Trends in
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Scientific Life

Towards Democratizing and Automating Online Conferences: Lessons from the Neuromatch Conferences

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Legacy conferences are costly and time consuming, and exclude scientists lacking various resources or abilities. During the 2020 pandemic, we created an online conference platform, Neuromatch Conferences (NMC), aimed at developing technological and cultural changes to make conferences more democratic, scalable, and accessible. We discuss the lessons we learned.

Neuromatch Conferences

Conferences are a backbone of scholarly communication, where scientists can learn about and share new ideas, meet colleagues, and make friendships. However, the need for travel and physical infrastructure means conferences are expensive and time consuming, they contribute to global climate change [1], and exclude scientists for many reasons (e.g., budgetary [2], mobility [3,4], or size constraints).

We created the NMC (https://neuromatch.io) [5] to make conferences more climate friendly [1], accessible [6], and democratic [7]. We held three events in March (NMC1), May (NMC2), and October (NMC3) 2020. Similar to legacy conferences, scientists gave and viewed talks, as well as networked in a variety of ways. NMC grew with each iteration. NMC3 featured >900 talks and ~4700 attendees while being driven by a small team of volunteers, so we had to develop technological solutions to enable this growth. Replacing the traditional review process where only a few submissions are selected for talks and most are delegated to posters or rejected, we opted for a light-handed editorial approach focused on scheduling rather than evaluation. All submissions were accepted for talks, and each talk was arranged at a time that maximized live audiences in all time zones. To help attendees select their program, we relied on a combination of search and recommendation algorithms. We also used recommendation engines to kickstart online socialization by introducing scientists to one another. To promote openness and inclusivity [8], NMC3 featured several curated events focused on both inclusion issues in various communities such as Black In Neuro (https://www.blackinneuro.com), Queer In Neuro (https://twitter.com/queerinneuro), and first-generation students, as well as professional development issues such as science communication and future funding priorities.

Towards Improving on Legacy Conferences

Use Data to Make Online Conferences More Democratic and Scalable

We created an automatic system for dealing with talk scheduling and agenda curation (Figure 1A). We asked attendees and presenters for their preferred times. After abstract submission closed, we evaluated each talk's expected audience by asking participants to choose talks. This happened double-blind because we wanted attendees to choose interesting science without regard to authors' status. We supplemented this interest-based assessment with a recommendation algorithm [9] that suggested additional talks based on other participants' choices and similarity of abstracts (Figure 1B). We debuted this solution for NMC3 and received >23 000 votes from 1231 attendees. With these votes, we could quickly build a picture of likely audiences (i.e., who wanted to see what and when) and which talks should not overlap.

Next, we used a custom-made, two-stage scheduling algorithm (Figure 1C). In the first stage, we grouped talks into sessions by their indicated availability. From the possible sets of sessions, we selected those which maximized session coherence based on audience overlap and topic similarity [9]. In the second scheduling stage, we assigned time slots to each session. We used an integer linear programming (ILP) approach[i] to maximize the total number of expected watch-hours for each session, assuming higher likelihood of watching a session if it contained multiple interesting talks and if assigned timeslots overlapped with core watch-hours in the time zones of the target audience (i.e., not in the middle of the night). We believe that automatic scheduling is useful but there is a challenging tradeoff between enabling scientists to participate and the desire to have maximal audiences.

Crucially, we could automate many other aspects of the organizational workflow. For example, speaker communications often happened via automated e-mails with relevant information and calendar links, and participants received talk suggestions that were relevant to their interests. Automation is needed to allow a small team to run large conferences.

Improve Inclusivity and Sustainability

Towards this goal, our editorial process filtered out only nonscience and off-topic
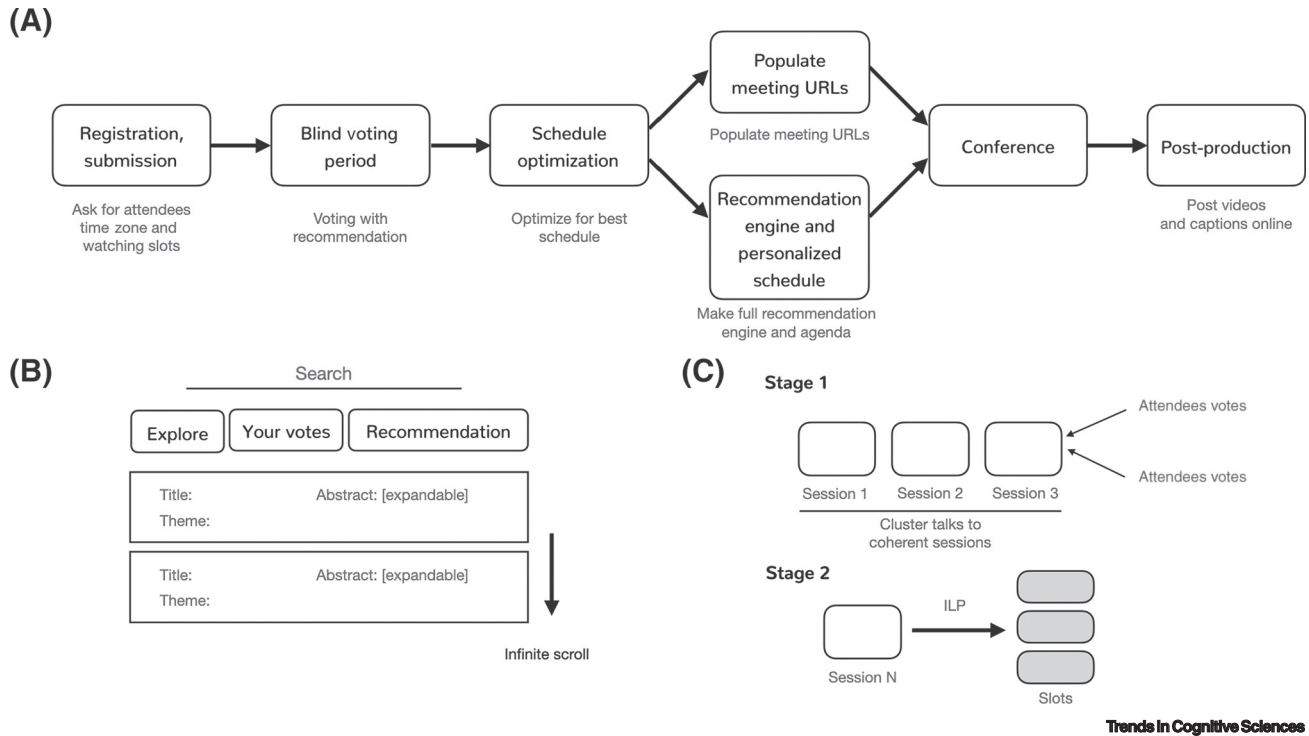
Figure 1. Automatic Agenda Building and Talk Scheduling. (A) Schematic of the agenda building and talk scheduling. We opened for registration and submission followed by the blind voting using our recommendation engine. We then ran the schedule optimization so as to maximize the number of attendees for each talk. After the conference, we populated the agenda and URLs followed by postproduction and release of videos after the conference. (B) Schematic of a recommendation engine for voting. We had a default tab for exploring, storing votes, and recommending similar abstracts. The recommendation tab returns abstracts related to the votes ranked by topical distance. Users can vote for abstracts that they would like to see and their selections are stored on Your votes tab. (C) Schematic of how we solved talk scheduling. We first grouped submissions into sessions using votes and topic similarity. We then applied ILP to assign time slots to each session.

submissions. We worked hard to achieve gender equality [10] at NMC, with approximately 50% female speakers at each NMC.

The ratio of female-to-male participants at all career stages roughly matched those of the field as a whole, as estimated by BiasWatchNeuro (https://biaswatchneuro.com/base-rates/neuroscience-base-rates). The 'leaky pipeline' [11] is clearly apparent, with a majority of undergraduates female, and worsening ratios at each consecutive career stage (Figure 2). We believe that, in part due to the democratization of science and the low financial and logistical barriers to participation, online conference formats can attract a more diverse set of attendees than legacy conferences, and may help to 'plug' the leaky pipeline. However, further

data and research are needed to validate that this is actually the case.

Lessons from Organizing Online Conferences
Online Conferences Can Be Inexpensive
Online streaming is relatively inexpensive. We spent a total of around $1000 for Crowdcast (CC) for NMC1 and 2 and $4000 for NMC3 for Zoom Webinar. Storing data and serving our website comes at nominal costs [5]. While NMC1 and 2 were free, we started charging a waivable $25 fee for participation in NMC3, hoping to put the conference on a sustainable path [2]. Indeed, we were able to collect all streaming costs of NMC3 from attendance fees. Algorithms enable major time and money savings; for example, when it comes to making schedules and their

development, algorithms promise to do it better and faster than volunteers. To facilitate scale-up, more automation is needed so as to minimize administrative, editorial, and program committees' work.

Streaming Platforms Affect User Experience
NMC1 and 2 focused mainly on computational neuroscience. For both, we had a main track with keynotes and submitted talks with five parallel tracks, delivered via Zoom at NMC1 and CC at NMC2. Talks were available for later viewing, and audience feedback indicated that interactions between speaker and participants were good. Unfortunately, CC audiovisual and streaming quality was inconsistent, and speakers had to restart their browser frequently. For NMC3, we expanded the conference to serve a broader range of
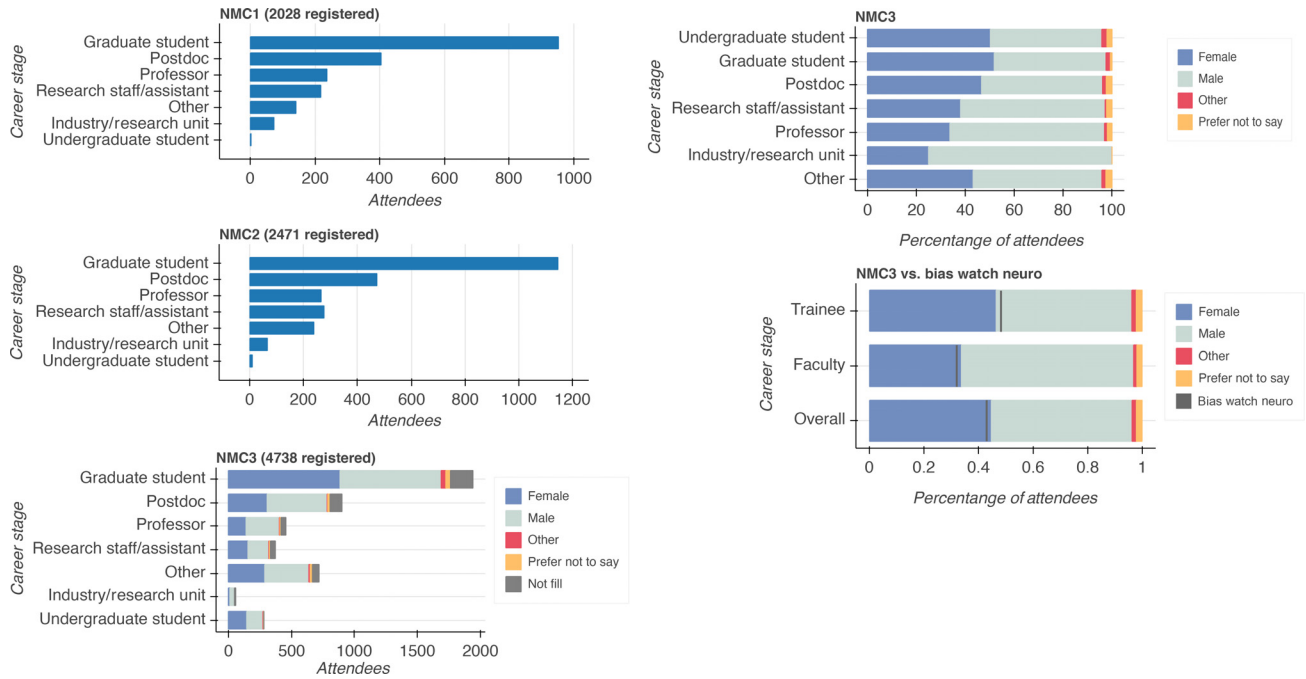
Figure 2. Number of Registered Attendees for Each Neuromatch Conference (NMC) Edition. Registrations for each NMC edition career stage and by gender in October 2020 (NMC3). Overall, NMCs brought diverse participants in both career stages and gender. In NMC3, we observed a higher percentage of female-to-male participants in early career stages but this was reversed in the postdoc, professor, industry, and research units. Our participants female-to-male trainee (graduate student and postdoc), faculty, and overall ratios are 48%, 35%, and 46%, roughly matching the estimates for neuroscience as a whole of 50%, 33%, and 44%, respectively, estimated by Bias Watch Neuro.

neuroscience with six themes and up to nine parallel tracks. We opted for Zoom Webinar as our streaming platform, which offered a more reliable service, but lagged in user engagement. As the choice of streaming software profoundly affects the user experience, we still look for solutions that offer both an interactive user interface and stable high-resolution streaming.

Hosting and Distributing Videos after the Conference

Hosting NMC3 required ~160 volunteers to host the set of ~900 events. We sent calendar links to hosts to make sure they got the correct time with detailed instructions. A live chat backbone (on Slack) was essential for addressing last-minute cancellations, no-shows, and technical problems. During NMC1 and 2, the hosts spent much of their time making sure that speakers knew where and when to show up and we experienced considerable

dropout. Thanks to hosting each session with two hosts, one for the technical and one for the introductions, NMC3 ran efficiently and reliably, despite having ten times more talks than the previous NMC. After NMC3, each talk was posted separately on YouTube, with labels and links to the original program. With this model the conference event is no longer the ephemeral end product. Rather, it includes the delivery of the scientific content in a durable and accessible long-term format. We believe that all online conferences have a duty to do so.

Online Conferences Should Facilitate Social Interactions: The Need to Replace Poster Sessions

In legacy conferences, much of the social interaction occurs during the coffee break and poster presentations. In online conferences, an important aspect is to ensure that the agenda and platform provide

enough social interaction. NMC uses machine learning algorithms to help match attendees for one-on-one meetings similar to the coffee break [12]. We tried to create the equivalent poster interaction online using two formats. In NMC2, we created a poster session allowing attendees to visit common sessions, view the content, and ask questions. Unfortunately, attendance was generally low. Feedback suggests that bad timing and low visibility were part of the issue. However, the problem of low poster attendance seems to be common with other online conferences [13]. To improve attendee experience at NMC3, we created interactive talks instead of posters: 5-min talks followed by 10 min of discussion. From our experience, these interactive talks fostered more interaction compared to our previous poster sessions, but still failed to capture the real poster experience. It remains to be seen whether a poster-like format

with free-wheeling personal interaction can successfully be transferred to the online space. Technical solutions regarding proximity-graded sharing of virtual spaces such as GatherTown or Mozilla Hubs have potential here, but more innovation is needed. Making online conferences feel great and personal is the ultimate goal that we need to innovate towards.

Concluding Remarks

Once the technical issues are resolved, online conferences can be organized by relatively small teams. Our experience, and that of others such as Federation of European Neuroscience Society Forum 2020 (https://forum2020.fens.org/), Organization for Human Brain Mapping (https://www.humanbrainmapping.org/), ICLR 2020 (https://medium.com/@iclr_conf/gone-virtual-lessons-from-iclr2020-1743ce6164a3), and NeurIPS 2020 [14], has shown that online conferences have potential to establish a forum for scientific exchange with numerous advantages to physical meetings: less costly, environmentally friendly, more inclusive, and largely interactive. The Neuromatch Conferences serve as proof that moving conferences online can alleviate inclusivity issues associated by reducing the barriers to participation for people from many areas of the world [6], people who cannot afford expensive accommodation and registration, those subject to travel restrictions, or those with caring responsibilities who cannot leave for long periods of time.

Supplemental Information

Supplemental information associated with this article can be found online at https://doi.org/10.1016/j.tics.2021.01.007.

Resources

ihttps://www.cis.upenn.edu/~cjtaylor/PUBLICATIONS/pdfs/TaylorTR08.pdf

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