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Review

REVIEW

Centering inclusivity in the design of online conferences—An OHBM–Open Science perspective

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Abstract

As the global health crisis unfolded, many academic conferences moved online in 2020. This move has been hailed as a positive step towards inclusivity in its attenuation of economic, physical, and legal barriers and effectively enabled many individuals from groups that have traditionally been underrepresented to join and participate. A number of studies have outlined how moving online made it possible to gather a more global community and has increased opportunities for individuals with various constraints, e.g., caregiving responsibilities.

Yet, the mere existence of online conferences is no guarantee that everyone can attend and participate meaningfully. In fact, many elements of an online conference are still significant barriers to truly diverse participation: the tools used can be inaccessible for some individuals; the scheduling choices can favour some geographical locations; the set-up of the conference can provide more visibility to well-established researchers and reduce opportunities for early-career researchers. While acknowledging the benefits of an online setting, especially for individuals who have traditionally been underrepresented or excluded, we recognize that fostering social justice requires inclusivity to actively be centered in every aspect of online conference design.

Here, we draw from the literature and from our own experiences to identify practices that purposefully encourage a diverse community to attend, participate in, and lead online conferences. Reflecting on how to design more inclusive online events is especially important as multiple scientific organizations have announced that they will continue offering an online version of their event when in-person conferences can resume.

Keywords: online conferences; diversity; inclusivity; open science; collaborative events

Background

Many of the conferences scheduled for 2020 had to move online in a rush as the global health crisis unfolded. By removing the need to travel or obtain visas and by decreasing overall costs, this move enabled more individuals from groups that have traditionally been underrepresented not only to participate in [1, 2] but to lead conferences [3]. This shift to online events has considerably changed how researchers envision conferences and will likely have long-lasting consequences in research communities.

Although online conferences suggest a more inclusive experience than in-person events, their mere existence is no guarantee that everyone can attend and participate meaningfully [4]. Some issues present at in-person events are in fact accentuated in online events: with an increased focus on talks, the visibility gained by early-career researchers presenting posters may be reduced. Some challenges are unique to online events, such as the scheduling of sessions to accommodate a range of time zones and participant commitments; or the availability of internet connectivity to seamlessly stream event content and participate in live sessions. Still other concerns exist across both conference structures and reflect broader long-standing problems in STEM, such as minorities being underrepresented in leadership positions [5].

These issues were likely to have been even more pronounced in the 2020 events because organizing committees had to adapt and make quick decisions. In practice, this meant that organizers often made this transition without enough time to carefully cater to attendees with different needs from their own, seek community input, onboard volunteers, and to promote their events beyond their own circles.

Now is a good time to review these issues and identify best practices for designing intentionally inclusive online events. Here, we focus on inclusivity, the process to purposefully encourage a diverse community to join, actively take part in, and lead online conferences. While there is no one-size-fits-all solution, we consider diversity with respect to traditionally underrepresented groups, including individuals from low- and middle-income countries; those with caretaker responsibilities; those with disabilities, chronic illness, neurodiversity, or mental health issues; and students and early-career researchers.

The Open Science Special Interest Group (OSSIG) of the Organization for Human Brain Mapping (OHBM) is dedicated to increasing open science practices in the brain mapping community. Each year this group holds 2 events: the OHBM Brainhack, which is a 3-day hackathon, and the Open Science Room (OSR), a space for collaborations and talks within the organization's annual conference. In 2020, both events ran fully online for the first time and gathered >1,000 participants.

Here, by reflecting on our own practices and building on existing work, we survey and provide guidelines for enhancing inclusivity in online conferences (Fig. 1). Although we have involved a diverse group of researchers in writing this article, we recognize that there are many diverse perspectives and experiences that are not discussed here. This article is organized in 3 sections. First, we focus on the mandatory step of removing

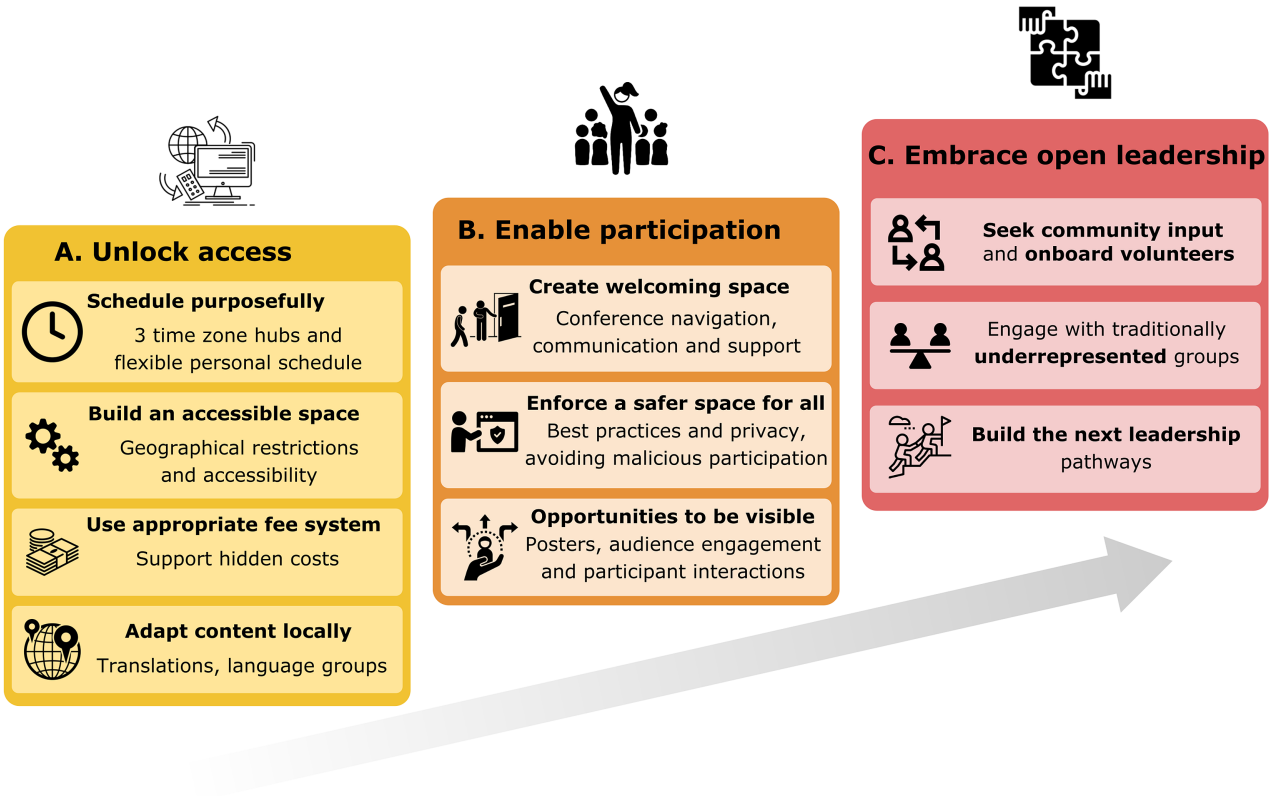

Figure 1: Three steps (with recommendations) to improve the inclusivity of online conferences. (A) Unlock access. (B) Design for meaningful participation. (C) Embrace co-creation and open leadership.
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barriers that prevent access to online conferences (A). We then discuss how to build an environment that will enable meaningful participation of a diverse audience (B). Finally, we look at the future and focus on building diverse leadership (C).

Unlocking Access

Schedule purposefully

Three time zone hubs for global accessibility: Asia, Pacific; Europe, Middle East, and Africa; the Americas

There is no common 4-hour time range that can suit everyone across the globe (Fig. 2). Scheduling choices will inevitably determine a more local or global reach of the conference and may prioritize certain parts of the world.

Defining 3 time zone hubs—Asia, Pacific; Africa, Europe, and Middle East; and the Americas—and repeating the content at suitable times for each hub allows content to be available nearly everywhere during typical working hours (e.g., OSR 2020, Note: All conferences cited in the manuscript are listed in Table 1 with their full name and website. NMA 2020, Note: All conferences cited in the manuscript are listed in Table 1). The repeated content can be interspersed with time blocks of hub-specific content such as questions to the speaker (Q&A) and socials. To accommodate non-traditional schedules, each hub can remain accessible to any participant from any time zone.

To avoid having to rely on presenters giving their virtual talk 3 times, we encourage giving them the option of recording the talk in advance as well. Pre-recorded talks were also preferred by many conferences to avoid technical issues. Scheduling a time to play the recorded talks for each hub is useful for participants to interact with the speakers and other attendees. For Q&A sessions, we recommend asking the presenters to nominate a representative (e.g., a collaborator) in each hub to participate in the Q&A session. We also recommend grouping Q&A sessions for multiple talks so as to make sure at least some of the talks will have speakers or representatives available for live Q&A. In addition, there should be an option for asynchronous Q&A in which written or recorded questions can be answered across a time range that is accessible to all participants.

While the 3-hub model is the most equitable solution, it is also more demanding for presenters and the organizing team. A less demanding option is to adopt a rotating schedule or very long days in order to prioritize 1 of the 3 geographical hubs for a subset of the conference (e.g., OHBM 2020). Finally, some conferences have decided to use a fully decentralized program (e.g., Brainhack Global 2020) or a single time zone with a more local reach (e.g., SIPS 2020) (see Supplementary Fig. S1).

Support the creation of flexible personal scheduling

Different people have different time constraints. For example, caregivers will often not be available outside of typical work-

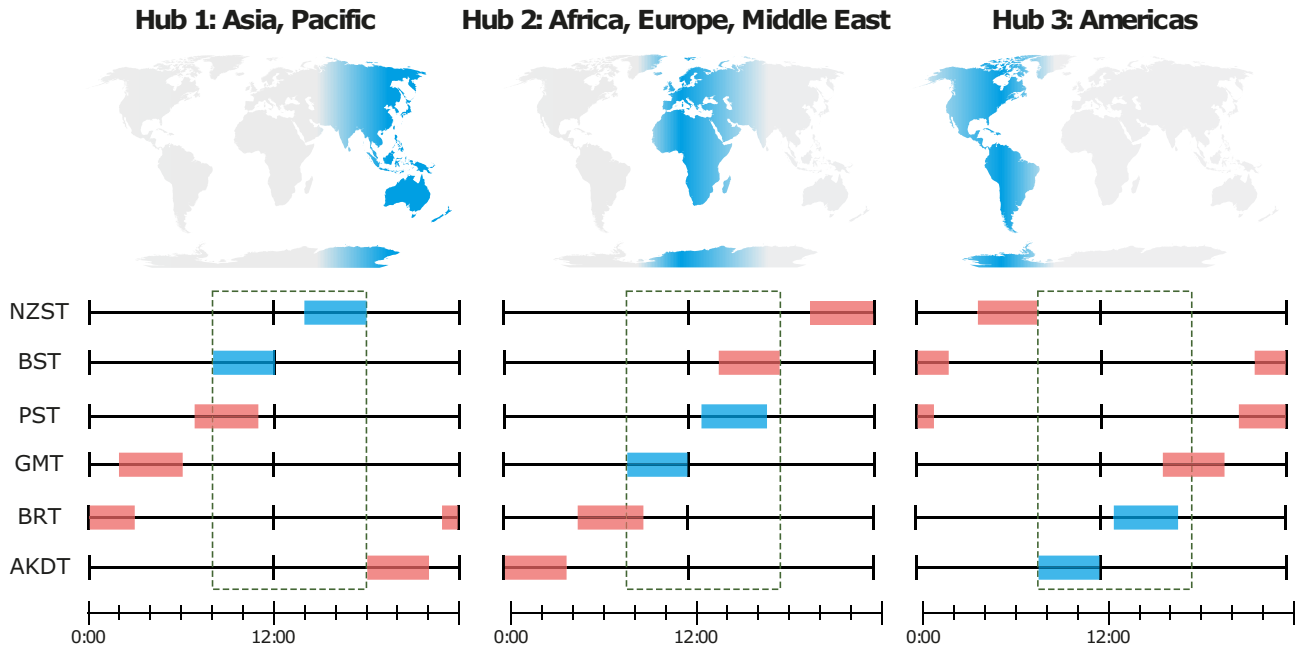

Figure 2: Three time zone hubs for global accessibility: Asia Pacific; Africa, Europe, and Middle East; and the Americas. The coloured bars represent the schedule range of each hub in 6 representative time zones. For each time zone, a blue box indicates the timing corresponding to the recommended hub. For example, researchers based in New Zealand (NZST) can attend hub 1 during 14:00–18:00 (local time). They will be joined in this hub by researchers from Bangladesh (BST) for whom the content will happen 8:00–12:00 (local time). The green dashed rectangles cover typical working hours, which often fall within the 8:00–18:00 range. The 3 time zone hubs make it possible to schedule 4 hours of content each day while remaining within typical working hours for nearly all time zones. NZST: New Zealand Standard Time (UTC+12); BST: Bangladesh Standard Time (UTC+6); PST: Pakistan Standard Time (UTC+5); GMT: Greenwich Mean Time (UTC+0); BRT: Brasília Time (UTC−3); AKDT: Alaska Daylight Time (UTC−8).

Table 1: Online conferences cited in the main text

Conference abbreviation	Full name	Website
ABCD-ReproNim	ABCD-ReproNim: Reproducible Analyses of ABCD Study Data	https://www.abcd-repronim.org
BCW 2021	The Brain Connectivity Workshop 2021	https://bcw-2021.com
BIIM 2020	BRAIN Initiative Investigators' Meeting 2020	https://www.brainmeeting2021.com/
Brainhack Global 2020		https://brainhack.org/global2020/
Cosyne 2020	Computational and Systems Neuroscience 2020	http://www.cosyne.org/c/index.php?title = Cosyne_21
ISMRM 2020	Annual Meeting of the International Society for Magnetic Resonance in Medicine 2020	https://www.ismrm.org/20m/
NeuroHackademy 2020		https://neurohackademy.org/
NMA 2020	NeuroMatch Academy 2020	https://www.neuromatchacademy.org/
OHBM 2020	Annual Meeting of the Organization for Human Brain Mapping 2020	https://www.humanbrainmapping.org/i4a/pages/index.cfm?pageid = 3958
OHBM Brainhack 2020	Brainhack of the Organization for Human Brain Mapping 2020	https://ohbm.github.io/hackathon2020/
OpenMR Virtual 2021		https://openmrbenelux.github.io/2021/page-program/
OSR 2020	Open Science Room 2020	https://ohbm.github.io/osr2020/
PyCon 2019	Python Conference 2019	https://us.pycon.org/2019/about/
SIPS 2020	Society for the Improvement of Psychological Science 2020	https://www.improvingpsych.org/SIPS2020/
TPATH 2021	Transgender Professional Association for Transgender Health 2021	https://tpathealth.org/conference2021/

The conferences are listed with their abbreviated name and year, their full name and their website.

ing hours. Other professional groups who typically perform shift work may instead prefer to have content outside of 9:00–17:00 schedules to better balance professional responsibilities. A further consideration is those for whom extended periods of "desk work" is physically or mentally prohibitive. Because different groups may have contradictory preferences, we recommend taking into account potential attendees when making scheduling decisions. In general, we encourage online event organizers to

explicitly prioritize attendee scheduling constraints in designing conference programs and carefully consider which days are included in the schedule. Because online events incur no rental costs for a physical space, we suggest that longer events—free from the need to compress the content into a few days—may be better suited for some online events.

Regardless of the timing of the event, all attendees are more likely to be interrupted by their usual personal and professional routines when attending an online conference compared to the protected time in-person conferences can offer. Attendees with caregiving responsibilities may be especially likely to be interrupted. Many in-person conferences have provided child care grants in the past few years to support parents in covering the costs of additional child care, or to bring a relative to the conference (e.g., [6]). When shifting to virtual settings, some conferences have stopped offering dependent support—effectively suggesting that caregivers at home should be able to juggle their caregiving responsibilities with attending the conference. We strongly encourage event organizers to continue providing those grants and, in fact, extend them to all types of caregivers and not exclusively to parents. Those grants can be key to providing more flexibility to participate in the online event and are also more easily used at home (e.g., participants can more easily request the help of a babysitter they trust or invite a parent to stay at home and help).

Incorporating breaks and providing the ability to watch talks, read post-talk discussions, and read live chat asynchronously makes it possible for attendees who cannot watch the content live to catch up and participate in the discussions. Furthermore, a less dense schedule can also help individuals to rest between events without being forced to skip part of the content. This can be especially important for those who require additional accommodations.

Build an accessible space

Identify geopolitical restrictions

Online conferences rely on technical solutions to make their content available to attendees: conference website, videoconferencing, messaging systems, video broadcasting, and so forth. When selecting tools, review any geopolitical restrictions that would prevent access from certain regions of the globe (e.g., YouTube is not accessible from China). When a single solution cannot answer all needs, consider proposing alternative tools. For example, the OHBM Brainhack and OSR 2020 proposed the following alternative tools for users based in China: HackMD or Microsoft 365 (in place of Google Docs) for collaborative editing, WeChat (in addition to Twitter) for general announcements, DouYu (in addition to YouTube) for live broadcasting, and Bilibili (in addition to YouTube) to archive videos. Geopolitical restrictions can also apply when the host country has sanctions against a country whose citizens are potential conference attendees. This was experienced recently in preparation for the Neuromatch Academy [7], where volunteers were initially prevented from providing educational services to attendees from Iran, due to sanctions imposed by the US government [8].

Select tools with consideration of disability accommodations

When selecting technical solutions, it is important to review their accessibility for individuals with disabilities. A first step is to ensure that the chosen solutions comply with existing accessibility standards, are compatible with adaptive technology (such as screen readers), and enable the addition of closed captions (see [9, 10] for recent reviews of the accessibility of conferencing solutions). When possible, we recommend using professional subtitles. While automatic subtitles are a cheaper option and have made great progress in the past few years (see [11]), they can unfortunately reinforce disparities among speakers as content is often better recovered for those who are native speakers. Providing a textual version of all audio content will not only help those whose vocal understanding is impaired and those experiencing poor sound quality but will also make it easier for non-native English speakers to follow along. Transcripts can also serve as input for all existing text-based accessibility features, such as automated text-to-speech or translation, and therefore extend the accessibility of the content to those who use those technologies. In all cases, accessibility features should be turned on as standard, rather than waiting for them to be requested by the individuals who need them.

Solicit and act upon feedback

Especially when solutions may not be obvious, it is important to provide participants—at an early stage—with ways to provide input or submit a request for additional solutions that meet their needs. Consider how to make the request for assistance as little of a burden to the participant as possible and avoid using stigmatizing language. A plan for how these needs will be accommodated should be created, including a backup plan in the case that needs fall outside of the organizers' means. To this end, it may be helpful to consult with institutional or organizational disability and accessibility experts for each unique group that may require additional support.

Do not let the cost of the conference be a barrier for attendance

Define an appropriate fee system

Online conferences offer a unique opportunity to broaden geographical diversity, but fees can remain a significant barrier if they do not take into account differences across countries. We recommend setting multiple fee levels by taking into account both the level of income (e.g., [12]) and the support provided to scientific research (e.g., [13]). In addition, we recommend providing a mechanism to waive fees for attendees to account for variations within countries and for individual circumstances such as no or less institutional support (OSR 2020, NMA 2020).

In many countries, additional fees and even taxes are incurred when paying with non-local currencies; we recommend using a platform that allows for payment in local currencies so as not to burden individual participants with additional fees. The use of credit cards is also not ubiquitous. For example, some countries mainly use cash, and others have local electronic payment systems. Because some participants might not have access to a credit card, it is important to support multiple payment methods. Options include allowing mobile money payments or app-based payment platforms, which can be connected directly to a bank account. In tandem, consider an option for laboratory or group fees for online events because these can help reduce administrative burden and ensure that more early-career trainees and support staff can attend.

Finally, because online conferences often cost less than their in-person counterparts, this is also the opportunity to consider reducing the fees overall (e.g., NeuroHackademy 2020 was offered gratis).

Provide support for hidden costs

Online conferences create new technical requirements for attendees. A combined headset or a desktop microphone and a set

of headphones can help create a more immersive experience or even enable participation. Part of the minimal requirements is also access to a high-quality, high-speed internet connection to support video-based systems, or, at the very least, a connection capable of supporting consistent text-based communication in various messaging systems [14].

Consider reducing the amount of live connection time and required bandwidth. While live-streaming is a popular feature because it enables direct interaction, it often requires a high-bandwidth internet connection. Provide an option to downgrade the quality of the video (or completely switch it off) and the possibility to download content rather than requiring participants to live-stream it. For content that can be watched later, provide the possibility to watch at a different speed. It is also preferable to make recordings of content available as soon as possible after live events, so those watching offline can contribute to the live text-based discussion.

Although there are several ways to reduce the barrier of hidden costs to access, we are especially interested in modes which synergistically increase accessibility in multiple domains. For example, if speakers are pre-recording their talks for presentation in different hubs (see section "Schedule purposefully"), providing an option to record the talk without being connected is especially important to ensure high-quality recordings for those with an unstable internet connection. We also encourage adapting existing infrastructure from in-person events to support online experiences. For example, in place of travel grants, consider offering small grants to offset the cost of small equipment (headphones, microphone, webcam) or a temporary SIM card to boost connectivity (for an example see OpenMR Virtual 2021).

Adapt the content to local audiences

As for in-person conferences, the provision of English-only content is a significant hurdle to many participants around the world [15] and online conferences offer an opportunity to lower this barrier.

Organizers can encourage the formation of connections between individuals speaking the same language to promote networking and communication for individuals less fluent in English (e.g. NMA 2020) [7]. This might be facilitated through the formation of local gatherings, which can also organize live translation with a professional using a separate audio channel (e.g. TPATH 2021). Part of the program can be delivered in other languages with a large audience of speakers such as Spanish or Chinese (e.g., OHBM Brainhack 2020).

Subtitles and closed captions can be included in different languages. In the case of pre-recorded content, this can be incrementally improved by adding crowd-sourced closed captioning in multiple languages (e.g., PyCon 2019). When possible, consider supporting the creation of local gatherings that will provide facilities so that individuals can attend the conference as a group [16] with the added benefit to support local interactions and networking.

Designing for Meaningful Participation

Create a welcoming space

Design navigation through the online conference

Navigating an online conference can be a new and sometimes frustrating experience. Researchers who have attended online conferences may struggle with a new platform given the variability in available structures and software, and first-time conference attendees might be especially unclear on what to expect if they are not already familiar with the in-person equivalent of the meeting. This difficulty has been amplified by the rapid transition to virtual conferencing because there were relatively few pre-existing industry standard platform options, resulting in a large variety of solutions.

To facilitate this experience, organizers should design user-friendly navigation through the online conference. This starts with the definition of what the "entrance" will be and how attendees will go from one space to another. When doing so, consider how different users will connect and participate, e.g., based on geographical location, or whether the content is watched live or asynchronously. We would recommend summarizing this information as a "cheat sheet" that describes the best places to go for different types of interactions.

It is equally important to plan how and when connection information will be shared. For in-person conferences, the address of the venue is easily shared, but online conferences provide unique challenges in publicizing the event. Specifically, many conference organizers may prefer to avoid posting connection details publicly to limit the risk of malicious participation, i.e., any non-affiliated attendee joining with the intent to disrupt or otherwise derail the event. Because connection details may not be posted publicly, a backup plan for attendees who did not get connection information (e.g., the connection details were blocked by an e-mail filter) in time should be easily accessible. Contact details for support on connection or technical issues should be easily accessible and posted in multiple locations.

In addition, we recommend repeating the connection links on the program, with only the password or login information being passed privately to each attendee. Provide a schedule in local time for each attendee or, if this is not possible, pick Universal Time Coordinated (UTC) over a local time zone (see BCW 2021).

Communicate and provide training

To accommodate all levels of digital literacy and familiarity with digital tools and platforms, instructions about the software and tools should be made available a few weeks before the conference along with an interactive demo of the platform. Giving attendees the option to connect early on may potentially identify issues ahead of time, and a complete tour of the various online tools can be provided prior to the start of the conference. Each session of the conference should start with a quick overview of the main ways to participate and interact with the content.

It can be particularly stressful for attendees to keep track of long e-mails describing all available tools, and we recommend sharing only as much information as needed at a time while reserving more detailed information for a frequently asked questions page on your conference website. Similarly, we encourage conference organizers to establish which communication channels will be used to contact attendees, speakers, and volunteers during the event (e.g., e-mail versus conference platform) and disseminate specific types of information ahead of time. In general, it is best to avoid last-minute changes in technology because these are likely to disproportionately affect attendees who are less connected with other members of the community, such as first-time attendees.

Provide on-site support

During an online conference it is often more difficult for less experienced attendees to rely on their more experienced peers to guide them through the event. This difficulty can be mitigated by building a support system to help orient and guide attendees

in the virtual conference. Some conferences have positioned greeters at their entrances or run an all-day "welcome desk" (as a videoconference or chat room) where attendees could find facilitators and ask questions as needed. Other conferences have connected attendees through a "buddy system," pairing first-time attendees with more experienced participants. This should be distinct from the support handling connection or technical issues.

Promote and enforce a safer space for all

Follow best practices of inclusive in-person conferences

To provide a safer online environment, it is important to adapt best practices applied to inclusive in-person conferences. One can minimize the risk of microaggression being portrayed by speakers, attendees, or through shared scientific content by having an explicit code of conduct (see OHBM 2020 Code of Conduct [17]) in place. To be effective, the code of conduct must be acknowledged and accepted by all participants (e.g., as part of the registration) and must include dedicated procedures to enable reporting and dealing with violations. To make enforcement possible, official conference forums where unmoderated interactions between attendees are possible should require user credentials and ways to exclude individuals who violate the code of conduct across all conference sites. If a code already exists for a given community, it should be adapted to the online context. If the event is global, it is important to ensure that reporting can be done efficiently from all time zones and in multiple languages, with the help of a globally distributed committee.

To provide an opportunity for researchers to self-identify their gender, conference organizers should endorse and normalize the use of specified pronouns [18]. This is especially necessary in online environments where gender as a social construct may not be as easily expressed. Pronouns can for instance be added to biography or display names on the various platforms, and all participants should be encouraged to specify their pronouns to normalize this practice.

Reduce the risk of malicious participation

Online conferences are at risk of a new kind of aggressive behaviour: malicious participation, colloquially referred to as "Zoom bombing," in which bots or anonymous spammers enter the event and take control of the audio or video channels to share unwanted material (see section "Design navigation through the online conference"). A number of best practices have been proposed to reduce this risk, including the adoption of registration processes that make it possible to share information only with those registered (even if the event is free), or the use of software that allows for administrative control of who can speak and share screen (see [19] for more information). In addition, we recommend preparing a crisis plan in case this form of aggression does happen, including a strategy for removing the intruder and clarifying who has the responsibility to do so.

Explicitly consider data privacy

Data protection and privacy in an online conference is both an ethical and a legal concern. With content being recorded and broadcasted, online conferences increase participants' exposure and require organizers to think carefully about data privacy [19]. It is important to be explicit about what is recorded or broadcasted and to obtain the consent of participants before sharing any of their personal content in compliance with regulations such as the European General Data Protection Regulation. Provide different ways to participate beyond joining on-screen (e.g., text chat, shared collaborative notes), and consider the data privacy policies of the tools used (e.g., which data are stored, their persistence, and whether they will be used by the company or shared with others). Conference organizers should ensure that the collection, use, and disclosure of personal data and, in particular, attendees' likeness is consistent with the expectations of attendees, and communicate these details clearly.

Provide opportunities to increase the visibility of all participants

In the rush to convert in-person conferences into online events, most of the attention has been given to online talks, effectively skewing online conferences to give more visibility to already established researchers. In this section, we review ongoing efforts into translating other conference features. Beyond the options discussed here, many solutions are still to be found or adopted [20] and we encourage online conference organizers to think creatively about how best to deliver their content.

Design interactive poster sessions

Scientific posters have a long-standing tradition in academic conferences and are more often presented by early-career researchers than those with established research careers. Relieved from the constraints of a physical space, online conferences may offer an opportunity to broaden the set of presenters who are selected to display their work and possibly increase the duration during which posters are displayed. But with more content available, online conferences are also more difficult to navigate. A number of attempts have been made in the past year to reproduce and extend poster sessions in an online setting.

Some conferences transformed online poster sessions into a series of very short talks in front of the whole audience. While those short talks are a good way to provide an overview of a large number of posters in a short amount of time, they do not alone replace the long explanations, reserved to an exclusive but also potentially random audience, that characterize poster sessions and that often translate into collaborations. To this aim, some conferences have successfully used map-based applications that mimic a physical space in a virtual environment (e.g., Gather [21] was used at Cosyne 2020). This provides a spatial familiarity to conference interactions. Because it is harder to stumble upon an interesting poster online, a well-designed abstract search system, as well as mechanisms to create and share curated lists, will bring a greater number of abstracts to the attention of potentially interested attendees. Similar to the aforementioned recommendations for talks (see section "Schedule purposefully"), a solution should be available to ask and answer questions about a poster asynchronously.

Provide multiple opportunities for audience engagement

Online conferences offer new opportunities for participant engagement. Proposing different channels with video, audio-only, or text-based methods [11] can reduce the barriers for asking a question, and designated volunteers can post on behalf of participants who would prefer to ask a question anonymously (e.g., in ABCD-ReproNim). Solutions are also available to let the audience vote for comments they like and steer the conversation towards topics of common interest. In addition, a live chat function also creates a sense of community as the audience can discuss the presentation, ask shorter clarifying questions, or post relevant literature to everyone. The chat also allows the speaker to receive feedback and applause from the audience, making a potentially impersonal online talk more rewarding and stimulat-

ing. Additionally, audience interaction solutions can be used to allow speakers to engage with their audience. At in-person conferences, longer discussions with the speaker are often held privately after the talk has ended. While this discourse often happens spontaneously at in-person conferences, in online conferences, the communication channel that will make this exchange possible has to be actively planned and implemented. More generally, the selected platform should offer the possibility to schedule impromptu meetings in a given location at a given time for follow-up discussions.

Moving from in-person meetings to virtual settings also offers exciting opportunities to advance beyond the traditional knowledge delivery format of the monologue lecture followed by a question session. Looking at non-academic consumption of information, it is apparent that attention may be better retained when switching between different speakers (as is used in the majority of news programs), or by using an interview format that mimics natural interaction even when it is not live (as is used in many podcasts), or through the use of video graphics (as is used in documentaries and instructional videos). We encourage online conference organizers to think creatively about the potential of these alternative modes of delivery.

Promote participant-to-participant interactions

A central aspect of in-person conferences is not only the talks and posters but also the unplanned encounters among attendees. These are especially important for early-career researchers, who may depend on these connections for collaboration and career opportunities. Online conferences will benefit from actively promoting opportunities for such encounters by providing planned social events and areas for attendees to mingle in between scheduled sessions.

A major challenge for online events is to motivate community members to socialize without access to typical in-person conference incentives such as food and in-person activities. Some conferences have used a gamified videoconferencing platform (see section "Design interactive poster sessions", e.g., ISMRM 2020 used Gather for their newbie reception) that allows spatially determined video interactions between attendees, as well as an array of engaging activities, game rooms, or an art gallery (e.g., the BIIM 2020 organized a scavenger hunt). Other platforms encourage users to interact by assigning points to activities such as posting on a message board, generating competition between participants to accrue points on a publicly visible leader board of engagement.

Beyond planned social activities, strategies for promoting online interaction and networking are an emerging topic; depending on the funds available one might also consider screening movies, having food or items delivered (best for small groups), and grouping or pairing individuals for meetings (NeuroMatch).

Embracing Co-creation and Open Leadership

Beyond increasing the representation of participants and speakers, inclusive online conferences need to provide opportunities for all to influence decisions about the conference and to join leadership.

Recruit volunteers and seek community input

Expanding on the idea of reaching out to attendees to help define the conference schedule (see section "Support the creation of flexible personal scheduling"), soliciting input of potential future participants is a great way to build a conference that meets the expectations of the community. Recruiting volunteers and proposing various ways of being involved, with roles requiring different levels and types of commitment, not only lowers the barrier to engagement but provides an active form of participation for new community members. Different roles may involve the same total time commitment but vary with regard to how the work needs to be scheduled, e.g., moderating a session for 2 hours straight versus spending 2 hours maintaining a conference website over the course of a week. It is important to advertise those roles early and often across multiple venues and provide comprehensive guidelines for volunteers and clear assignment of responsibilities. This may not only help relieve imposter syndrome for newly recruited volunteers, but it will give team members freedom and confidence to complete their tasks effectively.

Studies have shown that marginalized researchers are more likely to innovate in ways that might not be apparent to majoritarian reviewers and to cross disciplinary boundaries more or differently than their majoritarian peers [22]. Inclusivity should apply not only to the conference set-up but also to its content. This idea—termed epistemic inclusivity—calls for the inclusion of multiple lines of enquiries, broad perspectives, contradictory views, and even different scientific paradigms, such that a multiplicity of theories and hypotheses can be formulated and discussed instead of only the dominant ones.

Engage with underrepresented groups from the start

In the active process of allowing attendees to have more of a voice in all aspects of the conference (see section "Solicit and act upon feedback"), it is important to specifically seek out underrepresented voices. By definition, members of underrepresented groups will not be well represented in input provided by the community. Being intentional about seeking this input, listening, and including these perspectives is essential to successfully accommodate a diverse audience. As with traditional conferences, involving underrepresented groups in the formation of organizing committees, speaker selection, sharing of announcements, or the recruitment of volunteers promotes researchers in these groups implicitly into positions of authority. Ensuring that the organization promotes underrepresented researchers with work that is a part of routine responsibilities, rather than by heaping unpaid labour upon those who are already disadvantaged, will promote their sustained involvement. Members of the most underrepresented groups are often the most difficult to find and recruit for an event, and it is possible that when found they may have limited time because they are already serving as a representative of their group in other forums. When soliciting these groups, consider not only waiving attendance fees but also paying honoraria to speakers and organizers in exchange for their labour.

A number of groups were created in the past few years to highlight the diversity of our research community. In neurosciences those include Black in Neuro [23], The Women in Neuroscience Repo [24], Queer in Neuro [25], Latinx in Neuro [26], Disabled in STEM [27], and Innovators in Cognitive Neuroscience [28]. Involving these communities and following the resources that they have created is essential to benefit from their knowledge and diversify scientific spaces both in terms of the research that is highlighted and to improve scientific culture.

Create pathways to join leadership

Online conferences are in their infancy, and the scientific community has an opportunity to create new formats that will enable more diverse participation. Future online conferences will be more inclusive only if their leadership is more diverse and it is essential to create opportunities now in order to diversify leadership in the coming years. Developing contributor pathways to specify how people can progress from attending the conference into joining leadership roles can both provide transparency on how leadership roles can be reached and help identify barriers to a diverse leadership (see [29] for more open leadership practices).

Conclusions

Online conferences offer unique opportunities to promote a more diverse scientific community. Some international organizations have already announced that they are considering hybrid online and in-person conferences for the future, and the shift initiated in 2020 is likely to impact research communities durably. We offered recommendations to center inclusivity in the design of online conferences to purposefully encourage a diverse community to join, to actively participate in, and to lead online conferences. Online conferences are just in their infancy, and we expect many aspects to evolve and improve in the future as communities take ownership of this new format. We also believe that making conferences more inclusive should go hand in hand with addressing larger structural issues—such as systemic racism and sexism. As an example, the widespread practice of relying on unpaid labour to set up and run conferences is especially problematic, and we hope that in the future appropriate compensations can be designed for those who invest their time and energy in organizing scientific events alongside their other professional commitments. We believe that the global challenges we are facing during the COVID-19 pandemic, taken together with recent events in different countries with respect to marginalized groups, should be a wake-up call for the scientific community to work towards the advancement of more inclusive conferences. The suggestions provided here reflect our shared experience of building a conference to serve our community, as a group of research professionals with a commitment to improving inclusivity in our field. We acknowledge, however, that these concerns in many ways reflect the diversity of our own leadership, which is notably lacking in some aspects. Accordingly, we expect and hope that these suggestions are not an exhaustive account of practices necessary to build a fully accessible and inclusive conference but rather a mechanism to signpost and learn from the experiences of 2020, making space for event organizers to focus on further improvements for 2021 and beyond.

Data Availability

Not applicable.

Additional Files

Supplementary Figure 1: Comparison of the schedules of OSR 2020, OHBM 2020, and SIPS 2020. The light yellow background represents the schedule range for each conference, with darker yellow corresponding to parts of the schedule that may overlap with typical working hours, which often fall within the 8:00–18:00 range.

Abbreviations

NIH: National Institutes of Health; NIMH: National Institute of Mental Health; NSF: National Science Foundation; OHBM: Organization for Human Brain Mapping; OSR: Open Science Room; OSSIG: Open Science Special Interest Group; STEM: science, technology, engineering, and mathematics.

Disclaimer

The presented opinions are those solely of the authors and do not necessarily represent the opinions of the National Institutes of Health.

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E.L. and R.G. chaired the 2020 OHBM Brainhack, and C.G.v.P. and S.H. chaired the 2020 Open Science Room, the two online events that led to the writing of this review. Other members of the OHBM Open Science Special Interest Group (OSSIG) 2020 leadership were: C.M. (chair), E.D. (treasurer), A.E.V. (secretary), K.B. (secretary elect), A.N. (chair elect), T.G. (treasurer elect), K.W. (past chair), E.Dup (past secretary), G.K. (past treasurer). All authors contributed to the OHBM Brainhack 2020 and/or the OSR 2020 as volunteers and/or speakers and/or were members of the OHBM OSSIG 2021 leadership.

Authors' Contributions

Figures: M.M, G.N. R.G., S.H., F.V., C.M. Writing of the manuscript: C.M, E.L., C.G.v.P., R.G., S.H. with support from all authors who reviewed the manuscript and contributed original ideas. The definition of "epistemic inclusivity" was contributed by P.D.M.

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