

# MAKING OPEN SCIENCE WORK FOR YOU

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NORTHEASTERN UNIVERSITY

# WHY DO OPEN SCIENCE?



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ADVANCE SCIENCE



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## ADVANCE SCIENCE

### Open data

Transparency through reproducible analysis, better outreach through exchange of data with partners like Encyclopedia of Life, and accelerated discovery through data reuse



### Open resources

Better training in Open Science methods and increasing access to resources for data collection and database construction



### Open Science Principles



### Open source

Reproducible analyses, accelerated synthesis through data and tool sharing, and improvement via shared data cleaning and checking



### Open access

Faster knowledge transfer as published works become more easily shareable



### Open methods

Standards development for collection protocols and metadata, and easier interpretation and decision-making scrutiny



### Open peer review

Greater scientific rigour through increased scrutiny of data and methods

adapted from Gallagher et al., 2020; Nature Ecology & Evolution

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## ADVANCE YOUR CAREER

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# OPEN SCIENCE: ALIGNING INCENTIVES

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- Why bother with...
  - Open code?
  - Open data?
  - Open publishing?
  - Open community?
  - Modern scientific programming?

# WHY BOTHER WITH...

## OPEN CODE?



sharing, collaborating, & record keeping



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- Save time, dissemination, recognition, & collaboration



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  - Most useful if your project involves...
    - Multiple “stages” of development
    - Multiple files
    - Code intended to be used by others (or future you, or you across computers, etc.)
  - Contributing to an existing project
  - Also to learn transferable skills: critical for many jobs

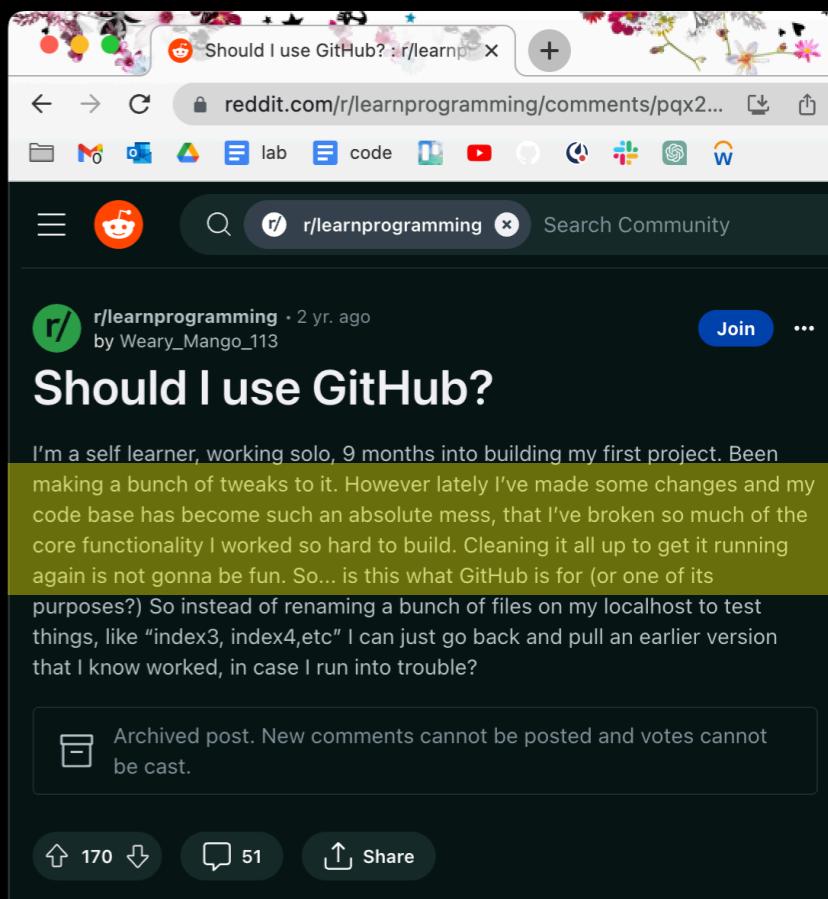


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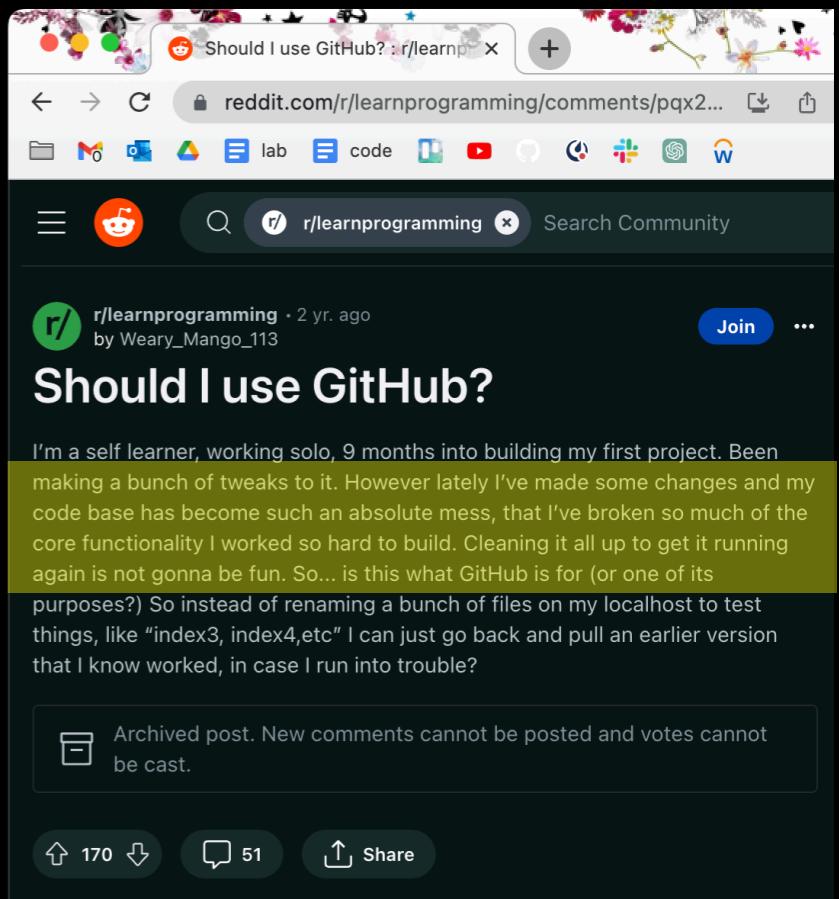


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    - A single file
    - A one-off quick & dirty test (but you’d be surprised...)

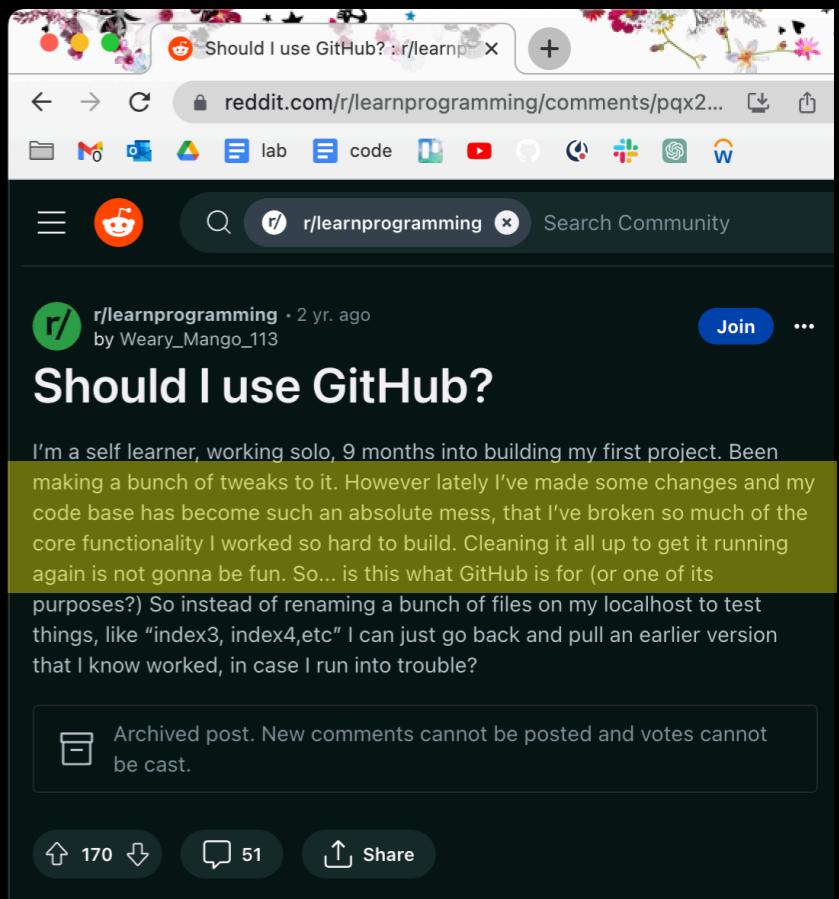


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  - Less critical if your project involves...
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    - A one-off quick & dirty test (but you’d be surprised...)
  - TLDR: Put in some time at the beginning to save lots of time / effort / heartache later



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- Again—dissemination, recognition (citations), & collaboration
  - You won't get scooped, but standard to release with first publication
- NIH wants you to (cf. Data Management & Sharing Plan)
- Trend towards sharing full statistical maps
- Reusable for others and you, too
- Bonus: BIDS apps work with BIDS data (fMRIprep, MRIQC)

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- Bonus: BIDS apps work with BIDS data (fMRIprep, MRIQC)
- Common bottlenecks:
  - Some medical institutions won't let you
  - As usual, involves some effort (but worth the benefits)

# WHY BOTHER WITH... USING PUBLICLY AVAILABLE DATA?



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- Save time, \$\$, effort
  - Feasibility in grants
- Larger samples than most labs can collect
  - Facilitates rigorous & reproducible science
  - Many of the most important recent papers in neuroimaging have relied on open datasets
- Learn transferable skills



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- Common bottlenecks:
  - For large ( $n>500$ ) datasets, need moderately large computational resources (most of you have access to HPC, though)
  - May not include specialized population (though more and more populations are being released)



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- Often faster, can be lower cost



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↳ open access, non-profit journals, preprints, registered reports, non-traditional research objects,...

- Again, dissemination, recognition (citations), & collaboration!
- Often faster, can be lower cost
- Common bottlenecks:
  - Growing recognition, competing against “glam” journals
    - ...but there is lots of community momentum + worth the benefits
  - Cost (depending)



# WHY BOTHER WITH... OPEN COMMUNITY?



Actively inclusive & collaborative communities

e.g., Brainhack, OHBM Open Science Room, Neuromatch Academy

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- Network, support, training, future collaborations, etc.



Neuron

CellPress

NeuroView

## Brainhack: Developing a culture of open, inclusive, community-driven neuroscience

Rémi Gau,<sup>1,76,\*</sup> Stephanie Noble,<sup>2,76</sup> Katja Heuer,<sup>3,4,76</sup> Katherine L. Bottenhorn,<sup>5,76</sup> Isil P. Bilgin,<sup>6,7,76</sup> Yu-Fang Yang,<sup>8,76</sup> Julia M. Huntenburg,<sup>9,76</sup> Johanna M.M. Bayer,<sup>10,11,76</sup> Richard A.I. Bethlehem,<sup>12,13,76</sup> Shawn A. Rhoads,<sup>14</sup> Christoph Vogelbacher,<sup>15</sup> Valentina Borghesani,<sup>16</sup> Elizabeth Levitis,<sup>17,18</sup> Hao-Ting Wang,<sup>19,20,21</sup> Sofie Van Den Bossche,<sup>22</sup> Xenia Koleleva,<sup>23,24</sup> Jon Haitz Legarreta,<sup>25</sup> Samuel Guay,<sup>26</sup> Selim Melvin Atay,<sup>27</sup> Gael P. Varoquaux,<sup>28,29</sup> Dorien C. Huijser,<sup>30,31</sup> Malin S. Sandström,<sup>32</sup> Peer Herholz,<sup>33</sup> Samuel A. Nastase,<sup>34</sup> Amanpreet Badhwar,<sup>16,35,36</sup> Guillaume Dumas,<sup>37,38</sup> Simon Schwab,<sup>39</sup> Stefano Moia,<sup>40,41</sup> Michael Dayan,<sup>42</sup> Yasmine Bassil,<sup>43</sup> Paula P. Brooks,<sup>34</sup> Matteo Mancini,<sup>20,44,45</sup> James M. Shine,<sup>46</sup> David O'Connor,<sup>47</sup> Xihe Xie,<sup>48</sup> Davide Poggiali,<sup>49</sup> Patrick Friedrich,<sup>50</sup>

### CONSORTIA

The Brainhack Community includes Nasim Anousheh, Aurina Armatkeviciute, Guillaume Au-zias, Dipankar Bachar, Elise Bannier, Ruggero Basanisi, Arshitha Basavaraj, Marco Bedini, Pierre Bellec, R. Austin Benn, Kathryn Berluti, Steffen Bollmann, Saskia Bollmann, Claire Bradley, Jesse Brown, Augusto Buchweitz, Patrick Callahan, Micaela Y. Chari, Bramsh Q. Chandro, Theresa Cheng, Sidhant Chopra, Ai Wern Chung, Thomas G. Close, Etienne Combrisson, Giorgia Cona, R. Todd Constable, Claire Cury, Kamalaker Dadi, Pablo F. Damasceno, Samir Das, Fabrizio De Vico Fallani, Krista DeStasio, Erin W. Dickie, Lena Dorfshmidt, Eugene P. Duff, Elizabeth DuPre, Sarah L. Dziura, Nathalia B. Esper, Oscar Esteban, Shreyas Fadnavis, Guillaume Flandin, Jessica E. Flannery, John Flournoy, Stephanie J. Forkel, Alexandre R. Franco, Saamprasad Ganesan, Siyuany Gao, José C. García Alain, Eleftherios Garyfallidis, Tristan Glataud, Enrico Glerean, Javier Gonzalez-Castillo, Cassandra D. Gould van Praag, Abigail S. Greene, Geetika Gupta, C. Alice Hahn, Yaroslav O. Halchenko, Daniel Handwerker, Thomas S. Hartmann, Valérie Hayot-Sasson, Stephan Heinrichs, Felix Hoffstaedter, Daniela M. Hohmann, Corey Horien, Horea-Ioan Ioanás, Alexandru D. Iordan, Chao Jiang, Michael Joseph, Jason Kai, Agah Karakuzu, David N. Kennedy, Anisha Keshavai, Ali R. Khan, Gregory Kiar, P. Christiaan Klink, Vincent Koppelman, Serge Koudoro, Angela R. Laird, Georg Langs, Marissa L. Laws, Roxane Licandro, Sook-Lei Liew, Tomislav Lipic, Krisanne Litinas, Daniel J. Lurie, Désirée Lussier, Christopher R. Madan, Lea-Theresa Mais, Sina Mansour L., J.P. Manzano-Patron, Dimitra Maoutsou, Matheus Marcon, Daniel S. Margulies, Giorgio Marinato, Danièle Marinazzo, Christopher J. Markiewicz, Camille Maunet, Felipe Meneguzzi, David Meunier, Michael P. Milham, Kathryn L. Mills, Davide Momi, Clara A. Moreau, Aysha Motala, Iska Moxon-Erme, Thomas E. Nichols, Dylan M. Nilsson, Gustav Nilssonne, Lisa Novello, Caroline O'Brien, Emily Olafson, Lindsay D. Oliver, John A. Onofrey, Edwina R. Orchard, Kendra Oudyk, Patrick J. Park, Mahboobeh Parsapoor, Lorenzo Pasquini, Scott Peltier, Cyril R. Pernet, Rudolph Piehaar, Pedro Pinheiro-Chagas, Jean-Baptiste Poline, Anqi Qiu, Tiago Quendera, Laura C. Rice, Joscelin Rocha-Hidalgo, Saige Rutherford, Matthias Scharinger, Dustin Scheinost, Deena Sharif, Thomas B. Shaw, Viviana Siless, Molly Simmonite, Nikoloz Simpliciatze, Hayli Spence, Julie Spenger, Andrija Stajduhar, Martin Szinte, Sylvain Takerkart, Angela Tam, Link Tejavibulya, Michel Thiebaut de Schotten, Ina Thome, Laura Tomaz da Silva, Nicolas Traut, Lucina Q. Uddin, Antonino Vallesi, John W. VanMeter, Nandita Vijayakumar, Matteo Visconti di Oleggio Castello, Jakub Vohryzek, Jakša Vuković, Kirstie Jane Whitaker, Lucy Whitmore, Steve Wideman, Suzanne T. Witt, Hua Xie, Ting Xu, Chao-Gan Yan, Fang-Cheng Yeh, B.T. Thomas Yeo, and Xi-Nian Zuo.

Brainhack is an innovative meeting format that promotes scientific collaboration and education in an open, inclusive environment. This NeuroView describes the myriad benefits for participants and the research community and how Brainhacks complement conventional formats to augment scientific progress.

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Actively inclusive & collaborative communities

e.g., Brainhack, OHBM Open Science Room, Neuromatch Academy

- Network, support, training, future collaborations, etc.



- Common bottlenecks:
  - You (or your mentor) may not have the funds or need to justify
    - Many virtual options
    - Justification: provides training & networking (Gau et al., 2021)

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# WHY BOTHER WITH... MODERN SCIENTIFIC PROGRAMMING

The image shows a code editor interface with a sidebar on the left displaying a file tree. The tree includes 'documentation', 'graphql', 'hooks', 'lib', 'node\_modules' (marked as library root), 'pages' (which contains 'admin', 'api', '\_app.tsx', '\_document.tsx', 'about.tsx', and 'index.tsx'), 'public', 'tests', and 'utils' (which contains 'theme.ts', 'babelrc', '.env.example', '.env.local', 'eslintrc.js', '.gitignore', 'next-env.d.ts', 'package.json', 'README.md', 'tsconfig.json', and 'yarn.lock'). Below the tree is a section for 'External Libraries' and 'Scratches and Consoles'. The main area of the editor displays a React component named 'App'. The component imports ApolloProvider, ThemeProvider, CssBaseline, Container, and useApollo from '@apollo/client', and lightTheme and darkTheme from '../utils/theme'. It also imports useLocalStorage from '../hooks/useLocalStorage'. The component uses useState to manage the current theme and set it via localStorage. It uses useApollo to provide the initial Apollo state. A useEffect hook is used to remove a JSS style element from the document if it exists. The component returns a fragment (<>) containing a Head element with a title of 'ECU-DEV', a meta tag for viewport, and a Container element with a ThemeProvider. The theme prop is determined by the currentTheme variable.

```
> documentation
> graphql
> hooks
> lib
> node_modules library root
  > pages
    > admin
    > api
    > _app.tsx
    > _document.tsx
    > about.tsx
    > index.tsx
  > public
  > tests
  > utils
    theme.ts
    babelrc
    .env.example
    .env.local
    eslintrc.js
    .gitignore
    next-env.d.ts
    package.json
    README.md
    tsconfig.json
    yarn.lock
  > External Libraries
  > Scratches and Consoles

import { ApolloProvider } from '@apollo/client'; 323.67 kB (gzip: 33.78 kB)
import { ThemeProvider } from '@material-ui/core/styles'; 2.45 kB (gzip: 1.15 kB)
import CssBaseline from '@material-ui/core/CssBaseline'; 61.61 kB (gzip: 20.02 kB)
import { Container } from '@material-ui/core'; 63.32 kB (gzip: 20.38 kB)
import { useApollo } from '../graphql/client';

import { lightTheme, darkTheme } from '../utils/theme';
import useLocalStorage from '../hooks/useLocalStorage';

import NavBar from '../components/NavBar';

function App({ Component, pageProps }: AppProps) {
  const [currentTheme, setCurrentTheme] = useLocalStorage(key: 'theme-value', initialValue: 'light');
  const apolloClient = useApollo(pageProps.initialApolloState);

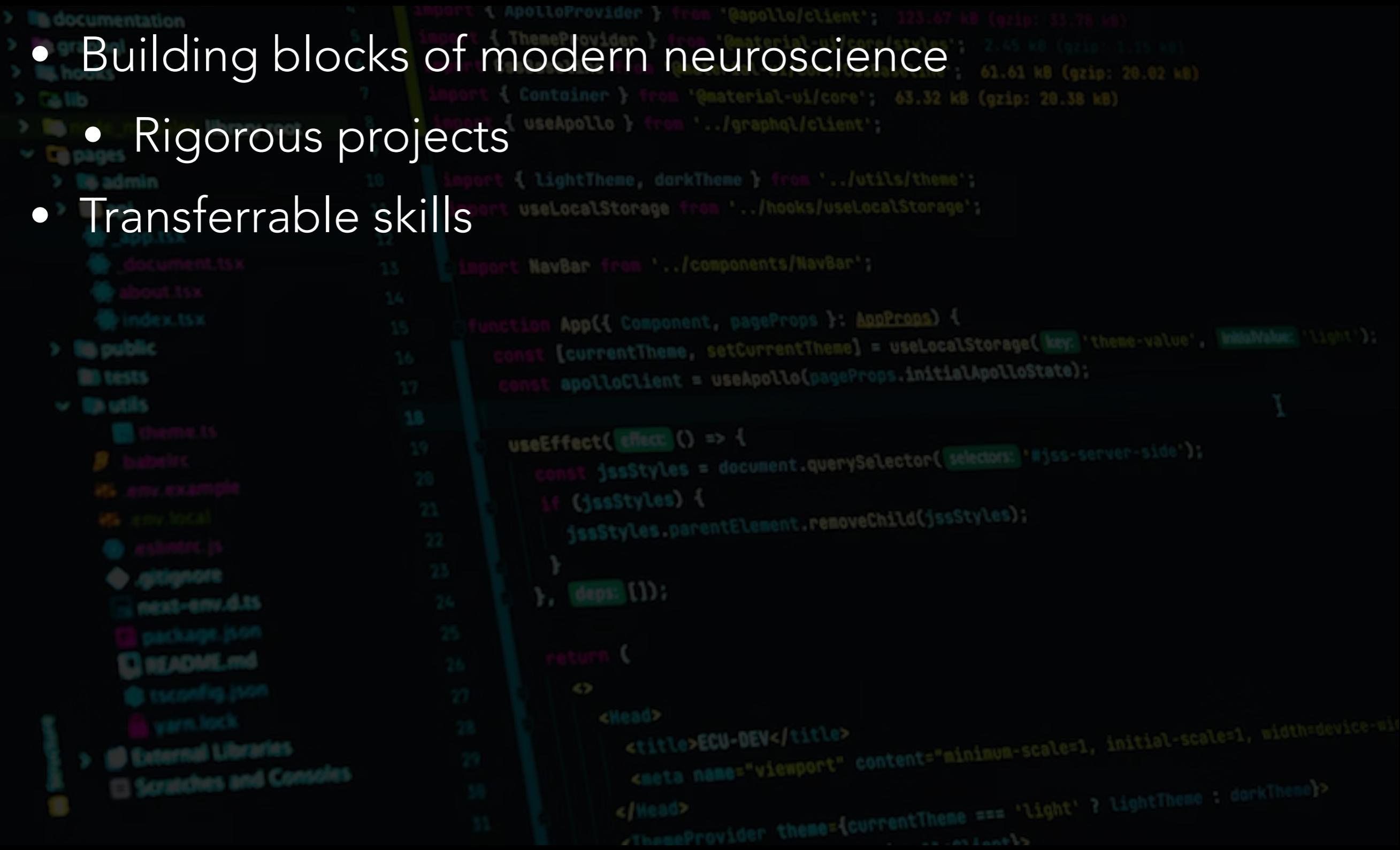
  useEffect(effect: () => {
    const jssStyles = document.querySelector(selectors: '#jss-server-side');
    if (jssStyles) {
      jssStyles.parentElement.removeChild(jssStyles);
    }
  }, deps: []);

  return (
    <>
      <Head>
        <title>ECU-DEV</title>
        <meta name="viewport" content="minimum-scale=1, initial-scale=1, width=device-width, height=device-height, user-scalable=no" />
      </Head>
      <ThemeProvider theme={currentTheme === 'light' ? lightTheme : darkTheme}>
        <Container>
          <Component {...pageProps} />
        </Container>
      </ThemeProvider>
    </>
  );
}

export default App;
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- Building blocks of modern neuroscience
  - Rigorous projects
- Transferrable skills



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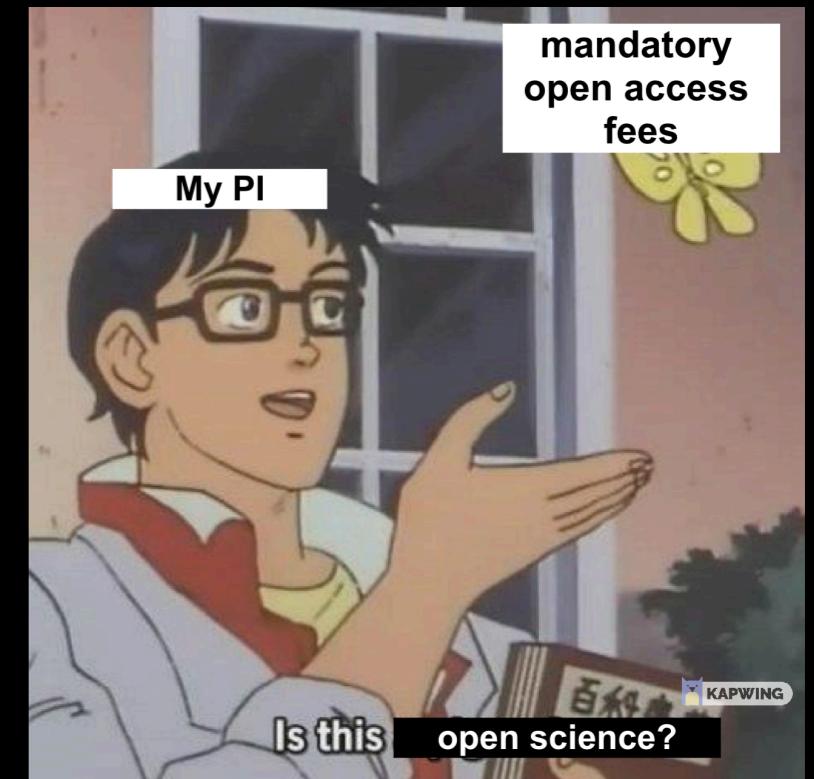
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    <>
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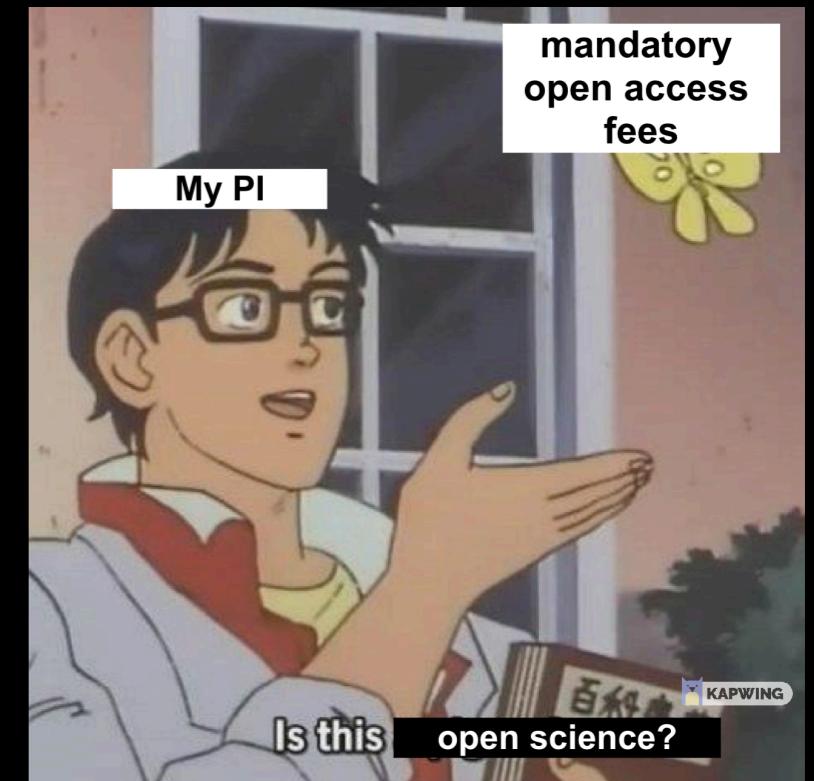
- Building blocks of modern neuroscience
  - Rigorous projects
- Transferrable skills
- Common bottlenecks:
  - Where to start?
    - Python is easiest + most flexible
      - but good to learn what your community uses most
      - Start with a real but manageable project (e.g., containers are more of an intermediate topic)

# HOW TO RESPOND IF A PI/COLLABORATOR SAYS...



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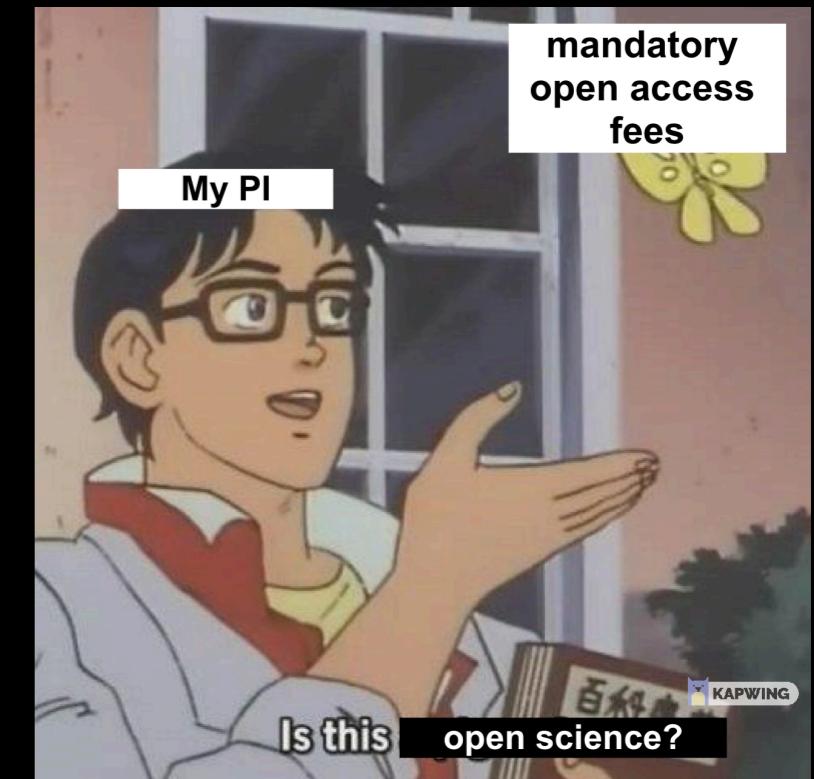
Using open data & code



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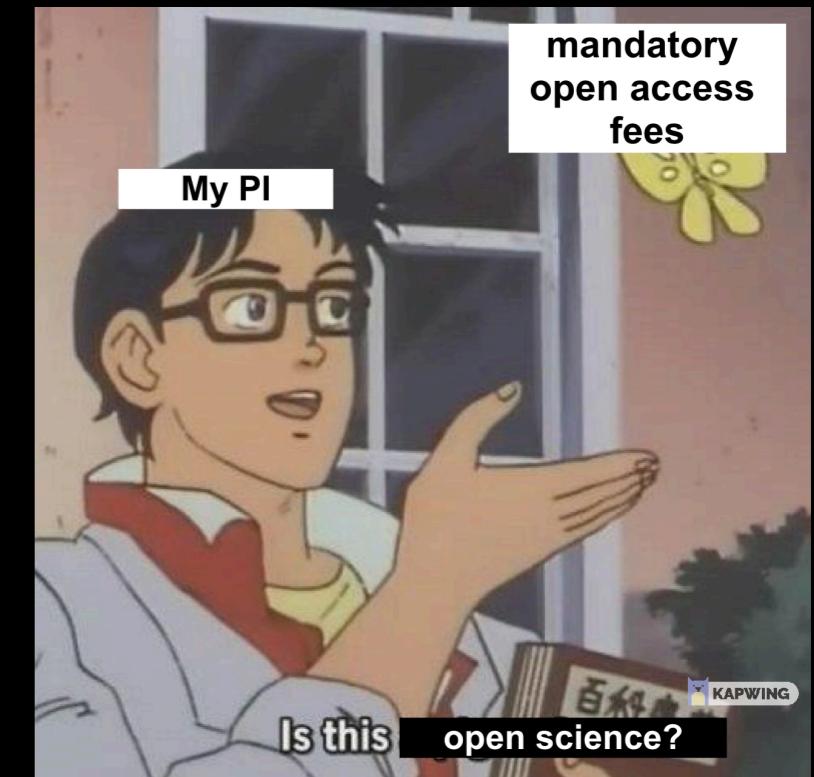
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## Using open data & code

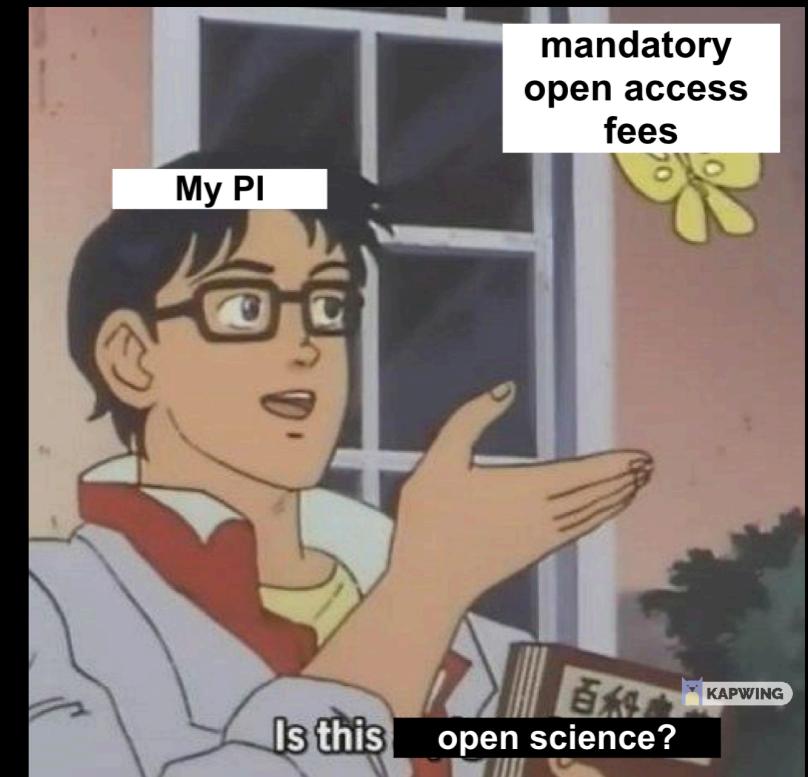
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  - Faster than new data; save time/\$\$ later



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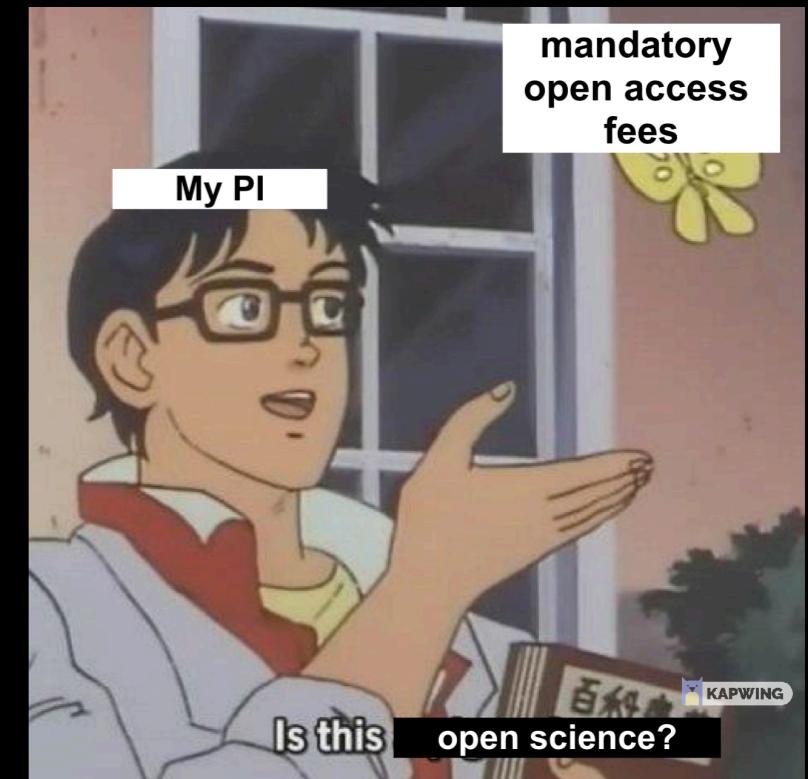
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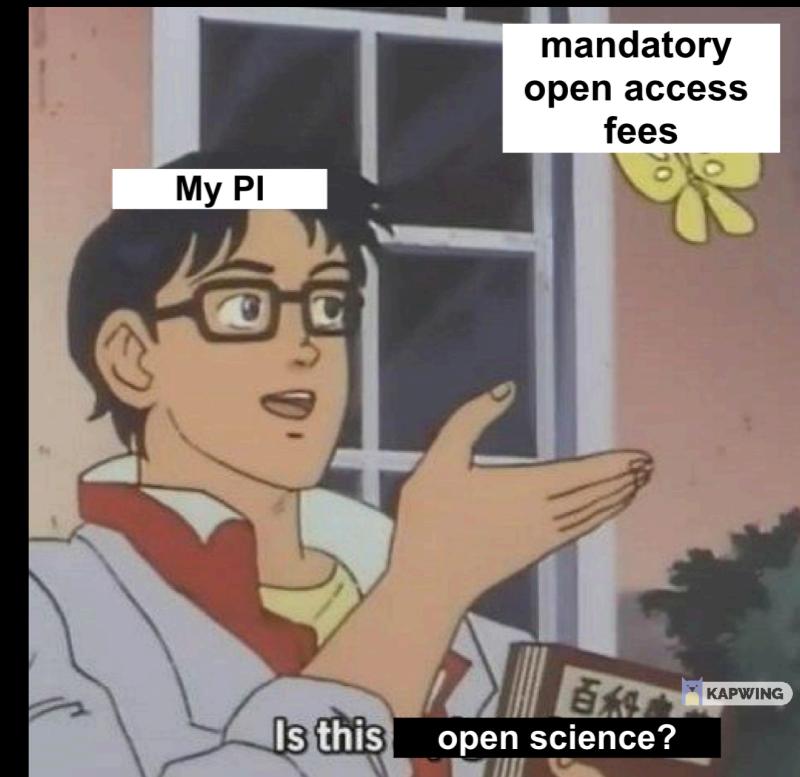


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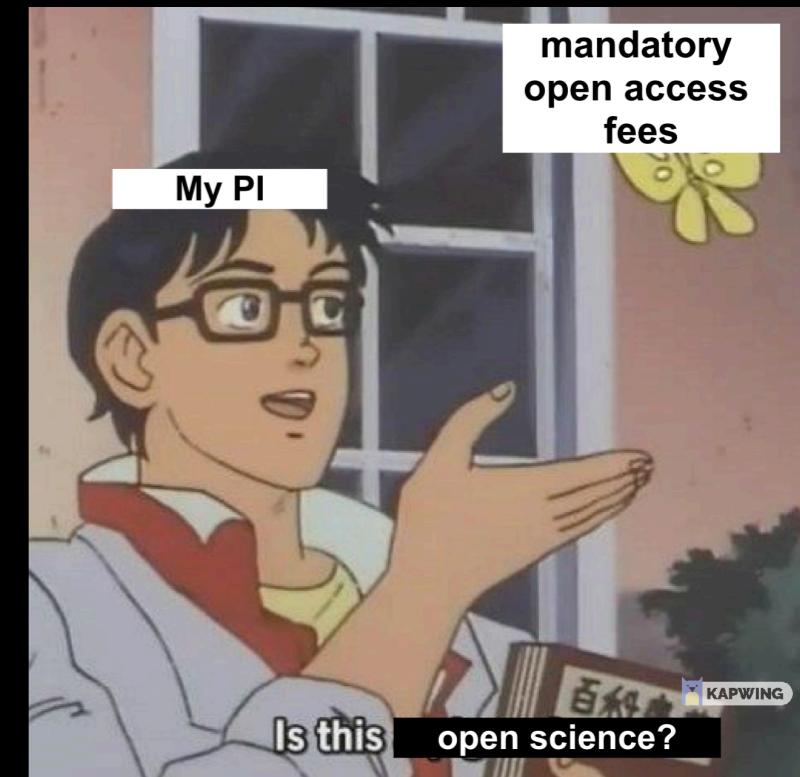
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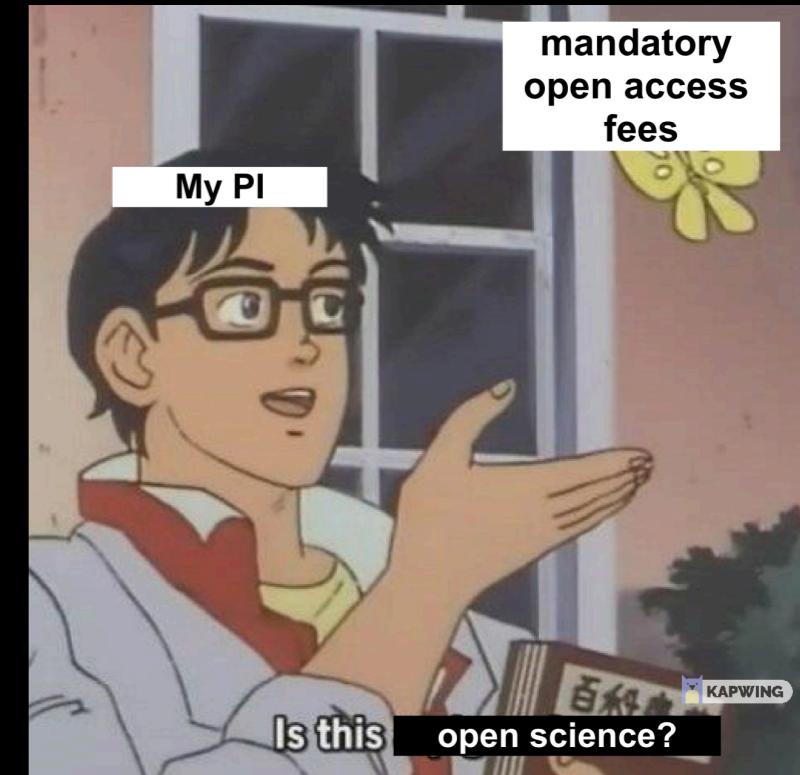
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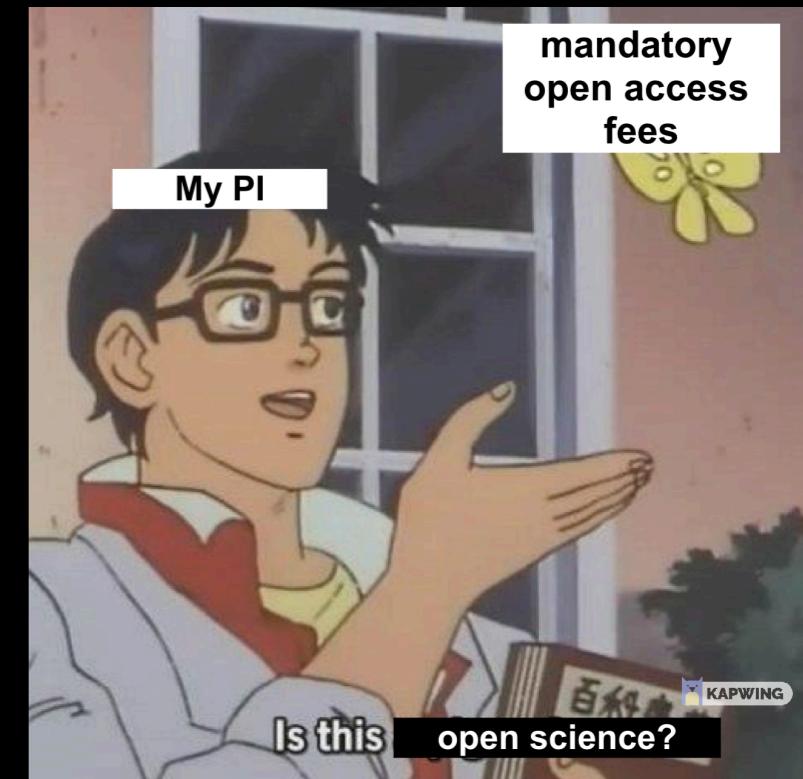
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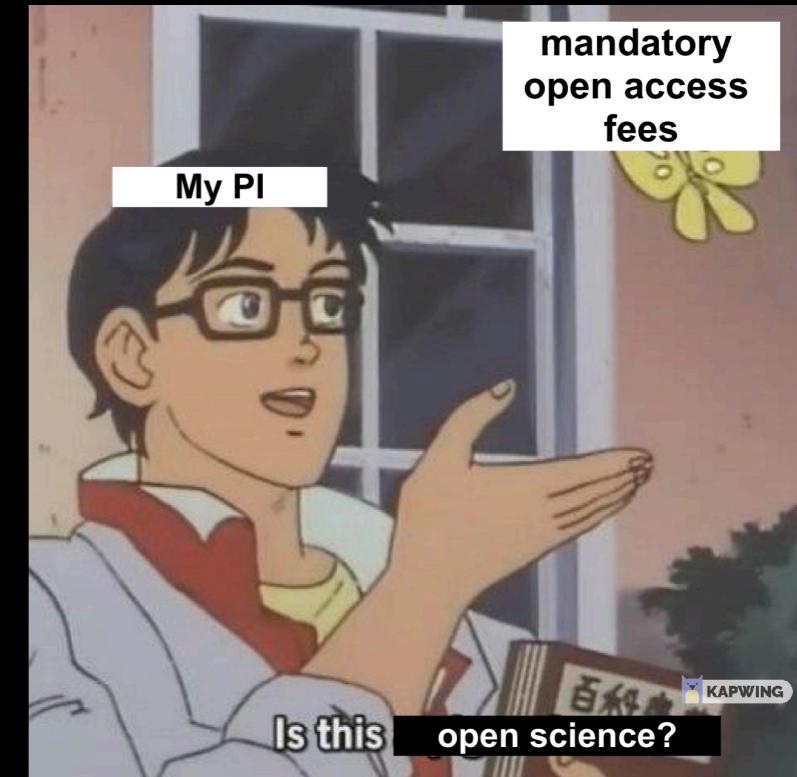
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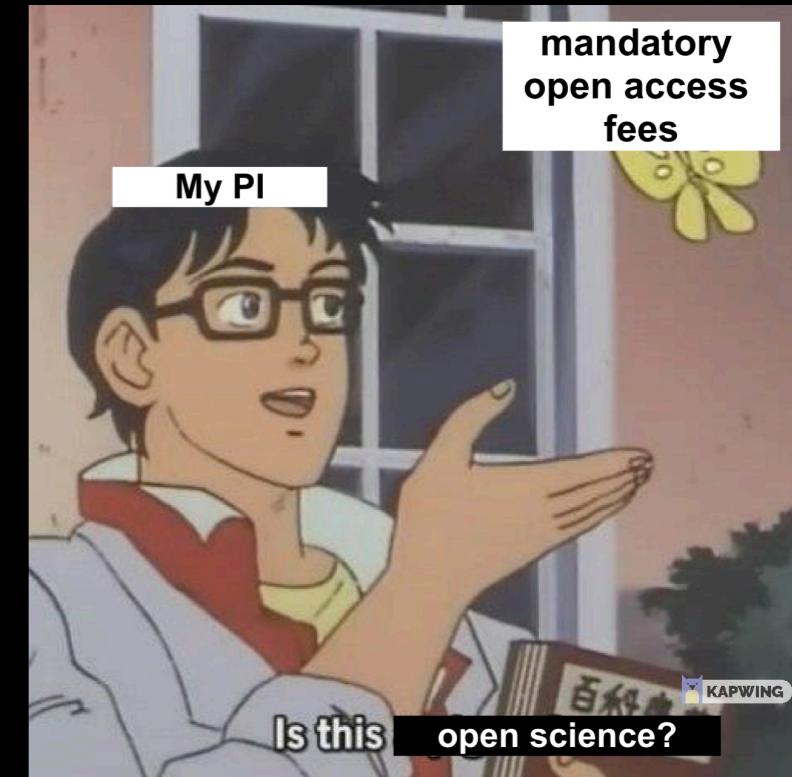
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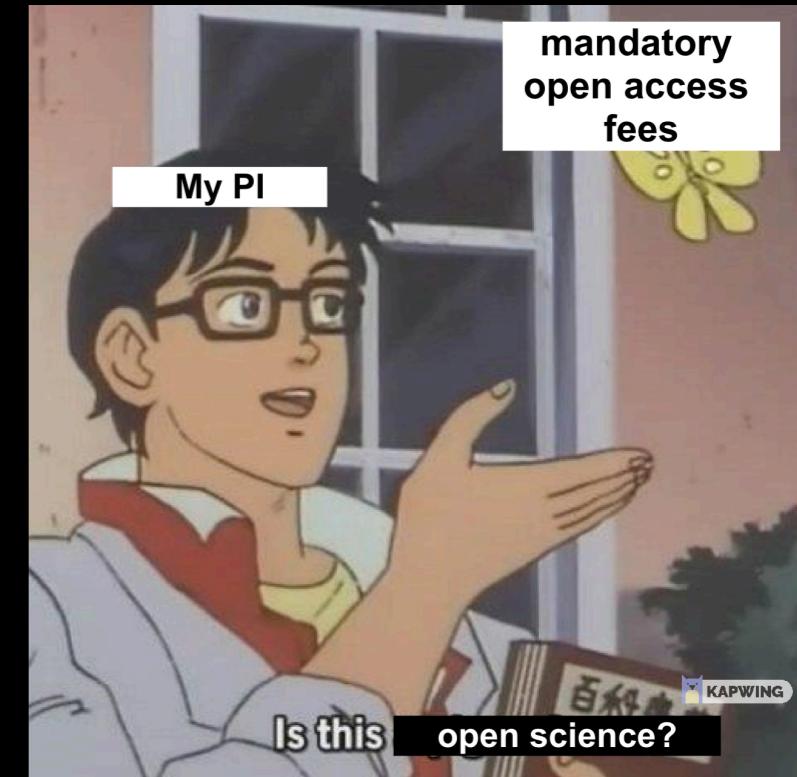
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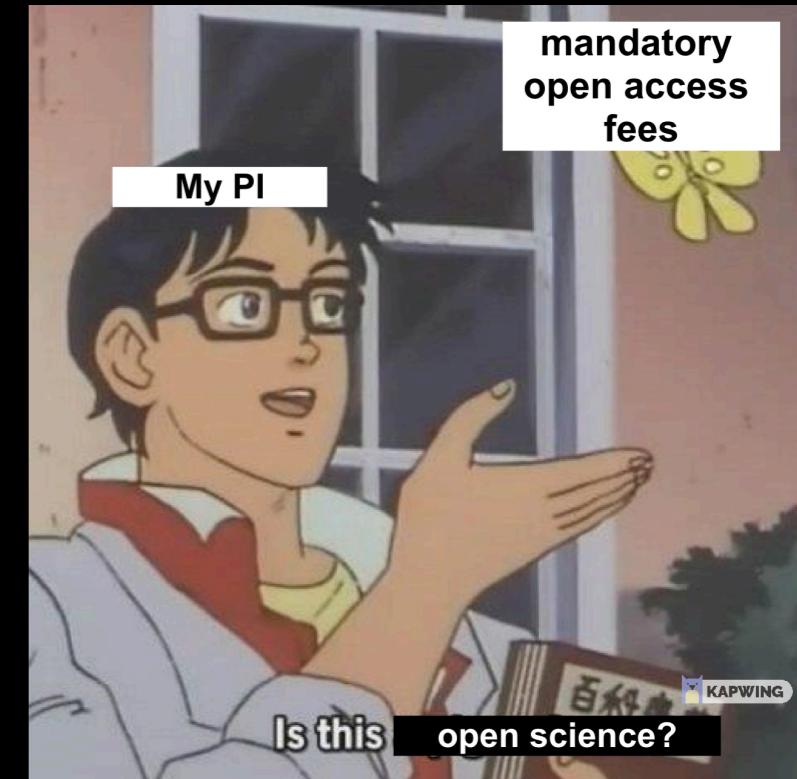
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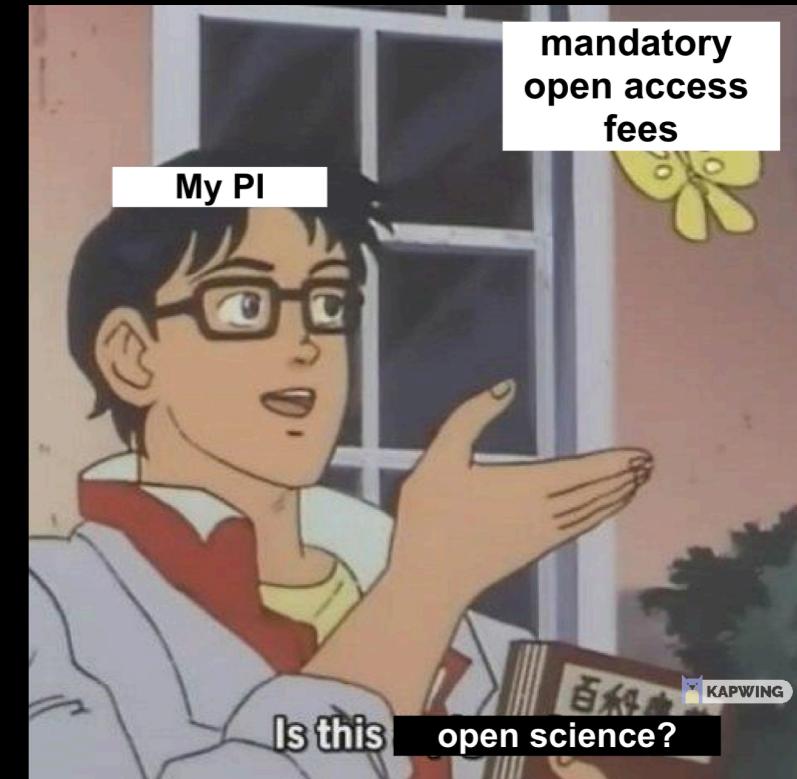
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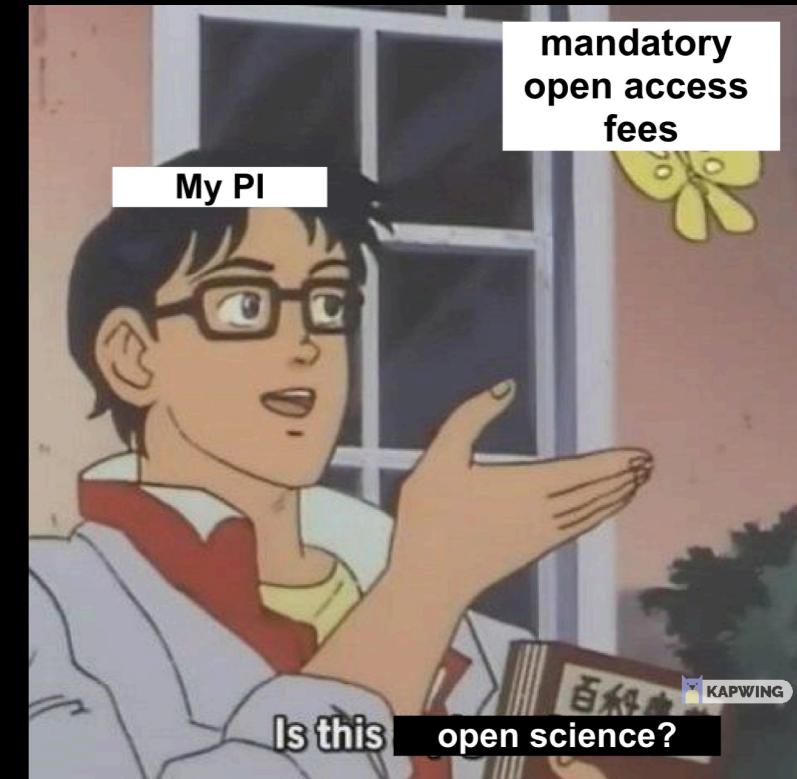
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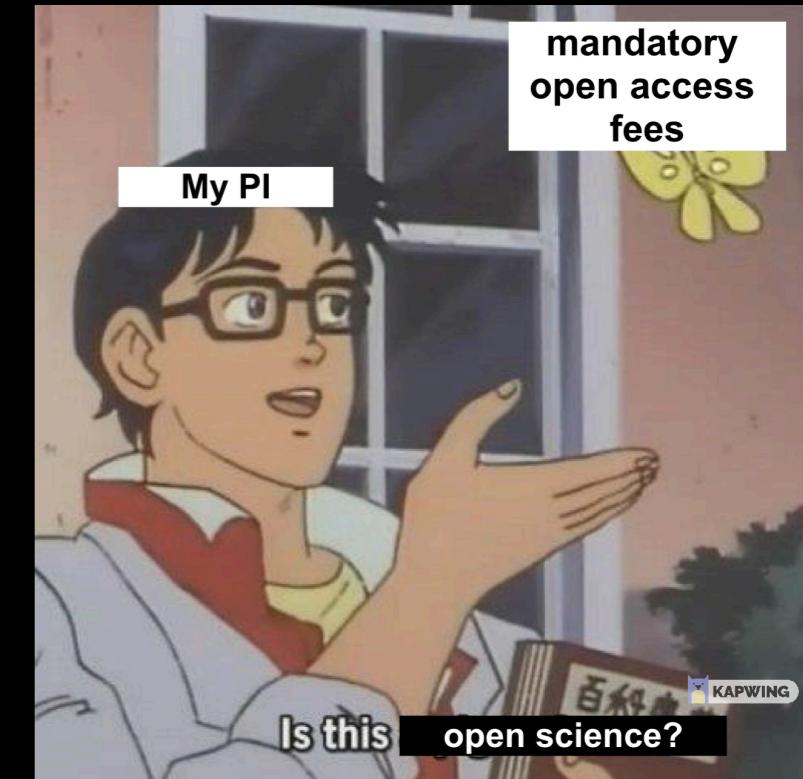
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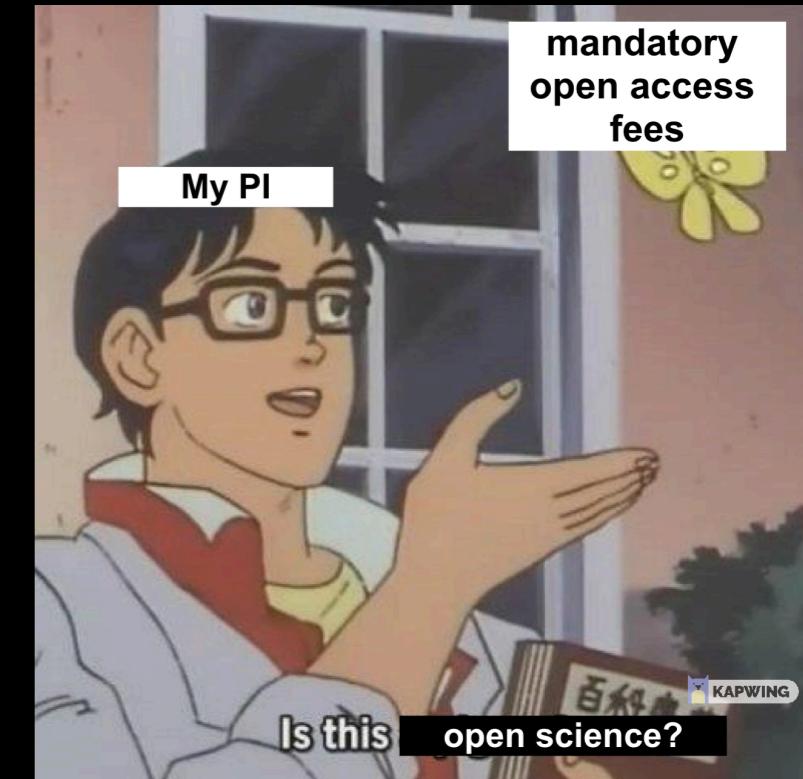
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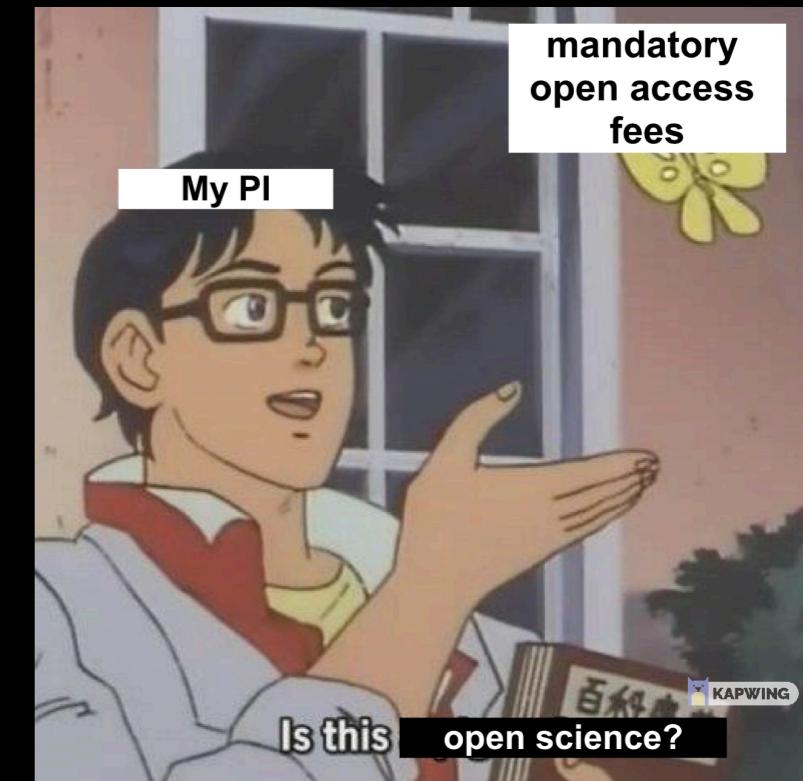
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  - They do, see NIH RePORTER

# SPECIAL CHALLENGES

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- Unfortunately, some best practices can disproportionately disadvantage ECRs, e.g.:
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  - Restricting publication choices
  - Cost
  - & more
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- Be strategic
  - Align your goals with your PI's / colleague's
  - Avoid burnout
  - Protect your career



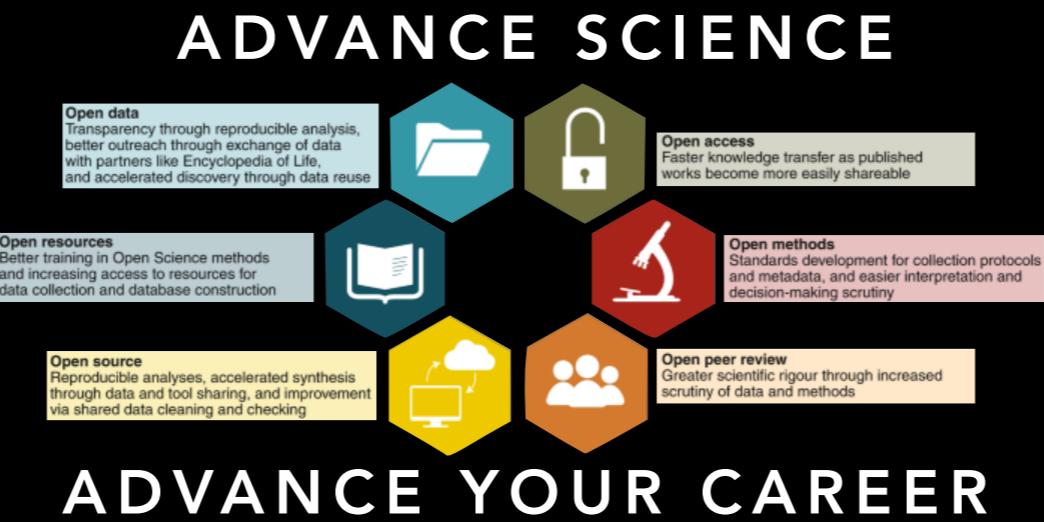
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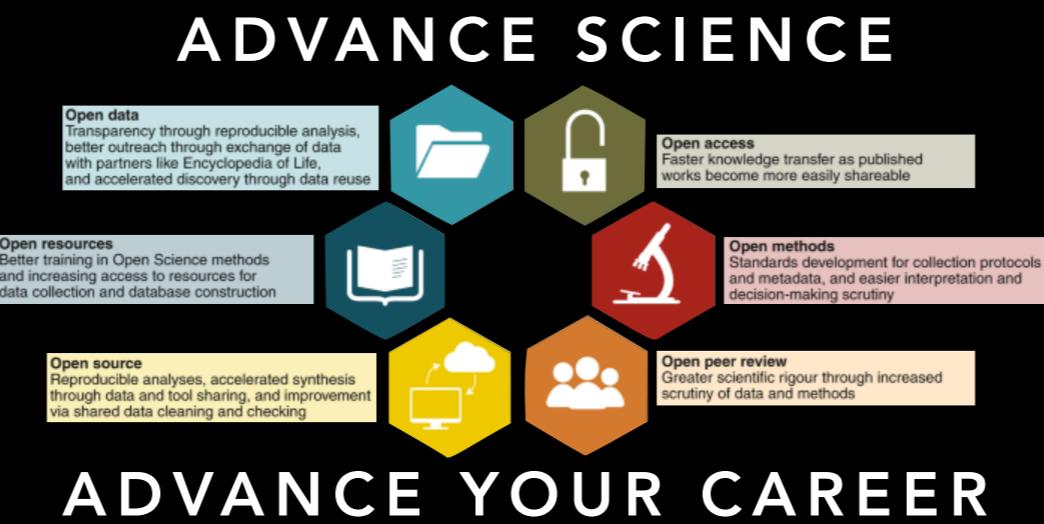
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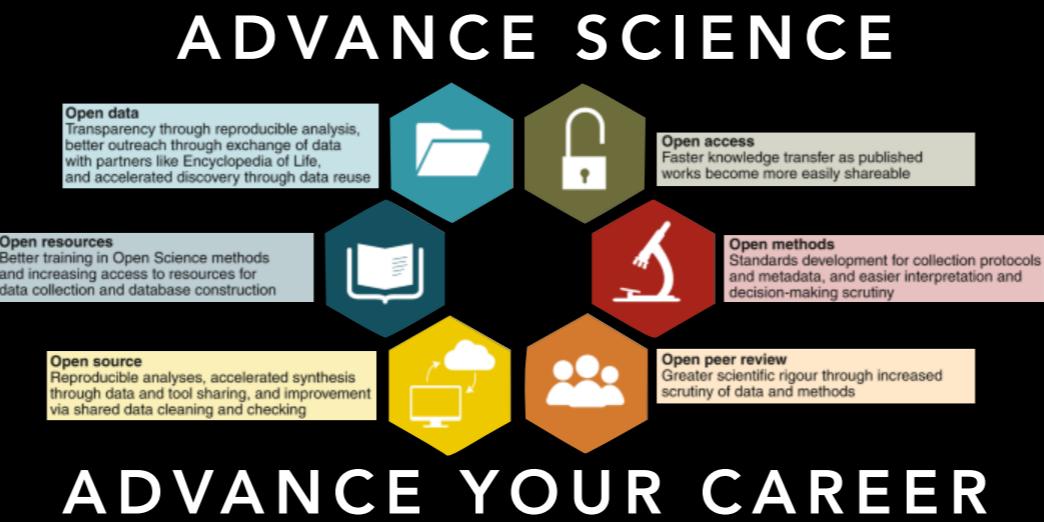
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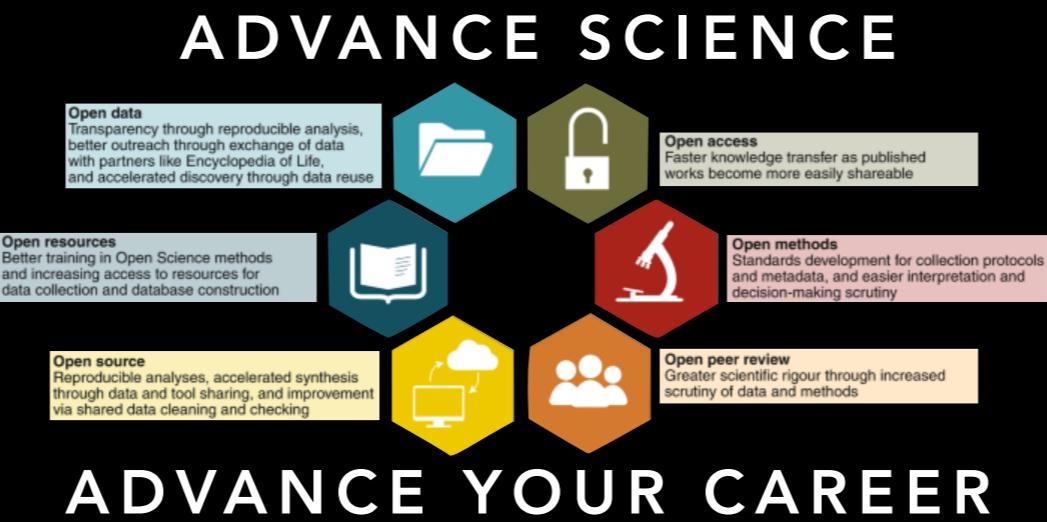
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- *Other topics in reproducible neuroscience*
  - Open publishing
  - Open community
  - Modern scientific programming

# ACKNOWLEDGMENTS

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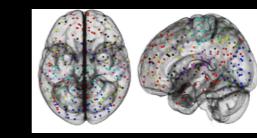
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NIH BRAIN K99/R00  
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Now hiring—join the Neuro-PRISM team!

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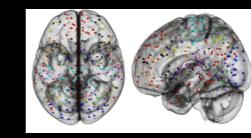
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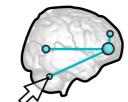


# THANK YOU! QUESTIONS?

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