostino McGowan, "Tools for analyzing R code the tidy way."

SDSS 2020 Oral Presentation

Lucy D'Agositno McGowan, "Best Practices for Teaching R A Randomized Controlled Trial."

# ASA Joint Statistical Meeting 2020

ORAL PRESENTATION

Lucy D'Agostino McGowan, "The Ups and Downs of Communicating Complex Statistics."

JupyterCon 2020 Keynote

Lucy D'Agostino McGowan, "Equipping and empowering future data scientists with confidence, intuition, and communication skills."

# CDC R Group 2020

ORAL PRESENTATION

Lucy D'Agostino McGowan, "ConTESSA: A Shiny App to Help Quantify Contact Tracing Efficacy."

Lucy D'Agostino McGowan, "Applied Demonstration of the tipr R Package."

# Macalester College 2019

ORAL PRESENTATION

Lucy D'Agostino McGowan, "There and back again, a data scientist's tale."

#### ASA Joint Statistical Meeting 2019

Oral Presentation

Lucy D'Agostino McGowan, "Challenges in Augmenting Randomized Trials with Observational Health Records."

ENAR 2018 Oral Presentation

Lucy D'Agostino McGowan, Robert A. Greevy, Jr, "Exploring finite-sample bias in propensity score weights."

## Data Day Texas 2018

ORAL PRESENTATION

Lucy D'Agostino McGowan, "Making Causal Claims as a Data Scientist: Tips and Tricks Using R."

# ASA Joint Statistical Meeting 2018

ORAL PRESENTATION

Lucy D'Agostino McGowan, "Harnessing the Power of the Web via R Clients for Web APIs."

#### SAS Global Forum 2017

ORAL PRESENTATION

Lucy D'Agostino McGowan, "Streamline Your Workflow: Integrating SAS, LaTeX, and R into a Single Reproducible Document."

#### R-Ladies Nashville 2017

ORAL PRESENTATION

Lucy D'Agostino McGowan, "An R + GitHub Journey."

#### SAS Global Forum 2016

ORAL PRESENTATION

Lucy D'Agostino McGowan, Robert A. Greevy, Jr, "Integrating SAS and R to Perform Optimal Propensity Score Matching."

## SAS Global Forum 2015

ORAL PRESENTATION

Lucy D'Agostino McGowan, Alice Toll, "Using PROC SURVEYREG and PROC SURVEY-LOGISTIC to Assess Potential Bias."

#### SAS Global Forum 2014

ORAL PRESENTATION

Lucy D'Agostino McGowan, Melody S. Goodman, Kimberly A. Kaphingst, "Using SAS/STAT® Software to Validate a Health Literacy Prediction Model in a Primary Care Setting."

# Workshops and Panels

# Women in Statistics and Data Science 2017

Panel

Jenny Bryan, Mine Cetinkaya-Rundel, Lucy D'Agostino McGowan, Gabriela de Queiroz, Mine Dogucu, Katherine Scranton, Jennifer Thompson, "R-Ladies Panel: Improving gender diversity in a male-dominated community."

#### ASA K-12 Virtual Workshops 2020

Workshop

Lucy D'Agostino McGowan and Shannon Ellis, "Using RStudio Cloud in the Classroom."

eCOTS 2020 PANEL

Laura Le, Kari Lock Morgan, Lucy D'Agostino McGowan, "Panel: Engaging Students during the COVID-19 Health Crisis."

## NC School of Science and Math Data Science Panel 2020

PANEL

Lucy D'Agostino McGowan, "Data Science at Wake Forest University."

user!2020 Workshop

Lucy D'Agostino McGowan and Malcolm Barrett, "Causal Inference in R."

#### R in Government Conference

Workshop

Lucy D'Agostino McGowan and Malcolm Barrett, "Causal Inference in R."

ENAR 2019 Workshop

Lucy D'Agostino McGowan, "Data Visualizations with ggplot2."

# Contributed Presentations

ENAR 2017 Oral Presentation

Lucy D'Agositno McGowan, Robert Alan Greevy, Jr, "Simplifying and Contextualizing Sensitivity to Unmeasured Confounding Tipping Point Analyses."

useR!2017 Oral Presentation

Lucy D'Agostino McGowan, Nick Strayer, Jeff Leek, "papr: Tinder for pre-prints, a Shiny Application for collecting gut-reactions to pre-prints from the scientific community."

# ASA Joint Statistical Meeting 2017

SPEED (ORAL + POSTER) PRESENTATION

Lucy D'Agostino McGowan, Robert A. Greevy, Jr, "Contextualizing Sensitivity Analysis in Observational Studies: Calculating Bias Factors for Known Covariates."

## ASA Joint Statistical Meeting 2016

Poster

Lucy D'Agostino McGowan, Robert A. Greevy, Jr, "Practical Guidance and Tools for Rule-Out Sensitivity to Unmeasured Confounding Analyses."

Ryan Jarrett, Lucy D'Agostino McGowan, "Assessing the Association Between Accident Injury Severity and NCAP Car Safety Ratings"."

## ASA Joint Statistical Meeting 2015

SPEED (ORAL + POSTER) PRESENTATION

Lucy D'Agostino McGowan, Alice Toll, "Census Tract-Level Disparities: Examining Food Swamps and Food Deserts."

# 141st American Public Health Association Annual Meeting 2013

POSTER

Lucy D'Agostino McGowan, Melody S. Goodman, "Developing County-Level Estimates of Racial Disparities in Obesity Using Multilevel Reweighted Regression."

#### 141st American Public Health Association Annual Meeting 2013

ORAL PRESENTATION

Lucy D'Agostino McGowan, Melody S. Goodman, "Small Areal Estimation of Racial Disparities in Diabetes Using Multilevel Reweighted Regression."

## SAS Analytics 2013

Poster

Lucy D'Agostino McGowan, Patrick J. McGowan, "Mining Through Resumes: Utilizing SAS to Increase Efficiency and Objectivity in the Hiring Process."

## Northeast SAS Users Group 2013

Poster

Lucy D'Agostino McGowan, "SAS ® for Budgeting an Ideal Wedding."

# Northeast SAS Users Group 2013

ORAL PRESENTATION

Lucy D'Agostino McGowan, Melody S. Goodman, "Using PROC GLIMMIX and PROC SGPLOT to Demonstrate County-level Racial Disparities in Obesity in North Carolina."

#### SAS Global Forum 2013

ORAL PRESENTATION

Lucy D'Agostino McGowan, Melody S. Goodman, "Multilevel Reweighted Regression Models to Estimate County-Level Racial Health Disparities Using PROC GLIMMIX."

# Software

#### Author & Maintainer

pald: An R package to calculate partioned local depth (PaLD) probabilities for clustering

tipr: An R package with tools for conducting tipping point sensitivity analyses.

**googledrive**: An R package that interfaces with Google Drive from R, allowing users to seamlessly manage files on Google Drive from the comfort of their console.

**contributr**: A Shiny Application developed in collaboration with Maelle and rOpenSci for finding beginner GitHub issues to contribute to.

**papr**: Tinder for pre-prints, a Shiny Application developed in collaboration with Jeff Leek and Nick Strayer for collecting gut-reactions to pre-prints from the scientific community

#### Author

datasauRus: An R package made in collaboration with Steph Locke consisting of The Datasaurus Dozen, a set of datasets with the same summary statistics. They retain the same summary statistics despite having radically different distributions. The datasets represent a larger and quirkier object lesson that is typically taught via Anscombe's Quartet.

meetupr: An R package authored and maintained by R-Ladies to interface with the Meetup API

#### Contributer

**cowsay**: An R package that allows printing of character strings as messages/warnings/etc. with ASCII animals, including cats, cows, frogs, chickens, ghosts, and more.

**RJafroc**: And R package for analyzing data acquired using the Receiver Operating Characteristic paradigm and its extensions.

# **PUBLICATIONS**

Îndicates equal contributions

- 1. **D'Agostino McGowan L**, Grantz K, Murray EJ (2020). "Quantifying Uncertainty in Infectious Disease Mechanistic Models (In Press)." *American Journal of Epidemiology*.
- 2. ^Cohen JB, ^**D'Agostino McGowan L**, Jensen E, Rigdon J, South AM (2020). "Evaluating Sources of Bias in Observational Studies of ACE Inhibitor/ARB Use During COVID-19: Beyond Confounding (In Press)." *Journal of Hypertension*.
- 3. Fox MP, **D'Agostino McGowan L**, James BD, Lessler J, Mehta SH, Murray EJ (2020). "Concerns About the Special Article on Hydroxychloroquine and Azithromycin in High Risk Outpatients with COVID-19 by Dr. Harvey Risch." *American Journal of Epidemiology*.
- 4. **D'Agostino McGowan L**, Kross S, Leek J (2020). "Tools for Analyzing R Code the Tidy Way." *The R Journal*, 12(1), 226-242. doi: 10.32614/RJ-2020-011 (URL: https://doi.org/10.32614/RJ-2020-011).
- 5. Liberman JS, **D'Agostino McGowan L**, Greevy RA, Morrow JA, Griffin MR, Roumie CL, Grijalva CG (2020). "Mental health conditions and the risk of chronic opioid therapy among patients with rheumatoid arthritis: a retrospective veterans affairs cohort study." *Clinical Rheumatology*, 1-10.
- 6. Griffin L, Carter M, D'Agostino Jr R, **D'Agostino McGowan L** (2019). "Comparative Effectiveness of Two Collagen-containing Dressings: Oxidized Regenerated Cellulose (ORC)/Collagen/Silver-ORC Dressing Versus Ovine Collagen Extracellular Matrix." Wounds: a compendium of clinical research and practice, 31(11), E73.
- 7. Wickham H, Averick M, Bryan J, Chang W, **D'Agostino McGowan L**, François R, Grolemund G, Hayes A, Henry L, Hester J, Kuhn M, Pedersen TL, Miller E, Bache SM, Müller K, Ooms J, Robinson D, Seidel DP, Spinu V, Takahashi K, Vaughan D, Wilke C, Woo K, Yutani H (2019). "Welcome to the tidyverse." *Journal of Open Source Software*, 4(43), 1686. doi: 10.21105/joss.01686 (URL: https://doi.org/10.21105/joss.01686).

- 8. Singh DP, Gabriel A, Silverman RP, Griffin LP, **D'Agostino McGowan L**, D'Agostino Jr RB (2019). "Meta-analysis Comparing Outcomes of Two Different Negative Pressure Therapy Systems in Closed Incision Management." *Plastic and Reconstructive Surgery Global Open*, 7(6).
- 9. Pun BT, Balas MC, Barnes-Daly MA, Thompson JL, Aldrich JM, Barr J, Byrum D, Carson SS, Devlin JW, Engel HJ, Esbrook CL, Hargett KD, Harmon LR, Hielsberg C, Jackson JC, Kelly TL, Kumar V, Millner L, Morse A, Perme CS, Posa PJ, Puntillo KA, Schweickert WD, Stollings JL, Tan A, **D'Agostino McGowan L**, Ely EW (2019). "Caring for critically ill patients with the ABCDEF bundle: results of the ICU liberation collaborative in over 15,000 adults." *Critical care medicine*, 47(1), 3-14.
- 10. Murff HJ, Roumie CL, Greevy RA, Hackstadt AJ, **D'Agostino McGowan L**, Hung AM, Grijalva CG, Griffin MR (2018). "Metformin use and incidence cancer risk: evidence for a selective protective effect against liver cancer." *Cancer causes & control : CCC*, 27(10), 1-10.
- 11. **D'Agostino McGowan L**, Roumie CL (2018). "Sulfonylureas as second line treatment for type 2 diabetes." *BMJ*, *362*.
- 12. Blume JD, **D'Agostino McGowan L**, Dupont WD, Greevy Jr RA (2018). "Second-generation p-values: Improved rigor, reproducibility, & transparency in statistical analyses." *PloS one*, 13(3), e0188299.
- 13. Roumie CL, Min JY, **D'Agostino McGowan L**, Presley C, Grijalva CG, Hackstadt AJ, Hung AM, Greevy RA, Elasy T, Griffin MR (2017). "Comparative safety of sulfonylurea and metformin monotherapy on the risk of heart failure: a cohort study." *Journal of the American Heart Association*, 6(4), e005379.
- 14. **D'Agostino McGowan L**, Bullen JA, Obuchowski NA (2016). "Location bias in ROC studies." Statistics in Biopharmaceutical Research, 8(3), 258-267.
- 15. Drake BF, Brown K, **D'Agostino McGowan L**, Haslag-Minoff J, Kaphingst K (2016). "Secondary consent to biospecimen use in a prostate cancer biorepository." *BMC research notes*, 9(1), 346.
- 16. **D'Agostino McGowan L**, Stafford JD, Thompson VL, Johnson-Javois B, Goodman MS (2015). "Quantitative evaluation of the community research fellows training program." *Frontiers in public health*, 3, 179.
- 17. Chen Y, **D'Agostino McGowan L**, Cimino PJ, Dahiya S, Leonard JR, Lee DY, Gutmann DH (2015). "Mouse low-grade gliomas contain cancer stem cells with unique molecular and functional properties." *Cell reports*, 10(11), 1899-1912.
- 18. Kaphingst KA, Stafford JD, **D'Agostino McGowan L**, Seo J, Lachance CR, Goodman MS (2015). "Effects of racial and ethnic group and health literacy on responses to genomic risk information in a medically underserved population." *Health Psychology*, 34(2), 101.
- 19. Griffey RT, Kennedy SK, **D'Agostino McGowan L**, Goodman M, Kaphingst KA (2014). "Is low health literacy associated with increased emergency department utilization and recidivism?" *Academic Emergency Medicine*, 21(10), 1109-1115.
- 20. Diggs-Andrews KA, Brown JA, Gianino SM, **D'Agostino McGowan L**, Rubin JB, Wozniak DF, Gutmann DH (2014). "reply." *Annals of neurology*, 75(5), 800-801.

- 21. Fisher MJ, Loguidice M, Gutmann DH, Listernick R, Ferner RE, Ullrich NJ, Packer RJ, Tabori U, Hoffman RO, Ardern-Holmes SL, Hummel TR, Hargrave DR, Bouffet E, Charrow J, Bilaniuk LT, Balcer LJ, **D'Agostino McGowan L**, Liu GT (2014). "Gender as a disease modifier in neurofibromatosis type 1 optic pathway glioma." *Annals of Neurology*, 75(5), 799-800.
- 22. Colditz GA, **D'Agostino McGowan L**, James AS, Bohlke K, Goodman MS (2014). "Screening for colorectal cancer: Using data to set prevention priorities." *Cancer Causes & Control*, 25(1), 93-98.
- 23. **D'Agostino McGowan L**, Gennarelli RL, Lyons SA, Goodman MS (2013). "Using small-area analysis to estimate county-level racial disparities in obesity demonstrating the necessity of targeted interventions." *International journal of environmental research and public health*, 11(1), 418-428.

# Press

The power of professors: Peer learning communities advance the art of teaching during a pandemic (2020) Wake Forest News. Available at: https://news.wfu.edu/2020/08/04/the-power-of-professors-peer-learning-communities-advance-the-art-of-teaching-during-a-pandemic/

Why the 'COVID-19 killed only 6%' argument is wrong by Justin Lessler and Lucy D'Agostino McGowan (2020) USA Today Op-Ed. Available at: https://www.usatoday.com/story/opinion/2020/09/02/why-covid-19-killed-only-6-argument-wrong-column/3454179001/

ASA Fellows Analysis by Lucy D'Agostino McGowan and Katherine Monti (2020) Amstat News Magazine. Available at: https://magazine.amstat.org/blog/2020/10/01/asa-fellows-analysis/

Indoor Church Services Are COVID-19 Hot Spots: Here's Why (2020) *Healthline*. Available at: https://www.healthline.com/health-news/indoor-church-services-are-covid-19-hot-spots-heres-why#Church-outbreaks

How to protect yourself and others from spreading COVID-19 at Thanksgiving dinner by Justin Lessler and Lucy D'Agostino McGowan (2020) USA Today Op-Ed. Available at: https://www.usatoday.com/story/opinion/2020/11/25/how-reduce-risk-getting-covid-19-thanksgiving-dinner-column/6419700002/

Rising Star Talks About Statistics Journey, Future of the Profession (2018) Amstat News Magazine. Available at: http://magazine.amstat.org/blog/2018/09/01/startalksstatistics/

Is your research hot or not? US boffins create "Tinder for preprints" (2017) The Register. Available at: https://www.theregister.co.uk/2017/06/19/science\_research\_tinder\_preprint\_app/

Great paper? Swipe right on the new "Tinder for preprints" app (2017) Science. Available at: http://www.sciencemag.org/news/2017/06/great-paper-swipe-right-new-tinder-preprints-app

Swipe right for science: Papr app is "Tinder for preprints" (2017) Nature. Available at: https://www.nature.com/news/swipe-right-for-science-papr-app-is-tinder-for-preprints-1.22163