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Conferences at a crossroads: networking, serendipity, and the cost of showing up

Cole A. DeForest  *^{abc}def

Scientific conferences remain one of the most effective mechanisms for driving multidisciplinary materials research forward, stemming not just from the podium talks delivered and posters presented but also through the informal, often accidental exchanges that happen around them. At the same time, the carbon cost, financial burden, and unequal accessibility of conference travel are serious enough that the field cannot keep treating the traditional in-person meeting as the primary way to build a research network. The community's task is not to choose between showing up or logging on, but to instead design conference formats deliberately around the mechanism that works: sustained, trust-building contact between people who likely otherwise would have never read each other's papers.

The unreasonable effectiveness of hallway conversations

Ask a materials scientist to name the collaboration that changed the direction of their career, and their story rarely begins with a literature search. It starts with a coffee queue, a poster session, a shared ride to the airport, or a chance seat at a conference dinner, a somewhat uncomfortable thing to admit in a field that prizes rigor. Materials science may be especially exposed to this pattern; the field sits at the intersection of chemistry, physics, biology, and engineering, and its most consequential advances often require synthetic expertise, device physics, and biological context to converge in a single program. None of those parent disciplines is organized to produce that convergence on its own, so it disproportionately happens in person, in the corridors and coffee breaks of conferences built around a shared problem rather than shared training.

A field experiment at a medical research symposium found that face-to-face encounters between scientists with only partial overlap in research interests produced measurably more co-authored work than those with too much or no overlap.¹ The peak productive zone sat in the middle, close enough for quick understanding yet far enough apart that the conversation

produced something neither had thought of alone. In many senses, this is the conference's most basic and important function, where the rate of productive cross-field contact is highest. Once networking is understood as one of a conference's most valuable, and least formally recognized, outputs, debates about cost, carbon, and who gets to attend morph instead into questions about how to protect and distribute such a valuable resource.

Two further studies point to conferences themselves, rather than to collaboration in general. An analysis of Gordon Research Conference attendance records found that temporary colocation at these meetings increased the formation of new collaborations, with junior researchers benefiting most.² A natural experiment offers a sharper test: when a hurricane forced the cancellation of a major annual meeting, researchers who had been scheduled to meet there went on to form fewer collaborations than would otherwise have been expected.³ The accidental encounter at the center of these findings cannot be scheduled. The conditions that make it more likely, however, can and should be thoughtfully designed.

Networks, not just talks, drive research forward

Conferences are usually justified to funding bodies and department chairs in terms of the research presentations: the plenary talks, the invited lectures, and the chance to share/hear the newest results before they appear in print. While important, that justification undersells a major part of what conferences deliver, namely the chance to grow one's network and drive scientific progress in unpredictable ways.

^a Department of Chemical Engineering, University of Washington, Seattle, WA 98195, USA. E-mail: profcole@uw.edu

^b Department of Bioengineering, University of Washington, Seattle, WA 98195, USA

^c Department of Chemistry, University of Washington, Seattle, WA 98195, USA

^d Institute of Stem Cell & Regenerative Medicine, University of Washington, Seattle, WA 98109, USA

^e Molecular Engineering & Sciences Institute, University of Washington, Seattle, WA 98195, USA

^f Institute for Protein Design, University of Washington, Seattle, WA 98195, USA

A 2016 editorial reflecting on more than a century of chemical engineering conferences concludes bluntly that the “major attraction is to listen and meet key leaders in the field and have a chance for networking”.⁴ The author traces the field from AIChE’s founding in 1908 through the postwar growth of international conferences and argues remote formats fail to reproduce this effect, since participants who dial in “feel left out of the discussions.” The same editorial flags mass conference travel’s contribution to greenhouse gas emissions, a full decade before more regular carbon accounting caught up with it.

That intuition is also consistent with the broader bibliometric literature on collaboration. An analysis of more than 166 000 collaboration records found that researchers’ careers are disproportionately shaped by a small number of unusually durable, high-trust partnerships termed “super ties”,⁵ associated with a roughly 17% increase in citations per paper relative to weak-tie collaborations. Super ties rarely stem from a single email exchange, instead requiring repeated, low-stakes contact over time. Seeing the same faces at the same meeting, year after year, is how a nodding acquaintance becomes a genuine collaborator.

The mechanism scales beyond individual friendships into the structure of entire fields. Career trajectory studies have found that the most-cited researchers are distinguished less by how much they publish than by how many different topics they bring collaborators into.⁶ Conferences, organized around topics and technological problems rather than institutions, are a natural venue for this kind of topic-spanning introduction. A departmental colloquium reinforces who a researcher already knows, while a well-attended international meeting introduces them to who they do not. These bibliometric studies do not isolate conferences as the cause of such ties, but they are consistent with the repeated, topic-centered contact that conferences provide.

Why crossing fields pays off

If networking is the mechanism, interdisciplinarity is often the payoff. A 2007 analysis of nearly 20 million papers and 2.1 million patents spanning five decades documented a steadily accelerating shift toward team-authored work.⁷ Not only do teams generally out-produce solo authors, they increasingly generate the exceptional, highly cited outliers that solo authorship used to dominate.

A follow-up analysis of nearly 18 million papers found that the highest-impact science pairs deeply conventional, well-established foundations with an atypical, cross-field combination of prior references.⁸ Purely novel combinations with no conventional anchor tend to underperform, and purely conventional papers with no atypical element tend to be safe but unremarkable. Finding that sweet spot takes knowing what a colleague across the country is working on, easier to stumble upon at a meeting than through a citation search. As with the network studies above, these analyses describe science as a whole rather than conferences in particular.

For materials science, this is close to a description of how the field advances. A synthetic chemist’s ligand design meets a device physicist’s transport problem meets a biologist’s assay, and the resulting solution belongs fully to none of the parent disciplines. Materials research has other features that raise the stakes. Advances often require synthesis, characterization, computation, and application-specific expertise that rarely sit in a single laboratory, and the community spans academia, industry, national laboratories, and user facilities. Departmental seminars are usually mono-disciplinary by design, and journals sort submissions along disciplinary lines, so a chemist browsing a chemistry journal is unlikely to encounter the physics paper that would have changed their next experiment. Conferences, and specifically the unscheduled time built around their formal program, remain one of the few structures organized to put a polymer chemist and a cell biologist in the same room for long enough for the highest-impact, field-crossing science to be made.

Training researchers to make the connection

If conference-based networking is so consequential, it is reasonable to ask whether that skill is explicitly taught. The honest answer is barely, and only recently. This matters as much as an equity issue as a pedagogical gap: a skill that is assumed rather than taught quietly rewards students who arrive already possessing it, typically because of academic/family background or prior institutional exposure, while penalizing everyone else.

A survey of undergraduate research students presenting at *American Chemical Society* national meetings found that conference participation functioned as a rite of passage into the scientific community, shaping students’ sense of themselves as researchers in ways laboratory work alone did not.⁹ A more recent evaluation of an informal, multidisciplinary chemistry research program for pre-college students found measurable gains not only in research competencies but specifically in attitudes toward working across fields,¹⁰ suggesting comfort with interdisciplinarity is trainable rather than a fixed trait.

Engineering education has begun to treat this explicitly as a curricular gap. A workshop reported in *Chemical Engineering Education* laid out best practices for engaging undergraduates in faculty research. Structured exposure to research and conference culture pays measurable dividends for students and faculty alike, and those who wait for students to seek it out on their own train a narrower group of future researchers.¹¹ A decade-long case study of one such intervention, a University of Washington seminar series I have helped oversee, documents how these skills develop through deliberate training rather than informal exposure.¹²

Students who arrive at their first conference already knowing how to work a room are not, on the whole, the ones with more raw talent; they are the ones with more resources, more travel funding, and/or more mentors who modeled the behavior. A field that wants networking’s benefits distributed on the

basis of merit rather than privilege must find ways to teach the skill, not assume it.

The case against business as usual

Though conferences are certainly valuable, I am by no means suggesting that researchers should fly to every conference, every year, indefinitely. The counterevidence has become too well quantified to wave away, clustering around distinct problems of carbon, cost, and access.

With high carbon costs associated with jet-setting across the globe for a short meeting, the environmental accounting for conferences is certainly uncomfortable. A life-cycle assessment comparing differently formatted conferences found that virtual meetings reduce environmental impact by two-to-three orders of magnitude relative to those held in-person.^{13,14} Well-designed hybrid formats, particularly those built around regional hubs, recover a substantial share of the same savings, where the overall travel footprint and attendance costs are substantially reduced.

The access argument strikes at the claim that conferences are meritocratic, open equally to anyone with something worth presenting. When a major international conference converted to a virtual format, a controlled before/after comparison found participation improved sharply across cost, gender, career stage, and geographic barriers.¹⁵ While virtual conferences provide measurably more equitable access, they are substantially weaker on the networking aspects that conferences are largely for.

Reflecting on the abrupt shift to virtual meetings during the 2020 COVID-19 pandemic, one widely cited PNAS opinion piece argued that the disruption to conference travel and visibility disproportionately harmed women's careers,¹⁶ in part through lost scholarly visibility. A 2024 Q&A with early-career materials scientists following a 'Rising Stars' workshop at the Henry Royce Institute made a related point, framing visibility, mentorship, and professional networks as career resources that researchers from underrepresented groups need deliberate support to access, rather than something automatic for anyone talented enough to deserve it.¹⁷ These barriers rarely operate one at a time and are common among academics. Caregiving responsibilities, an unpredictable visa process, a chronic illness, and a limited travel budget compound into a structural disadvantage that accumulates over a career. A conference model that assumes an unencumbered attendee is one that distributes its benefits unevenly by design.

One of the most rigorous comparisons of conference modalities to date, drawing on more than 12 000 potential collaborator pairs across five virtual and four in-person meetings, found that structured interactions produced new collaborations at least as effectively online as in person.¹⁸ It was the informal channel that suffered in virtual settings, playing a significantly larger role in connecting scientists at in-person meetings. Controlled experiments suggest one reason why. Pairs working over videoconference generated fewer creative

ideas than those working in person, an effect attributed to the narrowed visual focus imposed by the screen,¹⁹ and sustained video interaction carries a cognitive load of its own.²⁰ Informal conversations, which depend most on attention to the other person and to shared surroundings, are the first to suffer. Our task is not to return to the old normal, but to design deliberately for a "better normal" that keeps what virtual formats do well without abandoning the value of shared physical space.²¹

Designing for the mechanism that works

The evidence for conferences' value points at informal, high-trust, cross-disciplinary contact repeated over time; the evidence against business-as-usual conferencing points at the cost, both in carbon and access, of manufacturing that contact through mass, in-person travel as the only route to it. Our goal is not to simply choose between the two, but instead thoughtfully reimagine conference formats around the mechanism that matters while discarding the parts of the traditional format that never did much work. Put differently, the aim is not to schedule serendipity but to raise its odds.

Decentralized, regionally hubbed hybrid formats can recover much of the environmental savings of virtual meetings while preserving informal contact within each hub. These hubs should complement national and international meetings rather than replace them. In a tiered model, regional hubs share a common program and are anchored by periodic flagship in-person meetings, so researchers keep the chance to meet a future collaborator from another region; virtual introductions across hubs can provide a first point of contact that later becomes an in-person conversation at the flagship meeting. Since conference participation weighs heavily in funding reports and promotion decisions, such a model is only viable if funders, professional societies, and promotion committees credit hub-based presentations on par with those given at the flagship meeting. Structured but lightweight matchmaking could be explicitly built into hybrid programming. Funding bodies and academic institutions could treat networking as a trainable competency worth resourcing, and professional societies converting meetings to hybrid formats should track the scientific products that follow, not just attendance and access. Asking attendees to complete surveys for years afterward would be burdensome, and lighter options exist. Authors could acknowledge the meeting where a collaboration began, much as they acknowledge funding, and societies could link attendee lists to later co-authorship records.

Each of these recommendations carries longer-term trade-offs, and the most important concerns serendipity. Chance encounters become more likely with single-track programs that keep attendees in the same space, mixed seating at shared meals, coffee placed alongside poster sessions, and long blocks of unstructured time. Matchmaking works best when it seeds a first conversation; built too heavily into the program, it risks crowding out the unplanned encounters it is meant to support.

None of these measures is meant to replace the in-person meeting. The goal is to keep what works about it while widening who benefits.

A conference designed from first principles around human connection would go further still. Formal talks would be shorter and potentially posted in advance, freeing most of the schedule for interaction. Attendees would be placed in small, cross-disciplinary cohorts organized around a shared open problem; these cohorts would meet repeatedly during the conference and, ideally, reconvene in later years to build the durable super ties discussed above. Invited speakers would present the unsolved problems in their area rather than finished results, giving attendees from adjacent fields a natural way in. Success would be judged by the new connections formed rather than by attendance.

Materials science offers a particular opportunity here. The field's largest meetings are already split into many parallel, topically distinct symposia, so two researchers with overlapping interests can attend the same conference without ever crossing paths. Problem-focused sessions and shared social spaces that draw attendees from several symposia around a common application, such as energy storage or regenerative medicine, would let a large multi-symposium meeting work as more than a set of separate conferences held under one roof.

The Gordon Research Conference (GRC) model already reflects many of these suggestions, with opportunity fellowships available for first-time attendees, a new structured mentor program, and shared meals and unstructured afternoons to specifically promote informal networking. Its effectiveness rests on a handful of structural features: small size, a single track of invited talks, a narrow topical focus, deliberate mixing of senior and junior researchers, a norm of presenting unpublished results, and built-in unstructured time. Having attended many such meetings and recently co-chaired the 2026 GRC on Bioinspired Materials, I can attest that these deliberate structural choices have helped advance many fields. Large conferences can borrow many of these features for their specialized symposia, for instance through a panel in which a session's invited speakers take audience questions on where the field is really going and what it needs to make progress. One emerging threat deserves mention: research-security and export-control concerns increasingly affect what unpublished work researchers are willing to present. Organizers and host institutions will need to provide clear guidance so that uncertainty does not lead researchers to withhold unpublished results altogether.

Many of my closest professional acquaintances are those whom I have serendipitously met at conferences over the past ~20 years. These folks have served as collaborators that help drive new research directions for our team, peers that can relate all-too-well to the challenges of securing research funding, mentors that have given invaluable career advice, and supporters that have generously written recommendation letters for my own promotion and tenure. These are the people I look forward to catching up with most whenever work takes me away from home.

As one final example highlighting how unstructured conference interactions can lead one into new scientific directions,

I note that this Opinion article began with an unplanned conversation with an RSC editor during a free afternoon at a recent GRC. Multidisciplinary materials research owes an unusually large debt to the accidental hallway conversation. Few fields depend as heavily on chemists, physicists, biologists, and engineers finding one another, which makes materials science a natural testing ground for conferences designed around that encounter. Our task now is not to protect that conversation by insisting everyone keep flying, nor to abandon it in the name of a lighter footprint. Instead, it is to deliberately build conferences that raise the odds of that conversation for a wider set of researchers and at a cost the field can still justify a decade from now.

Conflicts of interest

There are no conflicts to declare.

Data availability

No primary research results, software or code have been included and no new data were generated or analyzed as part of this opinion article.

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