ACS AMA: Hi Reddit! My name is Johannes Richers. I am a scientist and a designer. Ask me anything about the visual communication of scientific data.

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[ACS AMA](file http://imgur.com/hoKm4RT)

Hello Reddit! I am a chemical scientist and a designer. I combine PhD-level scientific knowledge with years of experience in graphic design to develop attractive design solutions with high scientific accuracy. I do this, because I think it is important to communicate research elegantly and efficiently.

Here's my background: I obtained my BS and MS in chemistry from the *Technical University of Munich*, Germany. I studied abroad at the *King Abdullah University of Science and Technology*, Saudi Arabia and worked as a research intern with the *Schlumberger Research Centre Cambridge*, United Kingdom. In 2012, I joined the group of Konrad Tiefenbacher at the chair of organic chemistry at TUM for my doctoral studies in the field of organic chemistry.

In 2016, I was selected to participate in the SciFinder Future Leaders program as part of a diverse group of 26 researchers from across the globe. Here I realized that I would like to build my future by combining my two passions: chemistry and design. Following this route, I moved to Berlin to start an independent career as a graphic designer for scientists. Please find more information and examples of my work over here: www.jorichers.com and on twitter: @JoRichers

Ask me anything about science visualization, cover designs, and illustrations. In particular, if you face a specific visualization challenge or want to improve a design, I am happy to give feedback and advice.

I'll be back at 11:00 a.m. EDT (3:00 p.m. UTC) to answer your questions.

/edit (11:05 a.m. EDT): Hi reddit! I see a lot of great questions, thank you for you interest! I try to answer as many as I can… /edit (1:25 p.m. EDT): Taking a short break. I will be back soon to answer more questions.

What's your favorite program/software to "science visualize" and why?

[Gwiel](#)

I work with Adobe software (Illustrator, Photoshop, After Effects and Indesign) for 2D graphics and Blender for 3D modelling and rendering. I appreciate the workflow of these programs since it allows the design process to become very intuitive once you learned to control the tools. Especially with the introduction of Adobe creative cloud these programs are somewhat costly however, but worth the investment for me. Blender on the other hand is free and open source and there are many tutorials, as well as a great community out there.

What are some of the common errors in science visualization you have seen in your work e.g. graphs, figures, tables etc etc

Do you have any fixes for said issues?

Thanks a bunch mate!

[HarryMaxNz](#)

Most common errors can be found in the use of color, typography and layout.
Color: the primary use of color is to convey information and when used effectively, color can simplify a complex analysis task. However, mis- and overuse can cause the wrong information to stand out and make meaningful information difficult to see. In particular, one important, but often neglected, issue is color blindness. Furthermore, it is always important to check how the design looks in greyscale.
Typography: Arranging type and using the right font, font style, and size. The information has to be readable and clearly visible. I am surprised how often good old comic sans is used, or an antiqua font with serifs instead of a sans-serif typeface such as Helvetica/Arial.
Layout: The arrangement of images and text according to an overall aesthetic scheme. It seems like many scientists are unaware of concepts such as reading order, rule of thirds, or the golden ration. Also: Whitespace matters! Regarding fixes: there is a great Nature Methods series written by Bang Wong: ["Points of View"](#)

Hopefully I'm not too late. I too am a graphic designer but started studying biology at the ETH. I always wanted to combine my two passions and make a living out of it, **you're living my dream**.

Do you have any advice how I could go from here? Is there any chance to work for a company or do you have to work independently?

[-R-R-](#)

Start building a network and get in contact with different scientific fields (a profound understanding of science in different areas will be helpful). Get a RSS feed reader and scan the literature to get a feeling for graphical abstracts (oh boy, there are so many, everyday). Follow the big five journals of your field and invest time to analyze cover images and figures of the papers you are interested in. If you can, assist colleagues with their design for presentations and publications. Science illustrators have a solid chance on the job market and certainly there are some job offers for graphic design employees from publishers and research companies. However, many in the field start with an independent career and therefore especially in the start phase have to rely on their network. Once you get in, word-of-mouth recommendation can help you a lot, in particular in the interdisciplinary, well-connected field of science publishing. I'd say, go for it! Good luck and keep me posted.

Hi Johannes, thanks for doing this AMA.

I would like your take on what you think is the best way to simplify scientific work for the sake of clarity and easy access without making it so simple that you no longer really convey useful information about what you do. At some point don't you run into the problem that you have to give someone a quick primer of your field before you can even begin to explain what you do? As a scientist, we have to communicate/deal with two worlds, the peer-reviewed journals and our colleagues, but also our laymen friends and family. When they ask me what I'm working on they invariably get a different answer.

Also, while I'm at it, do you believe there is a limit to information density that you can convey in an infographic/chart/other visual medium before you need to expand and just split it up between multiple mediums?

[mephistophyles](#)

Tough question. You are absolutely right about the danger of oversimplification and the multi-

dimensionality of sci-comm on different levels. There is great video about communicating neuroscience on five different levels: 5 y/o, 13 y/o, college, grad student, neuroscience entrepreneur http://youtu.be/opqIa5Jiwuw

A reasonable way for clarifying and simplifying scientific work starts with a good understanding of what to visualize. Usually this is done by reading a good portion of papers and have conversations with experts in the field. Here, I ask for tumbling blocks and typical mistakes. This is followed by condensation and reduction of the information. „If you can't explain it simply, you don't understand it well enough." I think there is no general recipe, but it often helps to create a mental model and to force yourself to view situations in a different way. Most visualization challenges have a degree of artistic freedom to it and you have to decide at which point a solution only "stretches" or "breaks" the underlying concept. A trick here is to try to represent crucial details. Consequently, the scientific accuracy might not remain on all levels but the design solution will address both laymen and experts. The multi-dimensional communication is a challenge, you are absolutely right. I try to follow the fundamental advice to "know your audience!" For graphical solutions, in particular, the audience is often quite clear and depends on the media you are publishing in. For example, a figure in a paper, a cover image for scientific journal, or a graphic for social media. For communicating science in general it is great to explain things using comparison or a model. I think it is an inherent circumstance that you have to give different answers and that your answer/communication solution depends on the level of expertise of your conversation partner.

Regarding information density. Yes, there is a limit and I would always prefer two have compact charts instead of one big overcrowded chart. However, there a many great examples of ingenious design solutions, such as cartographic depiction of numerical data of Napoleon's losses suffered during the Russian campaign by Minard: https://en.wikipedia.org/wiki/Charles_Joseph_Minard

I would like to ask you about you opinion of youtube as means of an educational platform, with youtubers like SmarterEveryDay, Vsauce, and others.

PM_Bad_Puns_Or_Jokes

I am pleasantly surprised how Youtube has evolved as a source of knowledge by using a format which is not only educating but also entertaining. Channels like "Kurzgesagt – In a Nutshell", "Vsauce", or "Nerdwritter1", show how to address highly complex issues and explain them in very informative and great way. I also appreciate the development of social media and notice a general trend. Platforms like "Futurism", "compoundchem", or "ACS Reactions" provide great content and have developed very distinct formats in order explain science.

I started out with SPSS (ugly!), then moved on to graphpad (better), then R (still my favourite), then python, and now Root. Data is constantly getting bigger in my field (bioinformatics) and it's getting harder to crunch numbers whilst making visually appealing plots; are you finding a similar trend in your field? How do you translate very 'sciency' plots into appealing infographics/visualisations?

Jared_Mamrot

+1 for use of R. However, I try to use such tools to interpret the data and then create the final representation with vector illustration tools such as adobe illustrator (or inkspace as free alternative). I agree on the problems and challenges associated with the growth of data in many fields. However, especially for organic, inorganic, biological, and medicinal chemistry, a big part of research still relies on the visualization of concepts in contrast to the raw display of quantitative information. Regarding very 'sciency' plots: I am not a big fan of decorating plots unnecessarily in order to turn them into fancy infographics. "Above else show the data" while maintaining a reasonable data/ink ratio is key. Subtle use of color, beneficial information flow, proper line weight and careful reduction of the graphical

representation to the essential core. In my opinion, a clear design which communicates information in a single glance is highly appealing.

To me, it seems like high quality infographics are effective persuasive tools, but not if you don't trust scientists and data. What do you think your role is in reestablishing credibility for scientists in places like the U.S.? Also, do you think those types of people will ever even see your products, or do you think your work only reaches an audience that would already believe your message?

Thanks for volunteering your time for an AMA Dr. Richers.

hellofellowkids420

In general, I see my role in changing the way *how* a message is delivered. I believe that science and research should be communicated efficiently and in a visually pleasing way. Nevertheless, I also notice that there is an alarming trend of mistrust in societies—"having enough of experts". I don't know if my work influences or helps the necessity to reach an audience which has turned away from facts. However, I think it might help to guarantee that there will always be a majority in the society with the necessary critical thinking skills by promoting science and scientific reasoning in general.

The rainbow colormap is a great example of something that is used widely by scientists, yet does a very poor job of communicating information. It took a long while, but people are slowly starting to move away from the rainbow colormap to perceptually uniform colormaps.

Are there other harmful visual decisions that scientists regularly make, and are not aware of? What change would you like to see next?

ForKibitzing

The problems associated with colormaps, and the development of Matplotlib is a very good example, indeed. I couldn't agree more. I think people underestimate one important, but often neglected, issue: color blindness. "If a submitted manuscript happens to go to three male reviewers of Northern European descent, the chance that at least one will be color blind is 22 percent." [doi: 10.1038/nmeth.1618] Use of above mentioned color schemes solves that problem at least for plots, but there are still many illustrations, figures and graphical abstracts with tiny red and light green text in comic sans. Also, I feel like there are a lot of unaware decisions when it comes the choice of style for chemical drawings, though ChemDraw and general style guides have helped in that respect.

What is your favorite design you have created? What is an existing popular model out there that is misleading or that should have been done better?

nondirtysocks

During my doctoral studies I was asked to visualize a molecular capsule (a hexameric resorcin[4]arene stabilized cavity which is held together by water molecules and is capable of catalyzing terpene cyclizations—great stuff!). I created a series of graphical representation of that molecule: a 3D-rendering, which was then used for the cover of Nature Chemistry, a vector-graphic solution, which was used in figures and graphical abstracts, and a symbolic representation for "encapsulation" by surrounding a guest with of four corners, which can be used among symbols like "[]" for a metal complex/catalyst. This design process was very satisfying and rewarding.
What grinds my gears are subtle mistakes commonly made for visualizing the DNA helix (e.g. wrong direction of rotation, neglect of minor and major grooves) or the general common mistakes when

the WINNOWER

ACS AMA: HI REDDIT! MY NAME IS JOHANNES RICHERS. I AM A SCIENTIST AND A DESIGNER. ASK ME ANYTHING ABOUT THE VISUAL COMMUNICATION OF SCIENTIFIC DATA. : REDDIT

drawing molecular structures. Furthermore, there is potential for improvements in the field of colormaps: https://bids.github.io/colormap/

I couldn't find any data visualization tools on your website, do you cover those? Enterprise is heavily invested in those (especially for analytics). Do you feel like the scientific community can benefit from the research/experience done in Enterprise over the past decade?

bitter_truth_

I offer custom-made graphic design solutions for scientists such as illustrations, 2D- and 3D-visualization and cover artworks. Therefore, I don't develop visualization tools, but use them to create scientific artworks and representations.

One of the most frustrating things as a scientist is the low quality of communication (writing as well as data presentation) in scientific writing. It's endemic in many fields, despite the well-recognized importance of communicating science to the public. What can we change in our education, our funding, or our publication models to correct this?

PS: Curious to know your take on the wonderful design work that goes on at OpenAI in communicating results! ie: https://blog.openai.com/robots-that-learn/

roboticc

I understand your frustration. For the academic field, one of the reasons could be that many scientists are non-native English speakers (with German as my first language, I have struggled a lot with writing manuscripts for peer-reviewed journals). However, I think many scientists seek assistance and hire professional proof-readers in order to improve their texts. I feel like this is most often not the case when it comes to illustration and graphic design.
In my opinion, a good starting point would be the superordinate institutions, e.g. universities, research institutes. In particular, I think, universities should be aware of their important role in the publication pipeline and should aid the professional communication of the work of their researchers. This could happen by offering lectures and seminars for science communication as well as providing monetary help. For example, I have signed a contract with the Technical University of Munich which allows PhD students to seek my assistance for graphic design jobs. The TUM Graduate School pays a large portion of the costs.

/edit. Robot learning, neuronal networks and AI: Such an amazing field. Nice sorting reproduction system. Furthermore, the poster/header designs are pretty neat. I like the design approach, also the illustrations are spot on.

What are some of the difficulties you faced getting into the field? Have you ever felt intimated by graphs and numbers? I know I have and that aspect of science is holding me back personally

BoxOfCurryos

Many scientists don't realize how important the adequate communication of their research is. After years of hard work and funding, the gained insights are finally published, but the work is represented with a hastily arranged graphics and poor illustration. This is very puzzling to me, especially in light of the rapid increase of the annual number of publications. During my PhD studies, I have learned to deal with such intimidations. In the end, graphs and numbers only represent a meaning and ask for a certain investment of time in order to understand it. As a designer in the field, your job is to address

that issue and ideally allow the information to be understood as fast and clear as possible in a clear, insightful way.

Are you excited for VR and 3D representations that can be manipulated?

ReasonablyBadass

Absolutely! It was only a few months ago that I experienced a convincing virtual environment with a VR headset. It's a truly remarkable technology. I was a Jedi for a few minutes holding a laser sword and defending laser beams. Also VR-drawing tools look fascinating. I hope that scientist will follow and use what artist and particularly the game industry will come up with.

Is Edward Tufte a god to you?

torkel-flatberg

I certainly enjoyed reading his books. In particular "The Visual Display of Quantitative Information" and „Visual Explanations: Images and Quantities, Evidence and Narrative" are some of my favorite sources of "wisdom" as they provide a set of guidelines and good advice on how to visually communicate data with terms such as "Data–Ink Ratio". Additionally, I admire the beauty of his work and his bold decision to take risks by self-publishing and financing "Visual Display".

Thank you for doing this AMA. Your artwork is beautiful and impressive.

- Which did you become interested in first: Art or Chemistry?

- When was the first time you realized you could combine science and art into a career?

marfalump

Thank you very much, I appreciate your feedback and your perspective. As far as I remember, I was always interested in art and drawing, especially geometric visualization such as the work of M.C. Escher. After school (in Germany, for me that was gymnasium, sort of like high school) I had a hard time to decide to study science or design. Eventually I went with chemistry, but never really lost interest in design. However, combining the two passions never really occurred to my until my doctoral studies. In particular, the international SciFinder program opened my eyes and gave me the courage to follow that path.

What program should someone use to show a graphic of biochemical signal transduction? If I include a graphic I made, could you critique it and tell me how I could making it more appealing/ clearer?

Chanela1786

Sounds like a job for vector-graphics (Adobe Illustrator and Inkscape). Upload the picture (e.g. on imgur), post the link and I am happy to give some feedback.

Do you think that emphasis should be put more on information or aesthetics in the figures of peer-reviewed publications?

[ScaryMango](#)

Form follows function, but then again, nobody likes to study ugly figures.

My Name is Johannes, I'm carrying the wheel.

[stavarz](#)

Come sit next to me
Pour yourself some tea?

Thoughts on 3D presentation? Worth the hassle or just stick to 2D graphs?

[NippPop](#)

Definitely, worth the hassle, especially when you have data from xray measurements or DFT calculations. But use with care. A solid 2D representation is gold.

Most graphs are 2 dimensional, but how many dimensions would you *like* to have to display data?

Would VR make it any easier?

[hasmanean](#)

I think the limiting factor here is the capability of the human mind. VR unfortunately won't change that. However, it would be fascinating to "walk around" a schematic representation and interact with it. Nevertheless, it is surprising how much data you can display with a 2D-graphic just by careful and skillful arrangement. Check out C. J. Minard's [Napoleon's March to Moscow](#)

I once was working on a piece of spectroscopy software. In it, the plots of several spectra were to be overlaid. Each spectrum represented a point in time. To differentiate the plots the proposal was to have the first spectrum green and then cycle from there to the color red in RGB value. Given that 10% of males have some form of color blindness and the majority of those have red-green color blindness, what would be the best way to differentiate those spectra but still convey the movement over time?

[quizibuck](#)

Have you checked out https://bids.github.io/colormap/

What has been the trickiest concept or scientific finding you've had to illustrate? What are some of your favorite designs you've made?

[shiruken](#)

Very recently I was asked to come up with a cover image for a publication in the field of metal-organic frameworks used as laser materials. As usual I asked for the crystal structure of the compounds, since I like to have real data as starting point for the design. Little did I know, that although the molecular structure of the unit cell was relatively simple, the whole structure and the grid system was so twisted and challenging that I spend multiple days in order to find a suitable way for its representation. In the end, I had to create a relatively reduced version of the grid system in order to underline the point of the

paper. It was worth the trouble and the image is one my favorites now. I even created an animated version with a pulsing laser beam: www.jorichers.com/preview/

Hi Dr Richers,

I am currently at university and your work sounds very close to what I hope to do later on (medical illustration). However my main hesitation is around being a freelance worker, as I really have no clue how one becomes successful at it - the lack of structure/authority seems daunting. What were the main challenges you faced working independently, and what would you suggest to someone looking to enter a similar profession?

effivd

Lack of structure and authority is definitely a challenge as a freelance artist, I agree. At the same time, there is lot of freedom to enjoy. Main challenges include establishing a proper work/life balance, in contrast to a PhD now with the difficulty to *define* work time, especially when you are in the concept phase for a design, paper work (e.g. taxes, insurance) and knowing what your time and know-how is worth. General tips above