The uneven impact of venues on creative careers

Yixuan Liu[1], Rodrigo Dorantes-Gilardi[1], Larry Han[2], and Albert-László Barabási[1,3,4,*]

[1]Network Science Institute, Northeastern University, Boston, USA
[2]Department of Public Health and Health Sciences, Northeastern University, Boston, USA
[3]Department of Data and Network Science, Central Eastern University, Hungary
[4]Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, USA
[*]barabasi@gmail.com

Abstract

Decades of research on status hierarchy have documented that career opportunities and recognition in creative fields are enhanced by access to top venues, like publishing in top journals for scientists or invitations to top biennials for artists. Yet, little is known about how selective access to these venues reinforces discriminative gender, career stage, and geography-based differences already in place. Here, we reconstruct the careers of all publishing scientists in physics, chemistry, biology, and sociology, along with the careers of visual and performing artists, offering an opportunity to examine the inherent biases of the venue effect. We begin by documenting a statistically significant venue-mediated effect in both sciences and art, finding that it represents a recent phenomenon and that its benefits are unevenly distributed. Further, we show that while the venue effect in science reinforces existing inequalities related to gender and career stage dynamics, in both visual and performing art it acts to mitigate these effects. We also find that prominent venues primarily benefit creative individuals from regions with a strong tradition in science or art, whereas the benefits for creators from less developed regions are often limited and not always sustainable. These results highlight that while venue access can amplify existing disparities, it also has the potential to lower barriers and provide opportunities for some underrepresented groups.

Introduction

Prominent venues provide creators with platforms to communicate and display their work, acting as unofficial authorities that enhance perceived status [1], [2], [3]. Indeed, the community's acceptance and recognition of intellectual and creative achievements frequently stem from endorsements by high-status institutions, individuals, venues, or prizes [1], [4], [5], [6], [7], resulting in well-documented status hierarchies [8], [9], [10], [11] that influence the perceived quality of individuals' future work [12], [13], [14] and can yield positive career impact [5], [15], [16], [17].

This "venue effect", first postulated by Robert Merton in 1968 within the context of science [1], has since been documented across various fields. For example, journal prestige continues to boost article-level citation performance that, which then propagates to enhance scientists' citations [18], [19], [20], similar to the impact of presenting at a top conference [21], being awarded a prestigious prize [7], or securing a prestigious institutional appointment [22], [23]. In the visual arts, invitations to prestigious biennials, such as Documenta or the Venice Biennial, can lead to new exhibiting opportunities and enhanced market value for visual artists [24], [25].

Yet, the nature of self-reinforcing status hierarchies, amplified by the venue effect, may serve to entrench unbalanced structures that benefit only those with access, perpetuating inequality. This raises the question of who truly benefits from the venue effect [20], [21], [22], [24]. In other words, is the documented impact purely linked to the prestige of the venue, thus benefiting all admitted participants equally, or is the venue effect modulated by the social and demographic characteristics of the participants? If so, to what extent does the venue effect contribute to systemic biases?

Barriers to addressing these important questions have traditionally been rooted in both data-driven and methodological challenges. One major challenge has been the difficulty of gathering sufficient treatment and appropriate control data to offer statistically significant evidence of the venue effect itself. Consequently, the depth of data required to disaggregate the cohort and their outcomes, necessary to explore the implications of the venue effect for access and equity, has historically been out of reach.

Here, we address these gaps by leveraging recent advances in data curation and aggregation that offer the publication history of published scientists, focusing on physics, chemistry, biology, and sociology; and detailed career histories for cultural workers, including contemporary artists in visual arts, and actors/actresses in performing arts [2], [26], [27], along with their time-resolved venue access and multiple measures that allow us to track downstream career outcomes. We also leverage recent methodological advances, like heterogeneous difference-in-differences analysis, which can accommodate different treatment cohorts and time periods [28]. This integrated framework allows us to examine how two distinct systems of prestige gatekeeping, one through peer-reviewing and the other relying on curatorial processes, relate to career success. We begin by confirming a positive and long-lasting venue effect in both science and the arts, along with statistical evidence of its spillover effects. These approaches further suggest that the career-based venue effect is a relatively new phenomenon that became a prominent force in both science and art after the 1990s. Most importantly, we find that the measurable benefits of venue access are neither universal nor equitable, but that its effect is modulated by the career stage, gender, and geographic location of the individuals, following patterns that reflect, or in some cases mitigate, specific discriminative forces present in both science and art. Finally, we discuss both the methodological and data limitations of our study and the steps taken to mitigate these challenges.

Data collection and methods

The venue effect is partially driven by uncertainty about our ability to assess quality, leading us to rely on social cues to resolve this uncertainty. This prompts us to explore the venue effect in two systems with different methods of quality assessment: science and arts. In the sciences, we test the hypothesis that access to high-impact publication venues influences scientists' future career development [15], [29], [30]. To do so, we first focused on physics, a discipline with a long publication history [26], [31], [32], assembling the full publication list of 3.4 million physicists from the Dimensions database [33] (SI 1), including their citations, number of publications as productivity, grants, and affiliations. We then focused on the three scientific journals previously identified as leading the physics publishing hierarchy (Science Venues SV1, SV2, and SV3) [3]. For control purposes, we also explore the impact of publishing in the disciplinary venue (SV4) that for decades was the top publication choice for physicists and in three lower-impact but high-volume professional journals with decades-long publication history (SV5-7). We then replicated our main finding in additional disciplines chosen for their intellectual diversity, including social science, biology and chemistry (SI 5.5), and in a leading computer science conference (SI 5.4).

In the arts, we test the hypothesis that invitations to prestigious biennials impact the career of the participating artists. To explore the role of venues in visual art, we compiled the exhibition history of over 1 million visual artists, extracting their nationality, birth/death details, associated artistic movements, exhibitions, biennials, and art fairs, along with their time and location (Figure SI 1). We further extracted historical transaction details related to each artist's work, including transaction dates, sale prices, geographical locations, titles, and auction houses. To quantify the venue effect, we focused on the top two art biennials (art venues AV1 and AV2). For control purposes, we also examined the effect of five lower-impact biennials (AV3-8). In the performing arts, we analyzed the career impact of four globally recognized movie and television prizes (Oscars, Emmys, Golden Globes, BAFTAs) [34]. For a list of science and art venues and related information, see SI 1, SI 5.8 and Tables SI 1, SI 3, SI 2, SI 4 and SI 5.

Methodologically, in each study we start by identifying three groups of individuals: the treated group and two control groups (the never-treated group and the not-yet-treated group, Figure 1 a). Here, we primarily focus on the mixture of never-treated individuals as the control group, given the adequate sizes of data, while comparable results that only include the not-yet-treated group are discussed in SI Section 5.6. We applied a dynamic matching methodology to ensure covariate balance between venue participants (treatment group) with a group of similar peers based on their career trajectories before venue participation (control group, SI 3). We assessed the distribution of multiple attributes, including age, career trajectory, publication history, citations and grants (for scientists); and exhibition and art-market performance (for artists, see Figure SI 12 b), for both treated and control groups (Figure 1 b, Figure SI 12 b).

To quantify the effect of venue participation on the career trajectory of the treatment group, we implemented a heterogeneous difference-in-differences (DiD) framework. We accounted for treatment heterogeneity by estimating treatment effects across different groups (defined by the period when units were first treated) and time (current time) to analyze the impact of exposure [28] (SI 4). We controlled for observable characteristics including citations, productivity, funding, gender, career stage, regional affiliation, and considered the Average Treatment Effect on the Treated (ATT) as the estimand of interest, capturing statistical evidence robust to confounders and consistent with a treatment-like effect. This allowed us to quantify the extent to which access to a specific venue relates to the future performance of those who were exposed to that venue (Figure 1 c,d,e). The ATT represents the difference between the average outcome that would be observed if all individuals in the target population (i.e., those who received the treatment) were treated, versus the average outcome those same individuals would have experienced had they not received the treatment. Treatment here refers to obtaining access to a specific venue, and the outcome is the subsequent career performance. For each individual, we consider only their first entry into a top venue as the treatment event. The ATT thus captures how much, on average, being exposed to the venue compare to the future performance of those who actually participate. Finally, in each case we report confidence intervals to indicate the precision of the ATT estimate and to help assess its statistical significance.

The heterogeneous difference-in-differences approach for assessing group-time effects can identify causal effects under specific assumptions, most notably, the absence of unmeasured confounders and the validity of parallel trends [28]. However, venue access is not random—it is affected by factors such as research quality and personal traits, which are often latent and difficult to measure, potentially biasing observed differences between treated and control groups. While these conditions are difficult to verify in observational data, making our estimates not causal in nature, we have implemented multiple robustness checks to estimate the magnitude of the venue effect against unmeasured confounders (SI 4.5). Our design, tested for sensitivity [35], provides evidence of a substantive effect associated with venue access.

To control for potential confounders, we implement two complementary strategies. First, we employ a heterogeneous difference-in-differences design using a not-yet-treated group as the control (Figure SI 31). This group offers a more refined counterfactual because its members eventually receive the same exposure, only differing in the time of exposure. While timing may still reflect elements of luck or opportunity, this approach reduces systematic differences unrelated to venue access and provides a tighter comparison.

Second, we isolate the venue effect from quality-related pathways by examining citation gains to pre-venue publications, focusing on the authors' research published prior to their first top venue publication (SI 5.2). This strategy, which follows prior work providing evidence on status dynamics [22], offers a crucial advantage: the quality of pre-venue publications cannot be influenced by the quality associated with the venue itself. This design feature allows us to rule out quality-related pathways when estimating the venue effect (Figure SI 17), therefore providing a conservative measure for the spillover effects of venue access on citations.

Access to top venues has long-lasting impact

We find that scientists publishing in top-tier journals in physics experience a substantial boost in future citations excluding the focal paper (10-year ATT: SV1 841, SV2 1287 SV3 1098). This finding aggregates across the various treatment cohorts to illustrate the dynamics of access to prestigious venues (Section SI 4.2, Figure 1d). Specifically, career trajectories of those who published in top-tier journals demonstrate super-linear citation growth compared to peers of similar impact and career length who did not publish in top-tier journals (Figures 2a and SI 16a,d; Table SI 9). Importantly, when we examine pre-venue citations (Figure 2a), which offer a conservative partial estimate of total career citation growth and help isolate the quality effect of the focal paper, we observe the same statistically significant pattern (Figure SI 17, SI 5.2). These results hold when citations are normalized by year and publication field (SI 5.11). The observed venue effect is particularly pronounced for the first and last authors, for whom we observe a greater long-term citation benefit from access to top venues than the (often numerous) middle authors (Figure 2d,e,f). For example, relative to middle authors, first authors show notable effect sizes, with differences of 215.74 and 635.94 at 5 and 10 years post-exposure in SV1, with respective z-scores of 2.251 ($p = 0.024$) and 2.883 ($p = 0.004$). We obtain similar effect in SV2 of 1.531 ($p = 0.126$) and 2.785 ($p = 0.005$) at 5 and 10 years. Last authors also benefit significantly, with differences of 549.82 and 1244.52 at 5 and 10 years in SV3, with respective z-scores of 2.097 ($p = 0.036$) and 2.186 ($p = 0.029$) (Table SI 12). These effects extend beyond physics: we find that researchers publishing in top venues in biology, chemistry, sociology, and computer science also experience significant increases in future citations (SI 5.5, SI 5.4).

We also found a significant increase in productivity over a decade following a top-tier publication, compared to a matched control group (10-year ATT: SV1 42, SV2 50, SV3 27, Figures 2b and SI 16b,e). As Merton posited, status not only influences perceptions of quality, but also attracts tangible resources (grants, collaborations, etc) that enhance future productivity [1], [7]. Indeed, we find that funding shows a positive venue effect: scientists who published in top journals received, on average, one to two additional grants over 10 years compared to controls (10-year ATT: SV1 2.37, SV2 1.89, SV3 3.62, Figures 2c and SI 16c,f).

To quantify the venue effect in art, we considered the number of solo and group exhibitions as measures of an artist's visibility and acceptance within the art community. Additionally, we included participation in art fairs, which are primarily geared toward sales to collectors, offering a measure of their market access and performance. Importantly, these three measures are complementary: some artists have well-established solo or group exhibition histories without notable market activity, while others attract high collector demand despite having limited access to established art institutions [36].

We find that artists in the visual arts invited to art venues AV1 and AV2 experience a statistically significant increase in both solo and group exhibitions following their participation. Specifically, the estimated 10-year ATT is 1.12 solo exhibitions and 5.51 group exhibitions, respectively (Figure 2g,h for AV1, Figure SI 16g,h,i for AV2), indicating that these venues accelerate artists' careers by opening new exhibition opportunities. Participation in AV1 and AV2 can also boost commercial opportunities, enhancing the artists' ability to produce more art. We capture this by measuring art fair participation, which also increases after participation in AV1 and AV2. Notably, significant gains in market access only appear after eight years (Figure 2i), supporting previous observations that many artists first need to secure sustained institutional support via solo and group exhibitions at museums and other nonprofit venues before attracting the attention of collectors [36]. Importantly, these patterns extend to performing arts, finding that both actors and actresses benefit from winning top film and television prizes compared to pool of nominated performers, resulting in significant increases in both the number of leading roles and future nominations (SI 5.8).

Overall, Figure 2 confirms that both scientists and artists benefit from status shocks linked to access to prominent venues. Our findings provide large-scale, statistically significant effects supporting pre-existing evidence on the important role of venues in creative domains [21], [22], [24]. The strength of this effect allows us to next examine the selective impact of the venue effect.

The venue effect is a recent phenomenon

The digitalization of scientific publishing has fundamentally changed access to publication opportunities, leading to the rapid introduction of new journals that range from high- to low-prestige alternatives to long-established venues. For example, the number of physics journals increased from 38 in 1950 to 903 by 2021 (Figure SI 1a). A similar trend can be observed in the art world: the development of a professional gallery system in the 1990s and the proliferation of art fairs after 2000 were accompanied by a surge in the number of biennials, increasing from 29 in 2000 to 117 in 2021 (Figure SI 1b). The exceptional proliferation of venues, combined with the heightened awareness of prestige hierarchies, could have resulted in corrective effects that diminished the magnitude of the venue effect. To investigate this possibility, we assessed the impact of venues over time by aggregating post-treatment effects across different treatment cohorts using a heterogeneous difference-in-differences approach [28] (Figure 1e).

Our analysis reveals that the measurable impact of participating in high-impact venues has shifted substantially over the years (Figure 3, Table SI 11), yet not in the direction we anticipated. Specifically, the data indicates that despite fewer choices, the career impact of publishing in the most prestigious cross-disciplinary venues (SV1-SV3) was minimal before 1980. However, after 1990, the citation boost from publishing in these high-prestige venues became markedly significant: while in 1980, authors working in physics publishing in SV1 received relatively few additional citations compared to the control group (resulting in an insignificant ATT), the effect swiftly increased to 142 citations by 1990, 316 in 2000 and 590 in 2010, trends that hold for SV2 and SV3 as well (Figure 3a). A similar temporal pattern emerges in biology, chemistry and sociology, where the venue effect becomes statistically significant only after 1980s for biology, 1990s for chemistry and after 2000s for sociology (SI 5.5, Figure SI 24, Figure SI 26). This effect is an aggregation over all possible exposure periods to show the variation of different treatment cohorts as in SI 4.2 (Figure 1 e). We find similar temporal patterns for productivity: while publishing in SV1 and SV2 was followed by only a small increase in productivity since the 1960s, the effect size markedly increased and gained clear statistical significance only after the 1990s (Figure 3b).

In the arts, we find the venue effect to be virtually nonexistent for AV1, the largest and arguably most prestigious biennial [24]. Interestingly, for artists of visual arts, this effect first appeared with the 1951 founding of AV3, the second-oldest biennial (Table SI 5). However, substantial growth in future exhibitions for participants in AV1 and AV2 only became evident after the 1990s (Figure 3 c,d). For example, artists who participated in the 1970s editions of AV1 had no more subsequent solo and group exhibitions than non-participants. By 1990, however, a pattern had emerged, and we observe a difference of 1.37 solo (and 5.57 group) exhibitions, increasing to 1.60 (and 9.27) in 1999, and by 2006 featured artists in AV1 had 2.60 more solo exhibitions and 15.96 more group exhibitions than their matched peers (Figure 3 c,d). We observe a similar temporal pattern in performing arts: historic prizes such as the Oscars reveal a pronounced post-award increase in future nominations only after the 1990s, although statistical significance remains limited due to the small number of nominees (SI 5.8, Figure SI 36).

In summary, we find that a strong and quantifiable venue effect is a relatively recent phenomenon: both the career impact of publishing in top cross-disciplinary journals and the influence of prestigious art venues only emerged prominently beginning in the 1990s. Contrary to expectations, the rapid proliferation of high and low-prestige opportunities, which also began in the 1990s, rather than diminishing, reinforced the role of a select few high-prestige venues.

Gender disparities widen in science and narrow in art

Gender disparities are well documented in science, including imbalances in participation [27], citation impact [37], and career awards [38]. In parallel, in art, women have been historically underrepresented in exhibitions and the auction market [39], [40]. The prevalence of these disparities raises the question of whether men and women benefit equally from access to prominent venues, or if such venues further reinforce existing gender imbalances. To address this, we inferred the gender of 3 million authors and 1 million artists using a binary classification approach established in prior research [27]. We quantified the impact for each gender subgroup separately by comparing participants from each gender with matched peers who did not have access to the high-impact venues. These analyses allow us to examine how institutional gatekeeping and recognition systems shape disparities by gender across science and art.

We find that women and men experience different long-term citation growth after publishing in SV1 (Figure 4a,b). For women, the effect results in 339 additional citations ten years after publication, and while the growth trend is clear, it never reaches statistical significance. In contrast, for male scientists, the impact of publishing in SV1 yields twice as many citations (877) after ten years compared to matched male controls, reaching statistical significance within five years after publication, with a 1-year z-score of 2.102 ($p = 0.034$) and a 5-year z-score of 2.073 ($p = 0.038$) (Table SI 17). As before, neither men nor women showed significant gains from a venue effect before the 1990s (Figure 4c). Across other scientific fields, like biology, chemistry, and sociology, we observe the same pattern of men consistently exhibiting larger venue-related gains than women (SI 5.5, Figure SI 28).

In the arts, both women and men visual artists benefit from participation in high-impact venues such as AV1 (Figure 4d,e). Although we observe statistical significance for both groups, the effect size differs notably between genders. For women artists, exhibiting in AV1 leads to an increase of 1.24 solo exhibitions within ten years (5-year ATT: 1.24; 10-year ATT: 2.17), compared to only 0.42 additional solo exhibitions for their male counterparts (1-year ATT: 5-year ATT: 0.42; 10-year ATT: 0.77), with a 1-year difference of 0.38, z-score of -2.417 ($p = 0.016$); and a 5-year difference of 1.41, z-score of -1.943 ($p = 0.052$), indicating a significantly stronger impact for women (Table SI 18). Notably, although women constitute only 16% of all biennale artists

(SI 2), they experience approximately twice the growth in solo exhibitions following participation in high-prestige venues. A similar advantage for women is observed in the performing arts (SI 5.8). For biennials, the signal for women becomes persistent only after 1995 (Figure 4f), a time frame that coincides with the invitation of women to important curatorial roles [41].

Taken together, the venue effect manifests differently in science and art: in science, it reinforces gender inequalities, with a strong and statistically significant ATT primarily for men. Admission to venues in science often depends on blind peer review and formalized scientific standards, embedded in a cumulative, citation-driven reward system [1], [22], [42]. By contrast, in art, high-impact venues demonstrate the opposite trend by reducing gender disparities and offering markedly stronger benefits for women artists. This difference may be rooted in the fact that the selection process for elite exhibitions is curator-mediated or academic-driven and socially embedded [43], [44]. Such processes are often oriented toward redistributive recognition, such as the 59th Venice Biennale in 2022, where nine out of ten artists in the central exhibition were women [45]. Indeed, this finding is striking in light of the long-standing historical imbalance favoring men across the art world, from exhibitions and permanent collections [46], [47], to sales values [39], [40], and historical participation in biennials [48].

The venue effect is modulated by career stage

Early career awards, as well as grants, collaborations, and affiliations, have a well-documented positive impact on the future careers of early career scientists [14], [15], [20], [49], [50]. Additionally, senior scientists tend to receive more citations, a manifestation of the Matthew effect [51]. These disparities across career stages suggest that the venue effect may not be uniform over a scientist's career. To test this hypothesis, we partitioned each scientist's career into three intervals: early (the first ten years after their first publication), mid (10–30 years), and late career (more than 30 years), and measured the venue effect in each career stage.

We find a strong and statistically significant venue effect in all career stages (Figure 5a–f), yet with clear differences in magnitude: the effect on both productivity and citations is the largest for late-career scientists (5-year ATT on productivity of 34 and a 10-year ATT of 61, Figure 5a–c; 5-year ATT on citations of 400 and a 10-year ATT of 1139). Where, the citation ATT for early and mid-career scientists are largely indistinguishable (10-year difference: 167.73, z-score 0.912, p-value 0.362), we observe a slight increase with seniority in both productivity (10-year difference: 27.79, z-score 4.166, p-value < 0.001 for early-career; 10-year difference: 18.74, z-score 2.706, p-value 0.007 for mid-career scientists) and citations (10-year difference: 653.06, z-score 2.038, p-value 0.042 for early-career; 10-year difference: 485.33, z-score 1.416, p-value 0.157 for mid-career scientists). Comparative results in Figure 5d–f, Table SI 13, Table SI 14). We find a similar late-career benefit from top-venue exposure in biology, chemistry, and sociology (Figure SI 29).

The trends are different in art: early-career artists experience the largest and the most significant gains in solo exhibitions–0.99 at five years and 1.45 at ten years (Figure 5g, Table SI 15). While early and mid-career artists show comparable growth in future group exhibitions (Figure 5j,k, Table SI 16), for late-career artists the increases never reach statistical significance (Figure 5i,l). We find a similar career stage-modulated pattern in film and the performing arts, where awards offer a strong boost in visibility and future nominations for early-career performers and actresses (SI 5.8). At the same time, late-career artists face diminishing returns, suggesting that art-world gatekeepers prioritize novelty and future potential, offering fewer follow-on opportunities to artists with extensive portfolios [52].

In summary, while we document a strong venue effect across all career stages in science, the data reveals the Matthew effect in action [1], reinforcing previous inequalities: prominent venues amplify the productivity and the citation impact for senior scientists, the most productive and frequently cited cohort [51]. Conversely, in the art world, the venue effect helps introduce new talent by facilitating new solo and group exhibition opportunities for both early- and mid-career artists. These results again document the uneven benefits conferred by elite venues across career stages, which diverge across domains and reflect distinct gatekeeping logics in art and science. In science, cumulative advantage is reinforced through standardized peer review and established scientific standards, which tend to favor late-career researchers who are already well-established; in art, by contrast, curatorial selection enables more active redistribution of visibility and opportunities toward emerging or underrepresented groups [25], [43], [44]. Recent edition of the Venice Biennale underscores this point: the 2024 edition featured artists prominently from the Global South and early-career [53], revealing a deliberate curatorial effort to counter historical imbalances in artist representation.

Venue effect amplifies regional inequalities

The marginal returns hypothesis suggests that scientists and artists from less privileged regions may benefit more from venue effects than those with well-established reputations embedded in the global knowledge network [54]. To test this hypothesis, we classified each scientist by continent using their research affiliation at the time of publication. To control for the false discovery rate during multiple hypothesis testing, we applied the Benjamini-Hochberg (BH) procedure (see SI 5.12). We find that the venue provides consistent and statistically significant benefits to scientists from continents with a robust scientific infrastructure, such as Europe, North America, and Asia (Figure 6a-d for citations, and Figure 6f-i for productivity). This pattern extends beyond physics: regional advantages remain pronounced in biology and chemistry, where researchers from Europe, North America, and Asia continue to experience the largest gains (Figure SI 30a–j). The only exception is in sociology, where researchers from Asia no longer exhibit a significant post-venue boost relative to their European and North American counterparts (Figure SI 30k–o). Consistent with the marginal returns hypothesis, we observe the largest effect size among South American scientists (Figure 6d), particularly in productivity (Table SI 20). The productivity and citation impact for African scientists remains statistically insignificant, and we even observe a slight decline (Figure 6e) or saturation (Figure 6j) after 5 years of exposure (Figure SI 41j, Figure SI 44).

The impact of art venues shows similar differentiation (Figure 6k–t): we find a small but consistent boost in group and solo exhibitions for artists from Europe and North America, the most represented cohorts. Recent efforts by leading art institutions to promote inclusivity have resulted in increased recognition of artists from previously underrepresented regions such as Asia, Africa, and South America, prompting us to test the role of marginal returns in the art context (Table SI 22, Table SI 21). We find that Asian artists, newcomers to international biennials, participating predominantly post-2000, derive the greatest and most consistent benefits from participation in AV1 (10-year ATT for Asia: 3.51, Figure 6i, 10-year difference with Europe: 2.81, z-score: 2.334, p-value: 0.020; and with North America: 2.46, z-score: 1.915, p-value: 0.056). Similarly, artists from South America show notable growth in subsequent group exhibitions following participation in AV1, though the effect barely reaches statistical significance and growth in solo exhibitions plateaus after several years. Consistent with our findings for scientists, we find no statistical significance for African artists, mirroring the saturation pattern seen for African scientists (Figure 6o,t).

In conclusion, our results highlight the discriminative tendencies of the venue effect: we find persistent and statistically significant effects favoring regions with established legacies in science and art, while, in line with the marginal returns hypothesis, these effects are particularly pronounced in Asia and South America. Paradoxically, the benefits remain limited and tend to saturate in Africa. This suggests that while African scientists and artists possess the talent necessary to reach top venues, they may lack the institutional support needed to reap the benefits of access. This lack of sustained support is evidenced by a declining trend in future publications (Figure 6e), as well as unique co-authors (Figure SI 44e) after five years, in contrast with the continuous increase in both metrics for scientists from other continents.

Conclusions and Discussions

Our ability to reconstruct the careers of most scientists and visual artists offers an unprecedented opportunity to explore the role of venues in creative careers at a scale and accuracy that was previously unattainable. Our results confirm that high-impact venues can exert a persistent positive impact on career trajectories, enhancing visibility, facilitating future opportunities, and shaping the careers of creative individuals by acting as catalysts for visibility and success. Crucially, the depth of the available data enables exploration of to what degree these benefits are distributed equitably. We find that in science, the venue effect reinforces existing hierarchies, enhancing the productivity and citation impact for established senior scientists. In art, however, we observe a more nuanced pattern, with prominent venues favorably impacting the careers of emerging and mid-career artists. Geographic disparities are particularly pronounced: prominent venues consistently favor scientists from regions with substantial scientific infrastructure, such as North America and Europe, but the effect is stronger for previously neglected Asian and South American artists, while benefits in Africa are uneven or even negligible. Venue effect is also modulated by research novelty [55], finding that scientists authoring papers grounded in well-established references gain the most citations (SI 5.9).

Surprisingly, our results indicate that the venue effect only emerged as a detectable force around the 1990s in both science and art, a period characterized by the considerable expansion of both scientific publication venues and exhibition opportunities. This finding suggests the phenomenon of status inflation [1], where the availability of an increased diversity of choices amplifies rather than diminishes the impact of leading venues. Put differently, the existence of multiple alternatives with varying perceived prestige has made access to established top venues an even stronger status signal within their respective fields. This amplification of these status signals raises concerns, given our findings that access to top-tier venues is not uniformly distributed and is often inequitable. These observations suggest that institutions could adopt strategies to broaden access to high-prestige venues, including targeted initiatives to support underrepresented groups and mitigate potential disparities.

Our study has several limitations that point to directions for future work. First, the difference-in-differences framework relies on the Stable Unit Treatment Value Assumption (SUTVA), which may be challenged in collaborative contexts where mentorship and peer influence shape outcomes [56]. Future research could employ causal inference methods that explicitly address such network interference [57]. While our estimates should not be interpreted as causal, as unmeasured confounders (like intrinsic quality) may bias our estimates, the extensive sensitivity analyses we performed indicate that our main results remain robust under moderate hidden correlations with venue participation (SI 4.5). To better isolate the venue effect from underlying quality, we first employed a pre-venue publications design which focused on venue spillover effect on papers with a fixed quality produced before the venue exposure (Figure 2a, Figure SI 17, SI 5.2). Then, we implemented a fuzzy regression discontinuity design using data from the International Conference on Learning Representations (ICLR) in computer science, exploiting reviewer score discontinuities. Specifically, we implemented a matched "twin research" design that pairs comparable studies in physics across venues (SI 5.4, SI 5.3). Future work could build on these approaches by incorporating dynamic weighting mechanisms that better align pre-treatment trajectories (SI 4.4).

Additionally, gender identification methods systematically underperform for authors from China, Japan, Korea, Brazil, Malaysia, and Singapore [27] and are limited to binary gender classification (see SI 1.3 for details on identification accuracy). Improving access to a more precise gender data and refining author classification could further enhance the robustness of our results. Our use of the Dimensions dataset also entails known limitations, such as incomplete author affiliations, missing researcher identifiers, name disambiguation problem and missing grant information as we discussed in SI 1.3. We have performed extensive robustness check to ensure that these limitations do not affect our main results (Figure SI 3, Figure SI 4, Figure SI 5). We also explicitly assess the robustness of both venue definitions and missing nominated-work information in the performing arts dataset (SI 1.3). Looking ahead, we expect that continued efforts to enrich metadata coverage and improve the precision of author disambiguation will enable even more comprehensive assessments of career dynamics across both science and art.

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Data Availability

The dataset is available at https://github.com/Barabasi-Lab/venue_effect.

Code Availability

The code used for this manuscript is available at https://github.com/Barabasi-Lab/venue_effect.

Author Contributions

All authors contributed to the research. ALB conceived the research. YL and RDG. collected and analyzed the data. YL implemented the models with the help of LH. YL, RDG, LH, and ALB. worked collaboratively to interpret the results. YL, RDG, and ALB wrote the first manuscript. All authors reviewed and edited the manuscript.

Competing Interests

A.-L.B. is the scientific founder of Scipher Medicine, Inc., which applies network medicine to biomarker development.

Correspondence

Correspondence and requests for materials should be addressed to A.-L.B. (email: a.barabasi@northeastern.edu).

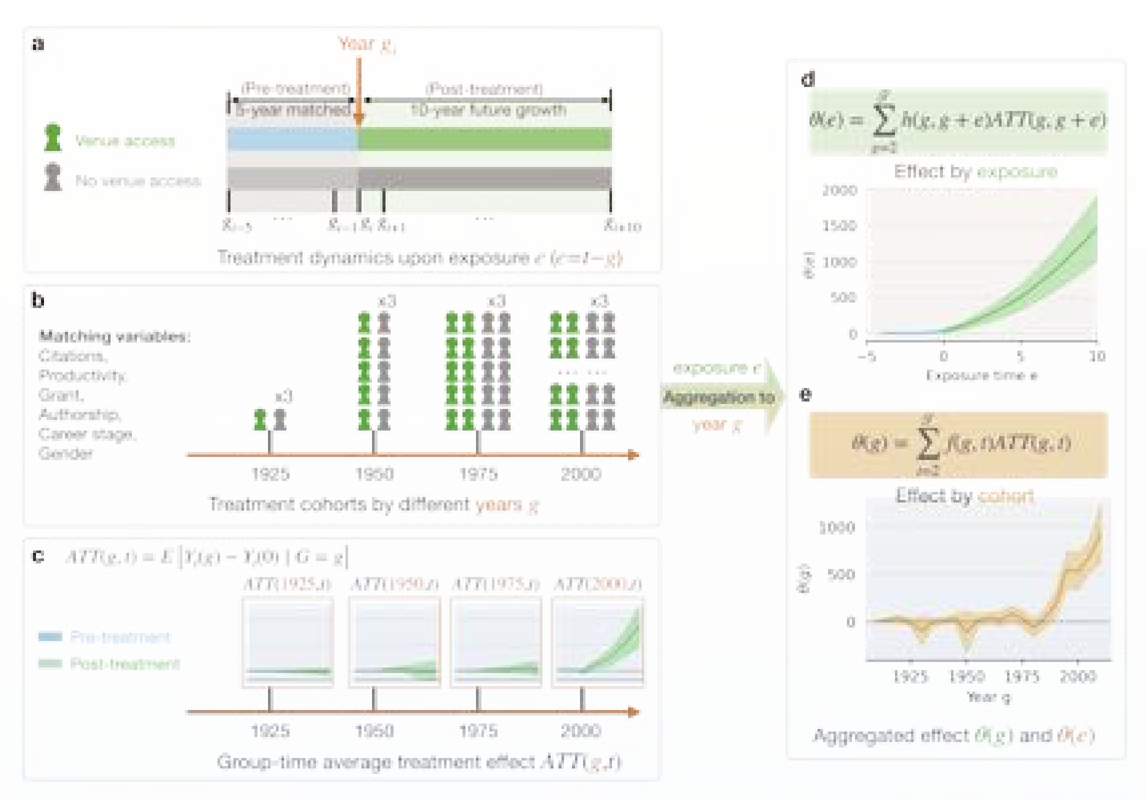

Figure 1: Analytical framework for examining the impact of venue access [28]. **a** We identified scientists who published in the high-impact venue SV1, along with matched control scientists who do not have venue access, defining a 5-year pre-treatment period and a 10-year follow-up period after the treatment year g_i. **b** Scientists in the treatment and control groups were matched based on variables such as citations, productivity, grants, authorship, career stage, and gender. For each treated individual, three matched counterparts were selected, marked by $\times 3$ in the figure. The figure illustrates the increasing number of scientists across different treatment years. **c** We estimated the Group-Time Average Treatment Effect on the Treated $ATT(g,t)$ to capture the effect of venue access on treated scientists compared to controls at treatment cohort g and current calendar time t. The four panels display $ATT(g,t)$ values for treatment cohorts g in 1925, 1950, 1975, and 2000, showing the impact within the range $t \in [-4, 10]$. **d-e** Aggregated effects of venue access. **d** Effect by exposure time $\theta(e)$: Here, $e = t - g$, representing the time elapsed since treatment. This panel shows the dynamic impact of venue access across cohorts, obtained by aggregating $ATT(g,t)$ values across treatment years g, where $h(g, g+e) = \frac{1}{\mathscr{T}-g+1}\mathbf{1}\{g \le t\}$, representing the dynamic treatment effects. **e** Effect by treatment cohort $\theta(g)$: The panel illustrates how the impact of venue access varies over time, capturing historical changes in venue effects by aggregating $ATT(g,t)$ for each cohort. This aggregation uses $f(g,t) = \mathbf{1}\{g + e \le \mathscr{T}\}\, P(G = g \mid G = e \le \mathscr{T})$, highlighting the treatment heterogeneity with respect to the treatment adoption period. For further details on the formulas and analytical framework, see Section SI4.2.

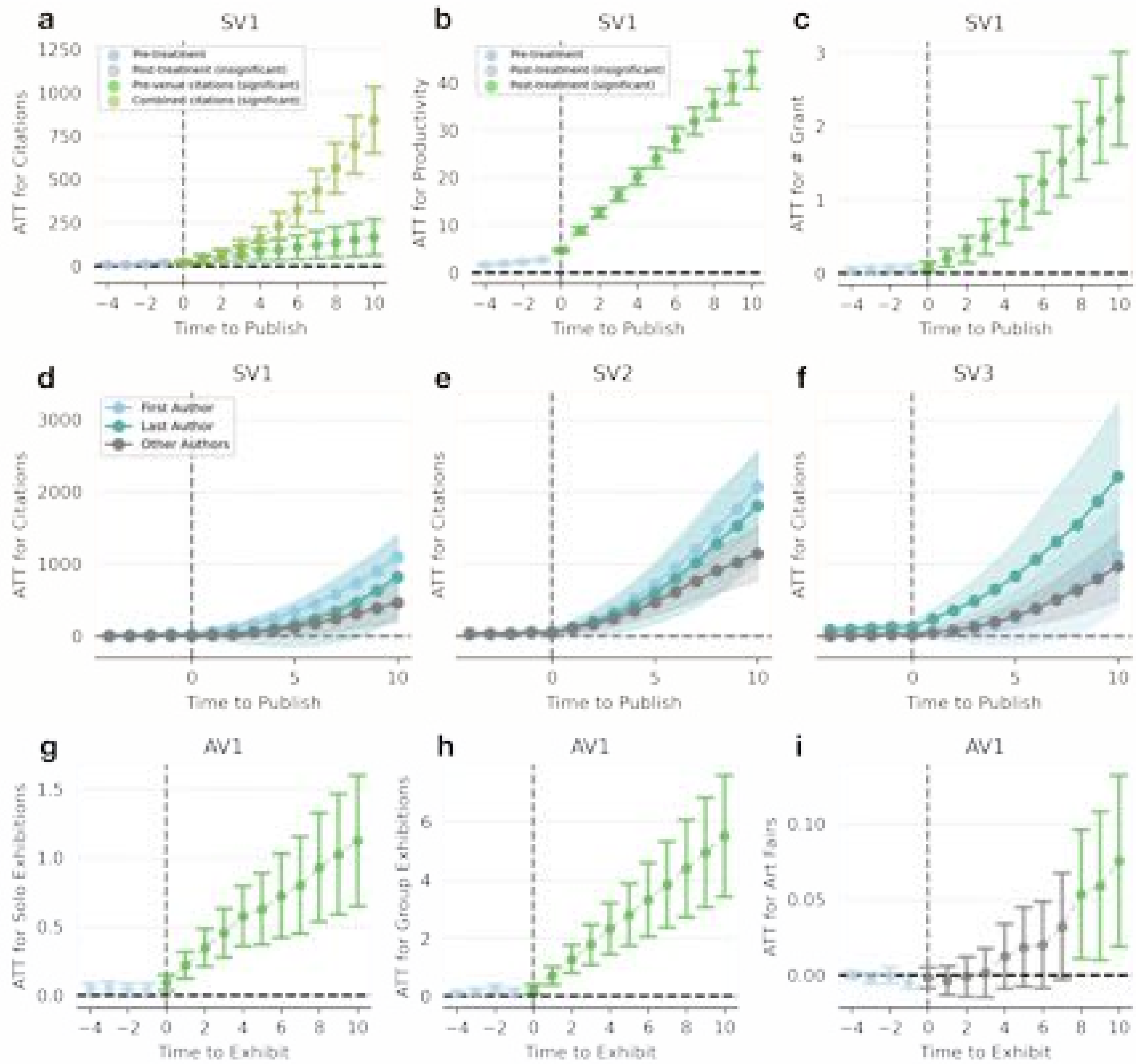

Figure 2: The venue effect in science and art. By measuring the Average Treatment Effect on the Treated (ATT) following participation in prominent science (**a**-**d**) and art venues (**f**-**i**), we find strong positive effects, lasting up to a decade. **a-c** ATT for SV1 publication in science, capturing its impact and future **a** citations (pre-venue publications $\&$ overall except for focal paper), **b** productivity, **c** number of grants. **d-f** ATT for SV1, SV2 and SV3 between first, last and other authors. **g-i** ATT for AV1 participation in arts. **g** ATT for solo exhibitions. **h** ATT for group exhibitions. **i** ATT for art fair participation. Significance appears after 8 years.

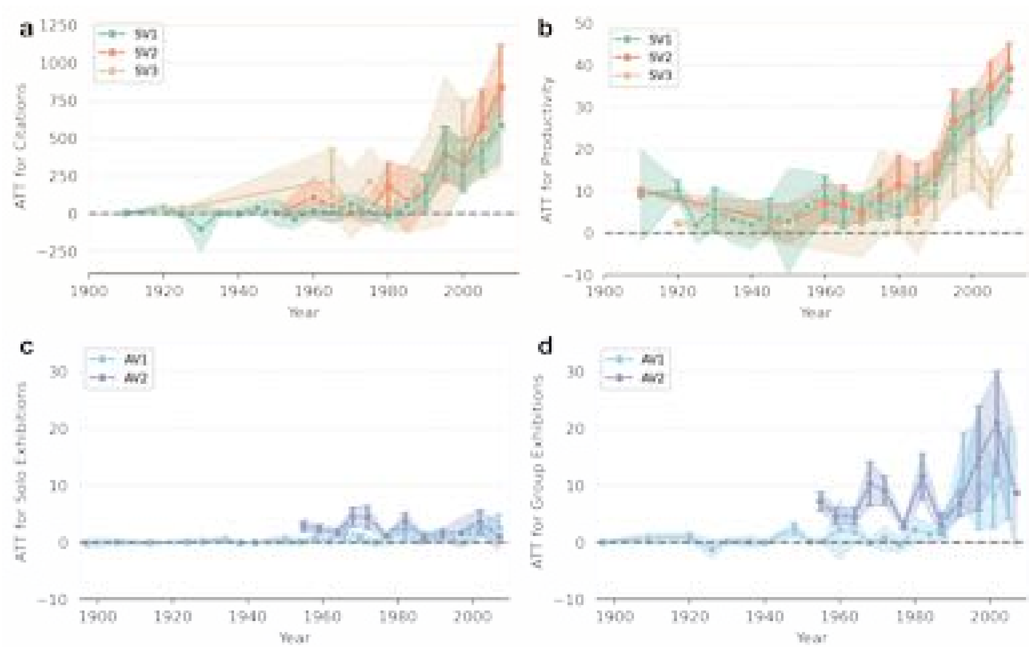

Figure 3: The venue effect is a recent phenomenon. **a** ATT (Average Treatment Effect on the Treated) of citations by cohort with access to publication venue, for SV1-3 showing the emergence of a persistent positive effect in the 1990s. **b** ATT of productivity by the same cohort of scientists. While we observe a positive (but often non-significant) productivity boost for SV1 and SV2 since the 1960s, its significance and magnitude has increased considerably after the 1990s. All estimated confidence intervals are shown, and only significant effect are shown in bars for clarity. **c** ATT for solo exhibitions. AV1 displayed the venue effect sporadically before the 1960s, the effect size increased after the 1990s. AV2 tends to be significant since its inception in 1951 but the effect size markedly increased after the 1990s **d** ATT of group exhibitions by cohort. AV1 and AV2 indicating that the magnitude of the venue effect increased markedly after 1990s.

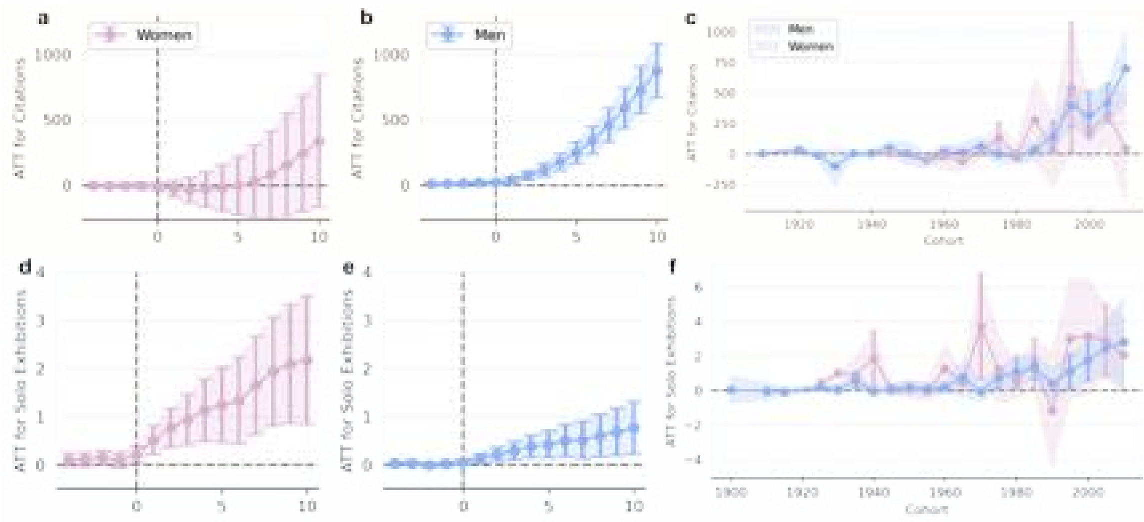

Figure 4: Venue effects are gender dependent. **a,b** ATT (Average Treatment Effect on the Treated) and 95% confidence intervals upon publishing in SV1 within women and men groups separately. While men experience a significant boost upon publication, the effect is smaller for women (1-year z-score: 2.12 p-value: 0.034, 5-year z-score: 2.07 p-value: 0.038, Table SI 17) and does not reach statistical significance. **c** Temporal effect in science, showing that for both genders the venue effect emerged only in the 1990s. All estimated confidence intervals are shown, and only significant effect are shown in bars for clarity. **d,e** Effect upon participating in top biennial AV1 within women and men groups ((1-year z-score: -2.42 p-value: 0.016, 5-year z-score: -1.94 p-value: 0.052, Table SI 18)). **f** Temporal variation of effect in arts indicates that a persistent effect only emerged after 1995.

Figure 5: The venue effect depends on career stage. **a-c** ATT (Average Treatment Effect on the Treated) of publications, mid-career authors receive the most post-treatment effect. **d-f** ATT of citations for early (less than 10 years), mid (10-30 years), and late (over 30 years) career authors for publishing in SV1. We find that late-career authors receive the most growth in citations. **g-i** ATT of solo exhibitions for early, mid, and late-career artists participating AV1. Late-career artists benefit most in solo exhibitions. **j-i** ATT of group exhibitions. Mid-career artists benefit the most in future group exhibitions. The filled area corresponds to 95% confidence intervals.

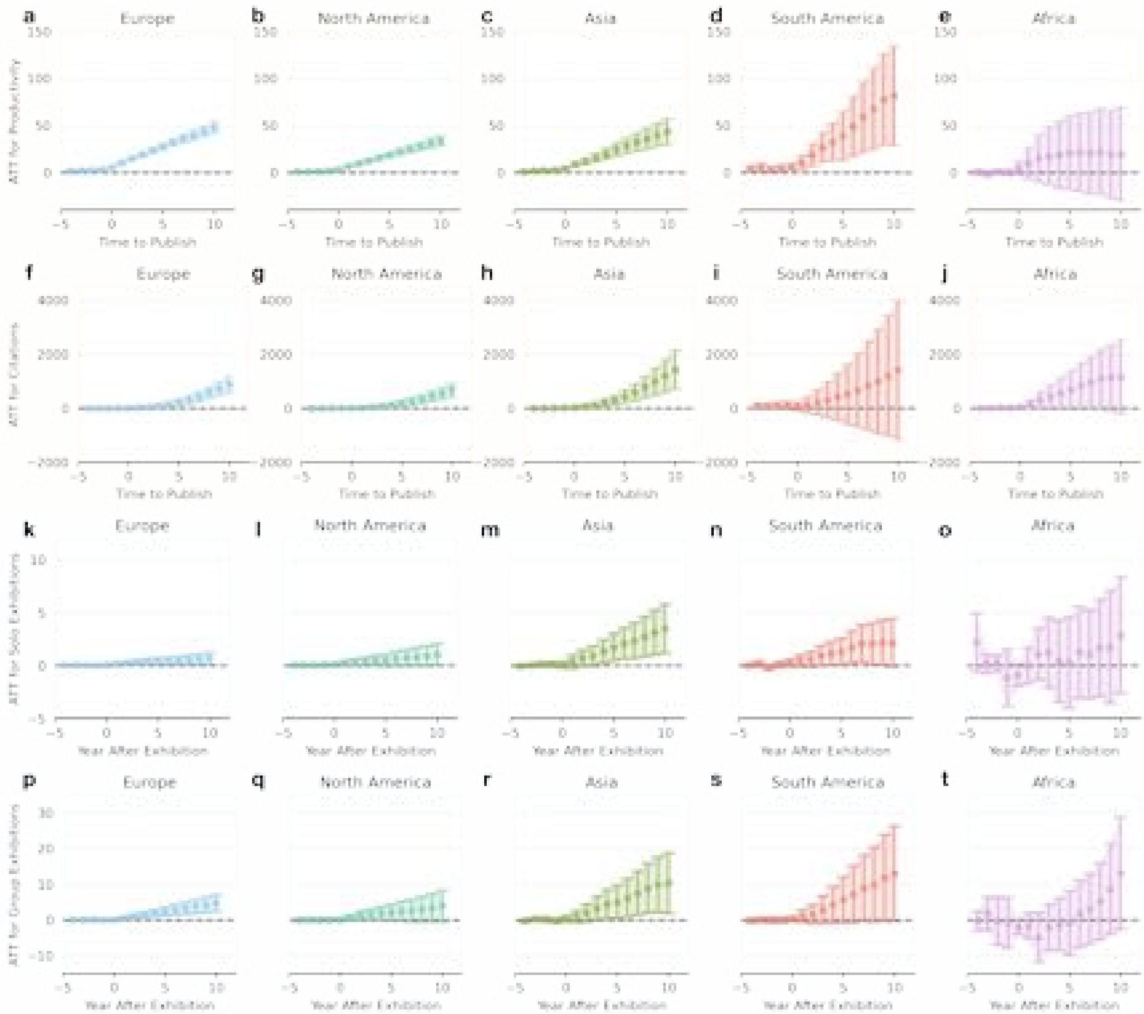

Figure 6: Geographic differences in the venue effect. **a-e** ATT (Average Treatment Effect on the Treated) for citations, with European, American, and Asian authors showing significant benefits upon publishing SV1. **f-j** ATT for productivity growth among physicists from Europe, North America, Asia, South America, Africa and Oceania upon publishing SV1. **k-o** ATT for solo exhibitions among artists from Europe, North America, Asia, South America, Africa, and Oceania upon AV1 participation. **p-t** ATT for group exhibitions among artists. Stars denote significance levels (*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$), highlighting statistically significant effects for European and Asian artists.

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Supplemental Information

The uneven impact of venues on creative careers

Yixuan Liu, Rodrigo Dorantes-Gilardi, Larry Han, and Albert-László Barabási

The Supplementary Materials is organized into five main sections. Section 1 begins by describing the dataset used in the study, which compiles comprehensive records for both scientists and visual artists, detailing their career events, such as publications and exhibitions, along with demographic data. Section 2 delves into the historical variation and representation in prestigious venues like the Venice Biennale, highlighting gender and national diversity trends. Section 3 discusses the hybrid matching methodology, including techniques like coarsened exact matching and dynamic distance matching for panel data to establish balanced treatment and control groups. Section 4 explains the process of estimating treatment effects using heterogeneous difference-in-differences, aggregation of average treatment effects on the treated (ATT), and a discussion on model assumptions and sensitivity analyses. Section 5 concludes by presenting the venue effect findings, showcasing the impact of prestigious venues on career trajectories, differences across social science journals, and heterogeneity across subregions.

1 The Dataset Description

The dataset at the core of our study serves as a foundation for examining how access to high-profile venues can shape the careers of creative individuals in both science and art. By compiling comprehensive records for scientists and visual artists, we are able to explore the patterns of professional achievement, institutional recognition, and sustained career development within these creative fields. This dataset brings together comprehensive information, capturing the full breadth of career events such as publication and exhibition history, as well as demographic data, to facilitate a nuanced analysis of the venue effect. In the following subsections, we provide an overview of the data sources, coverage, and structure for both scientific publications and art exhibitions, highlighting the distinct pathways through which career trajectories are influenced by exposure to prestigious venues.

1.1 Science and art data

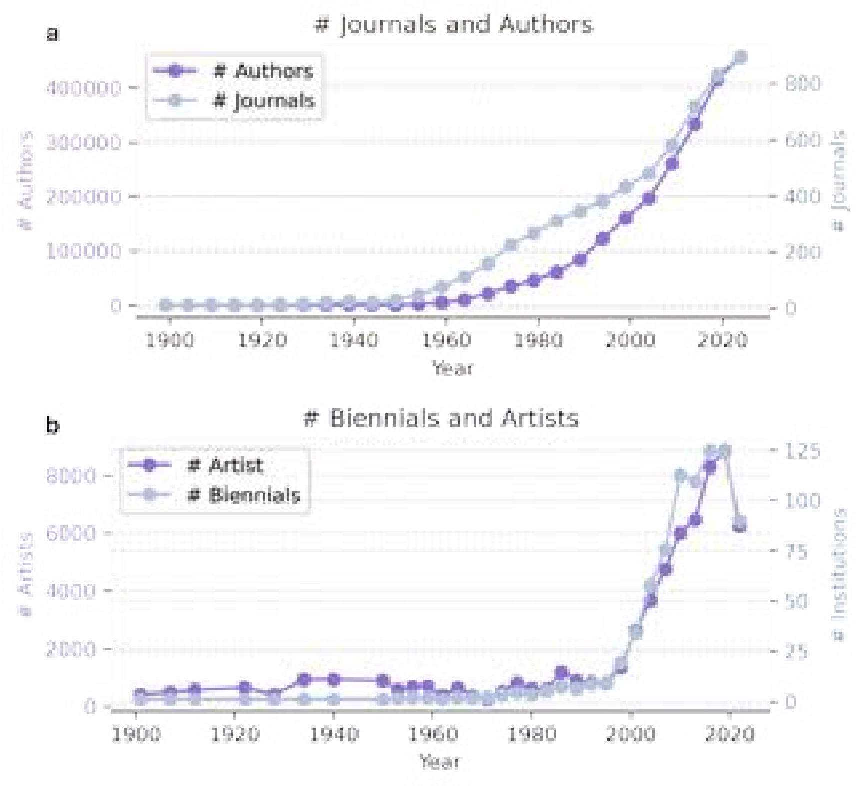


Figure SI 1: Growth of publication venues and art venues from 1900-2023. **a** Steady growth in number of physics journals and involved authors since 1960, with more rapid growth around 2000. **b** Explosive growth in the number of biennials and involved artists around 2000.

Scientific publication venues and scientists data. We assembled a comprehensive dataset encompassing the full publication histories of 3.4 million physicists from the Dimensions database [1]. This dataset includes detailed bibliographic information such as publication titles, author affiliations, publication dates, journal names, and citation counts. To investigate the venue effect on scientific careers, we focused on publications specifically within physics and identified key venues, including the top three scientific journals (SV1, SV2, and SV3) and a leading disciplinary journal (SV4). For each scientist, we applied name-based algorithms to infer gender, enabling an analysis of gender disparities in career trajectories [2]. Figure SI 1a depicts the number of venues and unique author involvement over time, providing insight into publication trends within the physics community.

Inclusive Discipline Classification of Scientists. In our study, we define physicists and sociologists as researchers who have published at least one paper in their respective fields classified by ANZSRC disciplinary codes (e.g., Physical Sciences or Social Sciences). Following and extending the standard practice in large-scale bibliometric research [2], [3], we do not restrict each author to a single "primary" discipline. Instead, we adopt an inclusive criterion that identifies all researchers who have ever published in the field, even if their broader careers span multiple domains. Figure S1 shows the yearly count of physicists/artists, along with the number of journals/biennials that physicists/artists involve in by year. Only limited fraction of researchers confine most of their work to only one field. Specifically, among the 2.1 million researchers labeled as researched in social science in our dataset, only 24.0% publish the majority of their work with sociology as the label; a ratio which is 30.5% for the 3.4 million physicists; 38.9% for the 5.8 million chemists; and 41.0% for the 7.6 million biologists. For each researcher, publications and citations are tracked through all fields.

Art biennials and artists data. We compiled an extensive dataset of over 1 million visual artists by extracting their exhibition histories from reputable art databases [4]. The dataset includes details on each artist's nationality, gender, birth and death dates, associated art movements, and detailed records of their exhibitions, including dates and locations. Additionally, we gathered historical transaction details of artworks from auction records, capturing sale prices, transaction dates, locations, artwork titles, and auction houses. This rich dataset enables us to analyze the impact of participating in prestigious art biennials, specifically the top two invitation-only biennials (AV1 and AV2), on artists' career development. Figure SI 1b presents the count of unique artists involved in various biennials over time, highlighting trends in participation and the prominence of different art venues.

Movie and Television Prizes in Performing Arts. Based on prior research using the Internet Movie Database (IMDb) [5], we curated a dataset of actors and actresses and their selection in top-tier awards, namely, the Oscars and BAFTAs (primarily film), the Emmys (television), and the Golden Globes (a hybrid platform recognizing both). Specifically, we assembled a panel of over 3,800 nominees (including 1,100 winners) for major acting awards and tracked two longitudinal dimensions for each individual: (i) productivity and visibility (measured by the number of leading film roles) and (ii) recognition (subsequent nominations, excluding those tied to the focal award-winning work).

Expansion of Scientific and Artistic Venues. As shown in Figure SI 1, the number of journals and active authors in physics has expanded substantially over time, paralleling the rise of biennials and exhibiting artists in the arts. This shared expansion motivates the central question of our study: as the opportunity structure of venues broadens, how do status hierarchies reorganize? Building on Gould's theory of the endogenous formation of status hierarchies [6], we interpret the prestige of top journals and exhibitions as coordination mechanisms that stabilize recognition within increasingly complex and crowded fields.

1.2 Top venues in science and arts

Below, we list the science and art venues we explored, along with their year of establishment and the number of participants in each venue. These venues were selected based on their prominence and influence within their respective fields.

The science venues listed in Table SI 1 represent a hierarchy of prestigious journals within the physics community. SV1 (Nature), SV2 (Science), and SV3 (PNAS) are multidisciplinary journals known for publishing high-impact research across various scientific fields, including physics. SV4 (Physical Review Letters) is a leading journal dedicated specifically to rapid dissemination of significant physics findings. The specialized journals SV5 to SV7 cover subfields within physics, such as atomic, molecular, and optical physics (PRA), condensed matter and materials physics (PRB), and nuclear physics (PRC). The author counts associated with each venue highlight their prominence and significance in contributing to the physics literature.

Table SI 1: Science Venues (Physics)

Venue Code	**Journals**	**Founding year**	**# of authors**	**IF(2023)**
SV1	Nature	1869	47k+	56.22
SV2	Science	1880	36k+	49.32
SV3	PNAS	1914	28k+	20.41
SV4	Physical Review Letters (PRL)	1950	195k+	17.67
SV5	Physical Review A (PRA)	1970	73k+	6.27
SV6	Physical Review B (PRB)	1970	158k+	7.67
SV7	Physical Review C (PRC)	1970	48k+	6.81

To expand beyond physicists, we added two additional STEM disciplines: chemistry and biology, examining both multidisciplinary top and historic venues (Nature, Science, PNAS) and more recent field-flagship journals like Cell and Nature Chemistry. As shown in Table SI 2 and Table SI 3, we report both the journal impact factors (JIF 2023) and the number of unique authors across these venues.

Table SI 2: Science Venues (Chemistry)

Journals	**Founding year**	**# of authors**	**IF(2023)**
Nature	1869	25k+	56.22
Science	1880	23k+	49.32
PNAS	1914	40k+	20.41
Nature Chemistry	2009	10k+	26.60

Table SI 3: Science Venues (Biology)

Journals	Founding year	# of authors	IF(2023)
Nature	1869	25k+	56.22
Science	1880	23k+	49.32
PNAS	1914	40k+	20.41
Cell	1974	59k+	57.45

Similarly, in sociology, the venues listed in Table SI 4 are among the most influential journals shaping research and discourse in the field. SSV1 (American Sociological Review) and SSV2 (American Journal of Sociology) are the flagship journals of sociology in the United States, publishing foundational and cutting-edge research. SSV3 (European Sociological Review) and SSV6 (Sociology) serve as prominent platforms for sociological scholarship in Europe. SSV4 (Social Forces) features articles with significant contributions to social science, while SSV5 (Gender and Society) focuses on gender studies within sociology. The participation numbers reflect the active engagement of sociologists over time with these venues.

Table SI 4: Social Science Venues (Sociology)

Venue Code	Journals	Founding year	# of authors	IF (2023)
SSV1	American Sociological Review	1936	6.2k+	15.42
SSV2	American Journal of Sociology	1895	3.4k+	7.37
SSV3	European Sociological Review	1985	1.8k+	3.84
SSV4	Social Forces	1922	8.2k+	5.29
SSV5	Gender and Sociology	1987	1.8k+	15.72
SSV6	Sociology	1967	3.2k+	5.58

The art venues in Table SI 5 include some of the most prestigious biennials that significantly impact artists' careers. Our selection followed both historical and empirical criteria that jointly capture the venues' prestige, scope, and sustained influence within the global art field. AV1 (Venice Biennale) is one of the oldest and most esteemed international art exhibitions, serving as a major platform for contemporary artists since 1895. AV2 (Bienal de São Paulo) has fostered cultural exchange since 1951 and remains a significant event in Latin American art. AV3 (Documenta) is distinguished by its critical and experimental approach to contemporary art, held every five years in Germany. AV4 (Whitney Biennial) has influenced American art since 1932, showcasing emerging trends and artists. The other biennials AV5 (Biennale of Sydney, the top in Oceania), AV6 (Istanbul Biennial, influencing Eastern Europe and Asia), AV7 (Manifesta, European pan-regional contemporary cultural biennale) and AV8 (Gwangju Biennale, top venue in Asia) represent prominent regional platforms that contribute to the global art discourse, each offering unique opportunities for artists to achieve international recognition. This is also consistent with external benchmarks such as Artnet's Power Rankings [7]. And the participant numbers reflect the scale and reach of these biennials and their roles in engaging artists within the art community.

Table SI 5: Art Venues

Venue Code	**Biennials**	**Founding year**	**# of artists**	**Region**
AV1	Venice Biennale	1895	27k+	Europe
AV2	Documenta	1955	3.7k+	Europe
AV3	Bienal de São Paulo	1951	5.9k+	Latin America
AV4	Whitney Biennial	1973	1.7k+	North America
AV5	Biennale of Sydney	1973	2.1k+	Oceania
AV6	Istanbul Biennial	1987	1.4k+	Europe/Asia
AV7	Manifesta	1994	1.2k+	Europe
AV8	Gwangju Biennale	1995	1.3k+	Asia

Further, our network centrality analyses of over 13k+ co-exhibition trajectories based on artists confirm that these venues occupy the most connected and central positions in the global exhibition network (Table SI 6), reinforcing their status as the core institutions of the contemporary art system.

Table SI 6: Top-5 venues by centrality measures through co-exhibition network.

Rank	Weighted Out-Degree		Weighted In-Degree		Eigenvector Centrality	
	Venue	Score	Venue	Score	Venue	Score
1	Venice Biennale	813	Venice Biennale	597	Biennale of Sydney	1.00
2	Bienal de São Paulo	526	Bienal de São Paulo	423	Manifesta	0.98
3	Biennale of Sydney	481	Biennale of Sydney	403	Venice Biennale	0.94
4	Istanbul Biennial	339	Ljubljana Biennial of Graphic Arts	293	Shanghai Biennale	0.94
5	Whitney Biennial	337	La Biennale de Lyon	293	La Biennale de Lyon	0.93

1.3 Limitations of art and science data

Both the scientific and artistic datasets used in this study have inherent limitations. In the case of science, our analysis relies on data from Dimensions.ai, a widely used but imperfect bibliometric source. Known issues include missing or incomplete affiliation identifiers, missing reference links, and incomplete researcher identifiers [8], [9], [10]. To better contextualize these challenges, we systematically examine each limitation and discuss its potential impact on our analyses and results:

Name disambiguation problem in science data. Author identification is a central challenge in any longitudinal bibliometric analysis. To empirically assess the precision of this disambiguation, we conducted validation using Wikidata, which maintains unique curated researcher profiles with verified identifiers, demographics, and affiliations. We evaluated two types of potential name disambiguation errors (Figure SI 2). First, the over-splitting rate, defined as cases where a single Wikidata author corresponds to multiple external IDs. Across more than 46,000 matched profiles, Dimensions exhibited the lowest fragmentation rate (0.65%), outperforming both Scopus and Web of Science. Second, we measured the profile-conflation (over-merging) rate, capturing instances where multiple Wikidata authors share a single external ID. Among 232,098 Dimensions, 268,894 WoS, 561,676 Scopus, along with 217178 ORCID author records, Scopus displayed the highest conflation rate (0.02%), while Dimensions and WoS remained below 0.01%. These findings indicate that the dataset we use achieves disambiguation performance at least on par with, and in several respects superior to, other major bibliometric sources.

Figure SI 2: Name disambiguation test. (left) Over-splitting, profiles likely be duplicated in bibliometric data. (right) Over-merging, unique profiles on bibliometric data is related to one profile from Wikidata.

To further ensure the robustness of author tracking across venues and over time, our core analyses are restricted to researchers with verified ORCID identifiers. ORCID provides a persistent, publisher-verified digital identifier that uniquely distinguishes individual scholars and is now systematically integrated into the metadata pipelines of major publishers (e.g., Crossref, DataCite, and Dimensions). In our dataset, ORCID information is obtained directly from the underlying bibliometric source, which aggregates ORCID–publication linkages verified by both publishers and authors. This design substantially mitigates the risk of misallocated publications and establishes a lower bound for the completeness of individual researchers' publication records. While ORCID coverage remains incomplete, particularly for earlier cohorts, this restriction yields a high-precision subset of the author population whose scholarly trajectories can be reliably traced. To evaluate whether our findings remain on this subset, we replicated core analyses using only ORCID-linked scientists within the Dimensions.ai dataset. As shown in Figure SI 3, the estimated treatment reflects the same long-term post-publication increase to those in the full sample in our study. Since ORCID coverage tends to underrepresent earlier works that predate its adoption, these results can be interpreted as a conservative lower bound on the true effect size, providing strong assurance that our conclusions are not artifacts of author misidentification or noise.

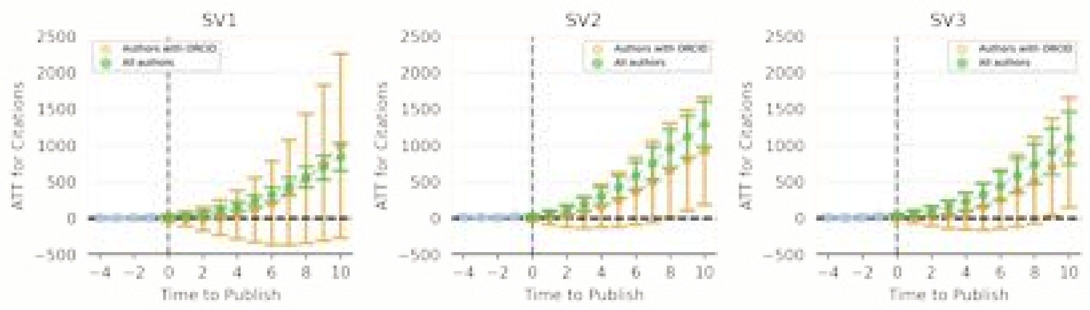


Figure SI 3: ATT on citations for authors having access to top three science venues, authors here all have ORCID IDs.

Missing affiliations and researcher IDs of science data. Like all large-scale bibliometric sources, Dimensions has some limitations (e.g., missing affiliations or cited references in earlier papers). Comparative evaluations have shown that Dimensions' coverage of citations are comparable to, and in many cases broader than, Scopus and Web of Science (WoS). For instance, earlier research [11] analyzed over three million citations to highly cited English-language works and found that Dimensions retrieved 84% of Scopus citations and 88% of WoS citations, while also identifying a substantial number of unique references. The areas where Dimensions shows relatively lower coverage are primarily in the humanities and related domains.

To assess potential data limitations, we systematically evaluated the completeness of researcher and affiliation information in the Dimensions database. As shown in Figure SI 4 left, missing affiliation identifiers remain moderate, while country codes—our main variable for country-level analyses, are highly complete, declining from roughly 28% in 1900 to below 8% by 2020. To further validate data accuracy, we cross-referenced Dimensions with OpenAlex using verified ORCID linkages (covering over 205,000 physicists between 2012 and 2023). Citation counts across the two databases are strongly correlated (Pearson $r = 0.76$), with discrepancies narrowing substantially after 30 citations (Figure SI 4 middle). Since over 85% of authors in our matched sample exceed this threshold (Figure SI 4 right), residual differences in citation coverage are unlikely to affect our estimates. Taken together, these results indicate that Dimensions' citation and affiliation data are highly consistent with independent bibliometric sources, supporting the robustness of our analyses.

Figure SI 4: Missing affiliations, researcher IDS, and citations by type, year and citation bins.

Finally, it is also worth noting that the sample we analyze consists exclusively of at least visible authors, who have either published in top-tier journals (e.g., Nature, Science, PNAS) or have similar pre-treatment performance. This population is extremely well represented in Dimensions. As noted in prior research [8], [11], the completeness of reference links improves with citations, this further mitigates concerns about potential coverage bias in our analysis.

Assessing the robustness of grant coverage in Dimensions.

An advantage of Dimensions for our study is that it integrates grant data directly linked to publications through persistent identifiers and metadata crosswalks across its internal data sources, beyond looking at text of acknowledgments. Specifically, Dimensions connects funded projects, resulting publications, and investigators by aggregating information from over 600 funding agencies using Crossref DOIs, funder registry IDs, and researcher identifiers [12]. Sadly, this resource is limited from OpenAlex, Scopus and earlier versions of WoS (before 2024) since their grant-publication linkages are based primarily on the acknowledgment texts [13], [14], [15]. The grant coverage is better for WoS after 2024 since it launched the Grant Index [16], but this is still not comparable to Dimensions [15]: whereas WoS Grant Index has 5.2 million awarded grant records from over 400 funding agencies [16], Dimensions includes over 8 million grant records from over 600 funding agencies by 2025.

At the grant level, Dimensions indexes more than eight million funding records dating back to 1950. Among these, only about 0.6% of grants lack active-year information, while approximately 12.4% lack linked researcher identifiers. The former suggests that temporal information of grants data in Dimensions is highly reliable. When looking at missing researcher IDs by decade, we observe expected historical patterns: coverage is lower in earlier decades—more than half of grants in the 1960s lack a researcher link—but improves substantially over time, reaching to 8.8% of missing IDs in the 2000s (Figure SI 5 a). We then evaluated coverage at the individual researcher level by leveraging a Wikidata-based crosswalk linking Scopus and Dimensions IDs. Among 126 physicists for whom both IDs exist on Wikidata—and have at least 20 grants in Dimensions, only one Scopus record displays author name ambiguity, and none are observed in Dimensions. We further compared the total number of grants attributed to each researcher from the two datasets. Across this matched cohort, researchers have significantly more grants recorded in Dimensions, by an average of 12 additional grants (paired t-test := 19.70, $p < 0.001$; Wilcoxon signed-rank test: $W = 10.50$, $p < 0.001$). Stratifying by citation impact yields a consistent conclusion (Figure SI 5 b): although both databases provide higher grant coverage for scientists with more citations, Dimensions consistently captures more funding records than Scopus. Together, these results demonstrate that grant metadata in Dimensions is both high-coverage and systematically more complete than Scopus for the subset of researchers, making it suitable for our study.

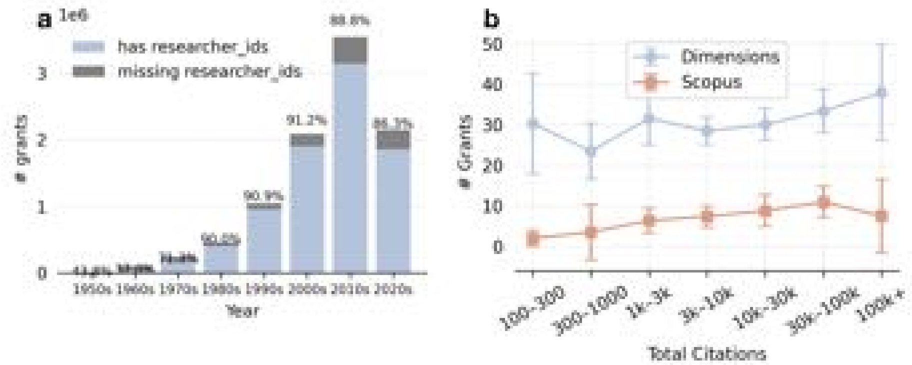


Figure SI 5: Evaluation of missing grant information. (a) Missing researcher ids, active years of each grant from Dimensions. (b) Comparison between individual-level grant records between Dimensions and Scopus.

Gender identification accuracy in science. The gender inference for scientists was conducted using name, gender mappings from established datasets of early work [2]. As in that work, we were unable to infer gender for scientists from several countries (including China, Japan, Korea, Brazil, Malaysia, and Singapore). Incorporating these groups would provide a more comprehensive global perspective on gender differences in science, and we view the development of improved gender-identification methods as an important direction for future work.

To further evaluate potential misclassifications, we compared our inferred genders with verified information from Wikidata. Among the subset of physicists successfully matched via their Dimensions Author IDs (over 20,000 with gender data available in Wikidata), 91.26% were correctly identified in our dataset. The confusion matrix as in Figure SI 6 yields an F1 score of 0.81, indicating strong overall reliability. While a small fraction of male authors were misclassified as female (precision = 0.77, recall = 0.86), these rates are well within expectations for large-scale bibliometric gender in-

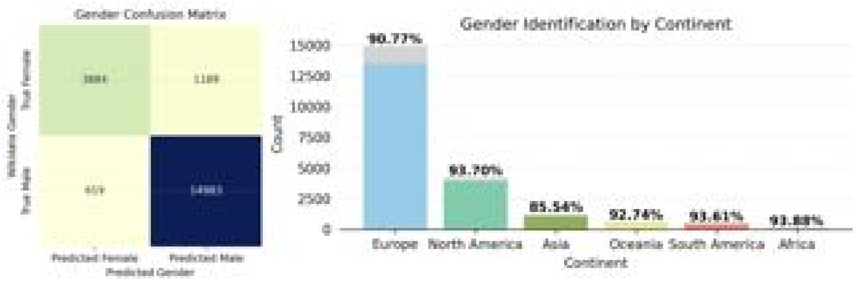


Figure SI 6: Gender identification accuracy and affiliation completeness. Gender accuracy: comparison of identified gender in Dimensions [2]) vs Wikidata gender. Affiliation completeness: missing linkages of institutions through publications.

ference. Furthermore, when breaking down accuracy by first affiliation country (used here as a proxy for scientists' likely cultural or ethnic background), we observed consistently high identification accuracy across regions, with the only notable exception being scientists affiliated with Asian institutions, for whom the misclassification rate was approximately 14.46%. This validation confirms that while modest uncertainty remains for a subset of Asian names, the overall gender-identification procedure is highly accurate and unlikely to bias our main findings.

Consistency with Major Bibliometric Databases. The scale of our data is consistent with other large-scale bibliometric infrastructures. The Dimensions database currently indexes over 70 million unique author identifiers, of which physicists (3.4 million in our study) comprise approximately 4.8% of all authors. Other databases report similar or greater magnitudes: MAG has over 200 million author profiles until 2020 [17], WoS has 33 million disambiguated author profiles [18], and even Scopus has 19.5 million author profiles by 2025 [19]. ORCID also announced that its registry passed 10M ids by 2020 [20]. These numbers further confirm that our reported count for physics is proportionally aligned with the scale of other authoritative databases.

Limitations of biennials and exhibitions data in art. For the arts domain, we draw on Artfacts.net, the most comprehensive dataset currently available for global exhibition histories. Our analysis focuses on biennials and major art fairs within the visual-arts ecosystem, where venue prestige functions analogously to scientific publishing. We acknowledge, however, that Artfacts.net tends to underrepresent smaller regional exhibitions and parts of the non-Western art world [21], [22]. That being said, Artfacts.net remains the most extensive and longitudinal record of artistic careers to date and provides a robust foundation for extending our framework to additional creative domains.

Limitations of movie and television prize-winning data in performing arts.

We also extended our analysis to performing arts, relying on IMDb for top venues

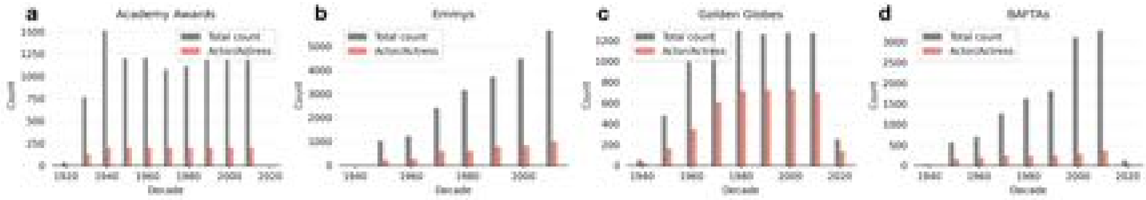


Figure SI 7: Number of total prizes vs prizes records for actors/actresses. Movie awards such as the Oscars and BAFTAs show a remarkably stable number over time, whereas television awards (e.g., Emmys, Golden Globes) exhibit substantial growth and variation in prize categories across decades.

and performer's trajectories. First, gender identification here relies on award categories that explicitly distinguish between actor and actress. This approach ensures accuracy but excludes gender-neutral categories (e.g., "Best Comedy Performance") and performers who have changed gender identity. Our sample focuses on the four most internationally recognized film awards that consistently appear in the award-center headlines, yielding over 11,000 gender-classifiable nominations out of 53,000+ total nominations from 1930 to 2020, preserving comparability across time and across venues with historically stable prize structures. Since our study focuses on high-status venues, we note that the consistency and definition of awards may vary across film and television. For example, the Oscars and BAFTAs have maintained a stable set of four principal acting prizes (Best Leading/Supporting Actor/Actress), enabling reliable longitudinal comparison (Figure SI 7a,d). In contrast, television awards (e.g., Emmys, Golden Globes) have experienced substantial category proliferation over time (Figure SI 7b,c), with greater variation in how recognition is defined across decades.

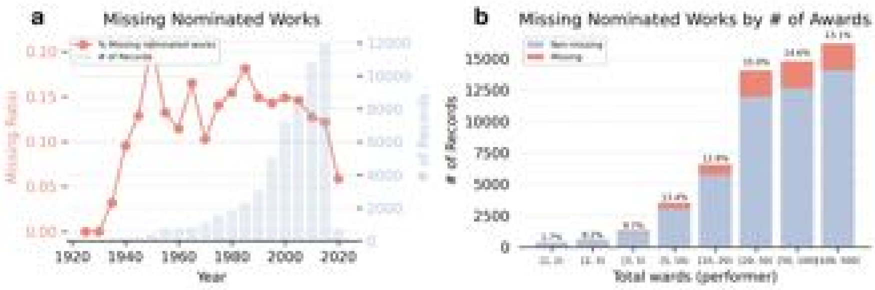


Figure SI 8: Missing nominated works in performing arts awards. (a) Ratio of missing nominated work vs total work count for all top awards nominees. (b) Missing nominated work by performers' total number of awards. Missingness is concentrated among highly decorated performers, consistent with lifetime achievement and honorary prizes.

Second, we note limitations related to missing information on the specific works for which performers were nominated. Our analysis focuses on future nominations not tied to the original prize-winning role, so incomplete "nominated-for-what" records could, in principle, affect precision. In practice, this missing data is modest: across more than 57,000 nomination records, only 13.7% lack work identifiers (Figure SI 8 a), aside from a known archival gap around 1960. Notably, as in Figure SI 8 b this pattern contrasts with citation data of Dimensions, where prominent papers tend to have more complete researcher IDs. Where in film awards, missing work information is more common among highly recognized performers because lifetime achievement and honorary prizes are not linked to specific titles. As such, the missing data does not systematically bias our estimates; rather, it underscores the difference between work-based nominations and career-wide honors, further supporting the validity of our performing-arts venue design.

2 Variation and history of Venice Biennale

Historically, science and art have been predominantly male-dominated domains, as evidenced by the fact that 84% of all Venice Biennale participants are men, and only 30% of authors publishing in Nature are women (Figure SI 9). However, we observe a trend toward greater gender diversity in both venues, with the percentage of women steadily rising since the 2000s, even surpassing that of men artists in 2011 for the first time (Figure SI 9b). This progress has been supported by influential women curators such as María de Corral and Rosa Martínez in 2005 and Bice Curiger in 2011 who have secured the Venice Biennale, reinforcing the role of women in leading venue.

When examining geographical representation, access to prestigious art and science venues has historically been limited to people from only a handful of countries, typically in the West. This pattern mirrors gender representation disparities. However, we note a historical representation of artists from Europe and Scientists from North America. There also shows the growing presence of individuals from different nationalities (Figure SI 9a,b). In science, the number of countries publishing in Nature has shown constant growth, with the exception of the World War II period, shows a noticeable dip (SI 9d). Compared to the Venice Biennale, Nature features fewer original contributing countries (61 vs. 93 for the Biennale), underscoring the different scopes and historical contexts of these high-impact venues in their respective fields of arts and sciences.

3 The hybrid matching methodology

In this section, we introduced our matching methodology in detail, focusing primarily on science venues, though similar methodologies and outcomes were applied for art venues. The balance of final covariates for both fields is presented in Figure SI 12. The goal of the matching process is to establish a reliable comparison between treated and control groups, ensuring that the parallel trend assumption for the difference-in-differences (DiD) analysis holds true. This assumption requires difference-in-differences requires that these groups to follow similar trends prior to intervention. Ensuring this similarity is essential for enhancing the validity of the subsequent group-time interaction in the difference-in-differences model.

3.1 Coarsened exact matching

To enhance comparability, we first coarsened key variables such as career stage, decade of venue access, and funding counts, which are typically limited in quantity, to group them into predefined bins. We evaluated various levels of coarsening (e.g., decade

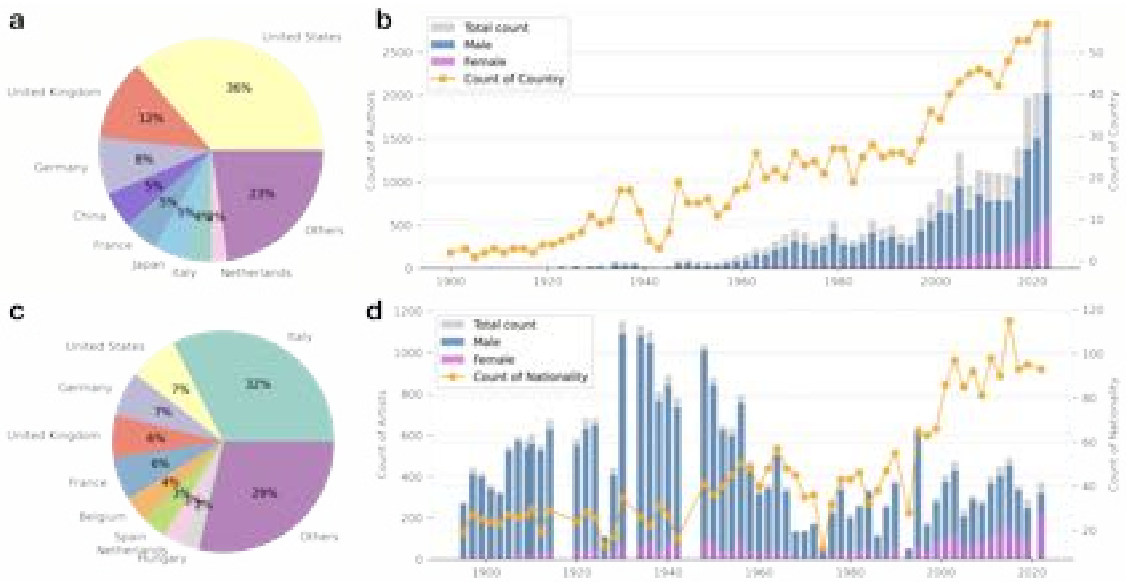


Figure SI 9: National and gender representation in art and science venues. **a, c** Nationality distribution. Among authors published in Nature journals, American and British-originated authors have the most publications. For Venice Biennale artists, Italian artists and American artists are the top participating groups. **(b, d**) Variation of gender and national representation. Nature from 1900-2023 and Venice Biennale from 1895-2022 show an increase in national diversity and a rising proportion of women artists over time.

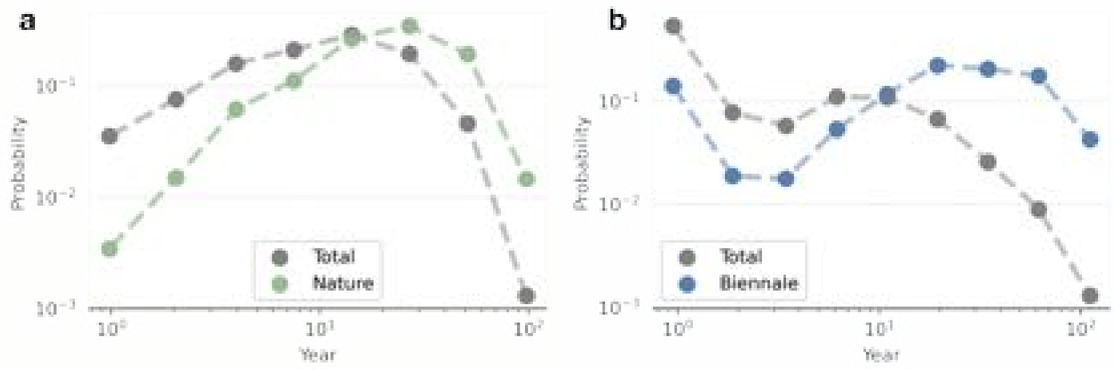


Figure SI 10: Distribution of career length. **a** Career length for Nature authors vs total population. Grey: For the entire dataset, the peak career length is around 14 years. **b** Career length for Biennale participants vs total artists. Grey: entire dataset, where 54.40% of artists have only 1 year of career length, and only 10.34% have over 20 years. Blue: Biennale artists, about 65.08% have careers over 20 years. Green: Nature authors, the peak of career length is around 27 years.

bins of 10 years vs. 20 years, career stages intervals) to determine the impact of bin granularity on our results. Following this, we conducted exact matching on categorical variables, including country, gender, and career stage, restricting the pool of potential matches to units with identical characteristics. A robustness check testing the effects of coarsening granularity is presented in Figure SI 11, showcasing the impact of different binning strategies on the outcomes of the matching process. We demonstrated that our results remain robust across various definitions of early, mid, and late career stages (Figure SI 11). The first separation (Figure SI 11a–c: early career $\leq$ 10yr, mid-career 10–30yr, late career $>$ 30yr; as applied in the main text), the second separation (early career $\leq$ 5yr, mid-career 10–25yr, late career $>$ 25yr), and the third separation (early career $\leq$ 15yr, mid-career 15–40yr, late career $>$ 40yr) yield consistent results, though the numbers are different, demonstrating that late-career scientists always exhibit the highest advantage. This robustness underscores the reliability of our findings.

3.2 Pre-filtering with difference threshold

For each unit in the treated group, we filtered the pool of exact matches to include only those control units with a difference of less than 30% in each time period for all time-series variables, while also limiting the absolute difference when prior treatment values are minimal. This method ensures that only units with closely aligned temporal patterns are considered, which is particularly valuable in cases with extensive longitudinal publication and citation data. This pre-selection procedure significantly enhances comparability and robustness of the final matched sample.

3.3 Dynamic distance matching for panel data

After the pre-filtering step, we applied distance-based matching on the remaining time-series variables to further ensure adherence to the parallel trends assumption. We selected Euclidean distance to capture absolute similarity between individuals, as it offers a straightforward measure. Additionally, dynamic time warping (DTW) was employed as a flexible alternative for capturing similar trends of behavioral variation, providing valuable insights in heterogeneous difference-in-differences analyses. This approach allows us to match individuals with comparable temporal patterns, enhancing the validity of the resulting comparisons and improving the reliability of the subsequent treatment effect estimates.

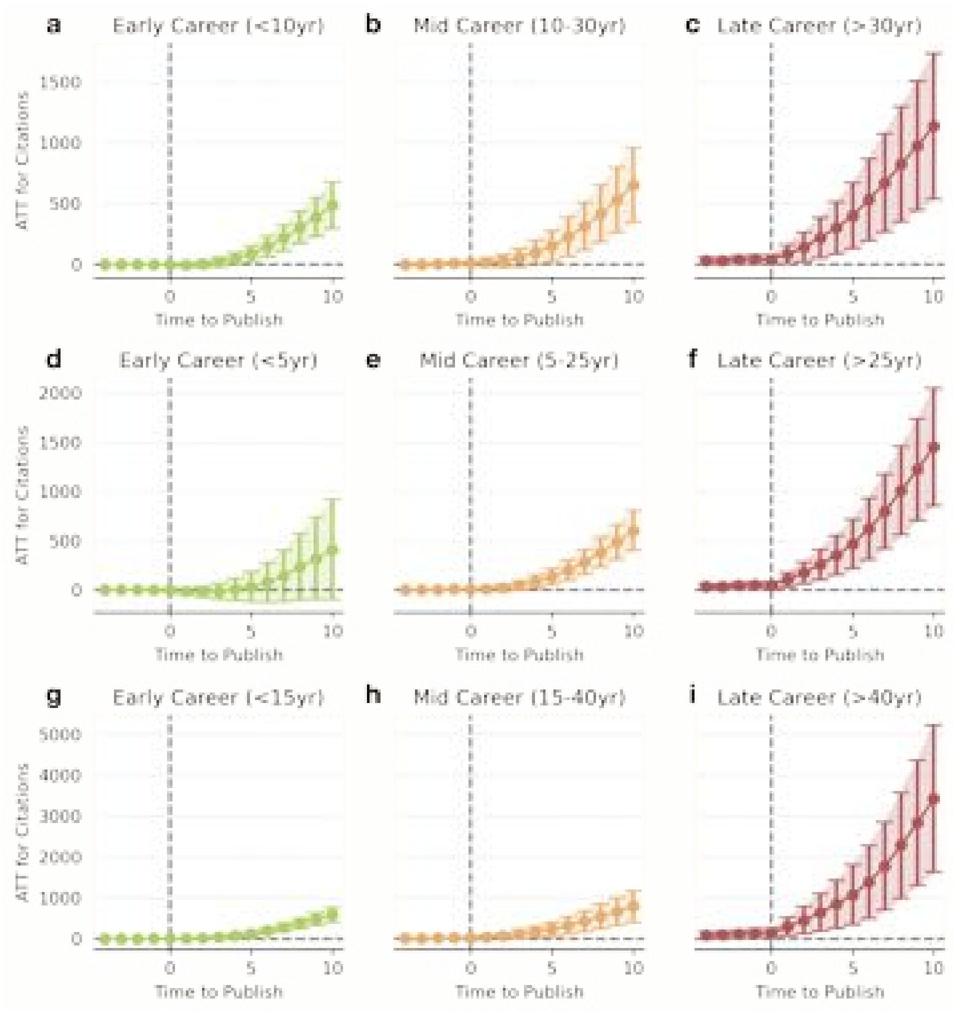


Figure SI 11: Robustness across varying career stage interval definitions. **(a–c)** Results based on Separation Method 1: early career (≤ 10 years), mid-career (10–30 years), late career (> 30 years). **(d–f)** Results based on Separation Method 2: early career (≤ 5 years), mid-career (10–25 years), late career (> 25 years). **(g–i)** Results based on Separation Method 3: early career (≤ 15 years), mid-career (15–40 years), late career (> 40 years). Each method evaluates early, mid, and late career stages under varying interval definitions, demonstrating consistent trends in the late-career advantage.

3.4 Nearest-neighbor selection

For each treated unit, we selected $k = 3$ control individuals with the smallest weighted distance as the nearest neighbor. Treated units without suitable matches within the specified thresholds were removed. The nearest neighbors for each treated unit $i \in T$ are defined as:

$$N_i = \arg \min_{j_1,j_2,j_3 \in C} \sum_{j \in \{j_1,j_2,j_3\}} d_{\mathrm{DTW}}(X_i, X_j),$$

subject to j_1, j_2, j_3 being unique.

All matched groups (consisting of one treated unit and three control units) are now considered to have comparably similar characteristics before being exposed to venues, based on observational data that includes all success measures and demographics. This ensures that the pre-exposure baseline conditions are adequately matched, thereby strengthening the validity of subsequent comparisons and analysis of treatment effects.

3.5 Assessing covariate balance

We demonstrated the balance of our covariates for both science and art before and after matching, as shown in Figure SI 12. In this analysis, we calculated the Absolute Standardized Difference (ASD) for each time period relative to exposure, defined as the absolute difference between the mean values of a variable for the treatment group and the control group:

$$\mathrm{ASD} = \left| \overline{X}_T - \overline{X}_C \right|,$$

where $\overline{X}_T = \frac{\sum_{i \in \mathcal{T}} X_i}{\sum_{i \in \mathcal{T}} 1}$ represents the average of X across all individuals i in the treatment group and $\overline{X}_C = \frac{\sum_{i \in \mathcal{C}} X_i}{\sum_{i \in \mathcal{C}} 1}$ represents the average of X across all individuals i in the control group.

An ASD below 0.1 is typically viewed as indicating good balance, between 0.1 and 0.25 as acceptable, and above 0.25 as poor balance that may require further adjustment. Our results showed most of our matched variables achieved balance in both science and art studies. We note one minor limitation on the parallel trends assumption, where there appears to be small pre-treatment effects in productivity, likely due to early recognition signals through mechanisms such as conference presentations or article preprints, which are contextually logical and do not undermine the overall validity of our approach.

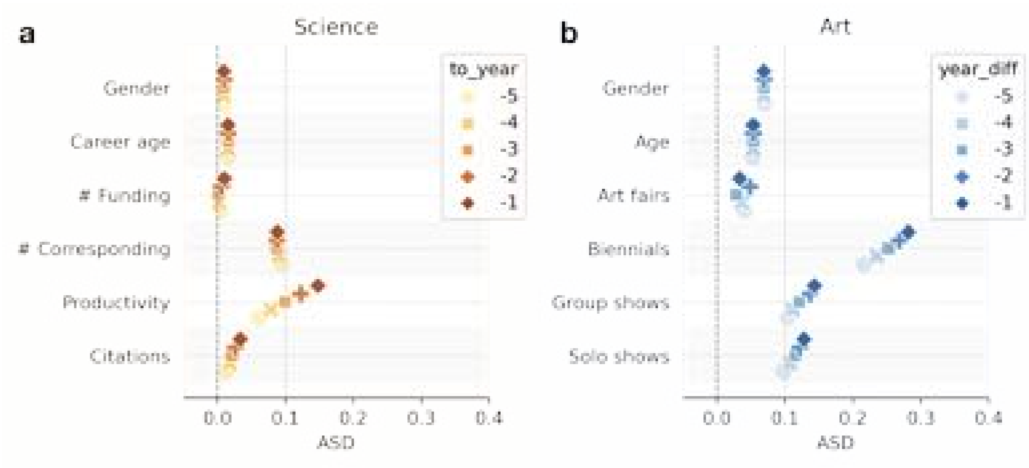


Figure SI 12: Balance table for matched and control scientists and artists (Pre-treatment). Most covariates fall within $[0, 0.1]$, indicating strong comparability, with only one near 0.3, suggesting an effective matching strategy overall.

4 Estimating the treatment effect

4.1 Heterogeneous Difference-in-differences

In this study, we aim to capture the group effects, treatment timing, and dynamics across multiple time periods. To achieve this, we employ the heterogeneous difference-in-differences (DiD) method [23]. Unlike the canonical DiD approach, which assumes that treatment occurs simultaneously for all individuals, the heterogeneous DiD framework takes into consideration that individuals might experience the treatment at different times (i.e., in different cohorts) and receive the impact at different periods. The model is specified as follows:

$$Y = \tilde{\alpha}_1^{g,t} + \tilde{\alpha}_2^{g,t}\tilde{X}_3^{g,t} + \tilde{\alpha}_3^{g,t}1\{T = t\} + \tilde{\beta}_{g,t}(1\{G = g\} \times 1\{T = t\}) + \tilde{\gamma}\tilde{X}_5^{g,t} + \tilde{\epsilon}_{g,t}$$

where

- Y: The outcome variable being measured in the study.
- $\tilde{\alpha}_1^{g,t}$: A time-and-group-specific intercept capturing the baseline level of the outcome for each group g at each time t.
- $\tilde{\alpha}_2^{g,t}$: The effect on Y of being in group g at time t, not considering treatment.
- $1\{G = g\}$: An indicator function that equals 1 for being in group g, either the treatment group ($g = 1$) or control group ($g = 0$).

- $1\{T = t\}$: An indicator function that equals 1 if the time period is t, capturing the effect of time on the outcome.
- $\tilde{\alpha}_3^{g,t} 1\{T = t\}$: This term captures the change over time in the outcome for group g at time t, without the treatment effect.
- $\tilde{\beta}_{g,t}$: The estimated ATT, measuring the effect on Y of the interaction between being in the treatment group and the post-treatment time period.
- $\tilde{\epsilon}_{g,t}$: The error term specific to group g at time t, accounting for unexplained variation in the outcome.

This model captures potential heterogeneity in treatment effects across different time intervals through $ATT(g,t) = \tilde{\beta}_{g,t}$. For instance, the effect of a publication in *Nature* in the year 2000, and the impact in the year 2010 is $ATT_{nature}(2000, 2010) = 780.84$. By estimating $\beta_{g,t}$ for each treatment cohort g and time t, we are able to quantify and show the dynamic treatment effect of the venue. This approach importantly allows us to assess how the impact of venues changes across all years, both in significance and magnitude. Some of these measures require aggregation, as discussed in Section 4.2.

4.2 Aggregation of ATT

By aggregating $ATT(g,t)$ over either the treatment cohort g or time t, we are able to analyze the effects from two perspectives: one that focuses on the treatment effect within each cohort, abstracting from time-based fluctuations, and another that emphasizes the treatment effect over time, averaging out cohort-specific differences, including the aggregated ATT that we use in Figure 3.

$$\theta_S(g) := \frac{1}{\mathcal{T} - g + 1} \sum_{t=2}^{\mathcal{T}} \mathbf{1}\{g \leq t\}\, ATT(g,t). \tag{1}$$

This parameter, $\theta_S(g)$, is valuable for highlighting treatment effect heterogeneity concerning the treatment adoption period. Aggregating further, we define an overall effect parameter that simplifies interpretation:

$$\theta_S^O := \sum_{g=2}^{\mathscr{T}} \theta_S(g) P(G = g). \tag{2}$$

The parameter θ_S^O represents the overall effect of participating in the treatment across all cohorts that have ever participated. In this multi-period context, it resembles the two-period ATT, offering a comprehensive summary of the treatment impact. We report θ_S^O as a singular treatment effect parameter for simplicity and interpretability when necessary; this is the parameter we used in Figure SI 15.

To explore how treatment effects vary with elapsed treatment time, a natural approach for dynamic analysis is as follows:

$$\theta_D(e) := \sum_{g \in \mathcal{G}} 1(g + e \leq T) \Pr(G = g \mid g + e \leq T) \, ATT(g, g + e). \tag{3}$$

In this formulation $\theta_D(e)$ represents the ATT for cohorts that have been exposed for exactly e time periods. This parameter is central to understanding how treatment effects evolve, reflecting the dynamics of the venue effect in fields like science and art, where career trajectory impacts accumulate and vary over time. It is this estimand that we plot in Figure 2, Figure 5, and Figure 6.

These aggregation methods help us present trends and consistent effects of high-impact venues on career trajectories. Analyzing the ATT across both cohort-based (Figures SI 15 and SI 16) and time-aggregated (Figure SI 38) perspectives enables us to capture the impact of prestigious venues like high-impact publications in science and biennials in art. This distinction is crucial in isolating the overall venue effect from variability that might appear within specific subgroups or years.

4.3 Limitations of difference-in-differences

Stable Unit Treatment Value Assumption (SUTVA) assumes that the treatment effect on any individual is independent of the treatment status of others. While collaboration and mentorship are integral to scientific careers, we mitigate potential interference by focusing on individual-level outcomes such as citations, productivity, and grant funding. Furthermore, by explicitly matching on shared affiliations and career stages, we account for network and peer effects indirectly, thereby reducing the likelihood of significant SUTVA violations. However, residual interdependence among researchers within closely-knit networks may still pose a limitation.

Consistency assumes that the treatment effect is well-defined and applies uniformly to individuals within the treatment group. In this study, the treatment is clearly defined as publication in top-tier venues, ensuring a well-specified intervention. Any observed variation in outcomes, such as differences in citation boosts, reflects heterogeneity in individual responses rather than inconsistencies in the treatment definition. This assumption holds by design, as the treatment is operationalized through a clear and observable criterion.

Positivity requires that every individual in the study has a non-zero probability of receiving the treatment, conditional on their covariates. To satisfy this assumption, we restrict our analysis to a well-defined sample of scientists who are plausibly eligible for publication in top-tier venues. This ensures sufficient overlap between treatment and control groups across the covariate space, allowing for reliable estimation of treatment effects without extrapolation beyond the observed data.

The no-anticipation assumption requires that treatment effects do not manifest before formal exposure. While minor pre-treatment effects are observed in some cases, these are likely attributable to early dissemination mechanisms, such as conference presentations or preprints, that precede publication in top-tier venues. These dynamics are inherent to the academic recognition process and do not undermine the interpretation of post-treatment outcomes. To address potential biases from these early effects, we employ dynamic weighting techniques to further reduce any residual confounding.

A key limitation of the difference-in-differences framework is its sensitivity to unobserved or unaccounted-for factors that vary over time and differentially affect treatment and control groups. Such factors – potentially including intangible personal attributes like charisma, perseverance, or innovative approaches – may confound the relationship between treatment and outcomes, such as the rate of productivity or career advancement. Since these characteristics are unmeasured and may correlate with both treatment assignment and outcomes, they present a challenge to validity. Addressing this limitation may require the integration of additional observational data or the application of alternative identification strategies.

4.4 Parallel Trend Assumption

A critical component of our heterogeneous difference-in-differences (DID) models is the parallel trend assumption, stating that the difference between the treatment and control groups would remain constant over time without the treatment. Ensuring that treated and control groups follow similar trends prior to the intervention is essential for isolating the true impact of high-prestige venues on career outcomes.

By maintaining this alignment, we can confidently attribute any post-intervention changes observed in the treated group to the effect of the venue, rather than to pre-existing differences. Additionally, we apply Granger causality tests to the dynamic effect upon exposures, assess the directionality of relationships in the data, enhancing the model by incorporating counterfactual treatment-time indicators. This step further validates that the observed effects are due to the treatment itself, rather than being influenced by reverse causality or unrelated temporal factors.

The difference-in-differences framework relies on a core assumption: that the treatment and control groups would follow parallel trajectories in the absence of treatment. This assumption is essential for interpretation of the treatment effect. While our results largely support this assumption, we observe minor deviations, with some treatment effects emerging slightly before formal exposure. These early effects may stem from pre-treatment factors such as conference presentations or preprints, which could have begun drawing attention to the work prior to publication.

Although noteworthy, these deviations are contextually logical and do not compromise the overall validity of our approach. Instead, they emphasize the dynamic nature of scientific dissemination, where early recognition signals often precede formal publication. The comparability between treatment and control groups remains robust, ensuring that the inferences drawn from our analysis are reliable. Future research could address these nuances by incorporating dynamic weighting mechanisms to better align pre-treatment trajectories. For example, consider two researchers with similar career trajectories and areas of expertise: if one publishes in a high-impact journal while the other does not, and pre-treatment alignment is accounted for, differences in subsequent outcomes can be more accurately attributed to the effect of the prestigious publication.

By carefully evaluating results against these assumptions and transparently addressing minor violations, our study underscores the reliability of its conclusions. These findings offer valuable insights into the influence of high-prestige publication venues on scientific careers, while also acknowledging the inherent complexities of working with real-world data.

4.5 Sensitivity analysis

In this section, we utilized tools for robust inference and sensitivity analysis for differences-in-differences and event study designs [24]. This method relies on two main intuitions: bounds on relative magnitudes and smoothness restrictions. After applying Callaway and Sant'Anna's estimation of $ATT(g,t)$ [23] and calculating the aggregated effect for treatment dynamics, we further conducted the sensitivity test for both relative magnitude and smoothness. Rather than requiring strict adherence to parallel trends, this method sets limits on how much post-treatment deviations from parallel trends can differ from the pre-treatment trend differences ("pre-trends").

One limitation of this method is that it currently supports only universal base periods (the period immediately before the treatment starts), whereas our approach accommodates varying base periods to account for anticipation effects (i.e., periods immediately preceding treatment). Despite this, we can still demonstrate the robustness of our results, even under slightly different settings. The inference approach employed involves using fixed-length confidence intervals (FLCIs).

We first use bounds on relative magnitudes to control post-treatment deviations from parallel trends, limiting them to be no more than a constant, $\bar{M}$, beyond the maximum deviation observed in the pre-treatment period. A higher $\bar{M}$ suggests greater robustness in the model's results. For example, if $\bar{M} = 0$, deviations are strictly linear; $\bar{M} = 1$ means that post-treatment deviations cannot exceed the largest pre-treatment deviation between consecutive periods. Similarly, $\bar{M} = 2$ limits post-treatment deviations to twice the largest pre-treatment deviation. In our analysis, we found that $\bar{M} = 0.25$ is the breakdown value for the 5-year effect and $\bar{M} > 2$ is the breakdown value for the 10-year effect, showing the degree of robustness for our analysis.

These bounds provide a nuanced understanding of how sensitive our estimated treatment effects are to potential violations of the parallel trends assumption, thus enhancing confidence in the robustness of our conclusions.

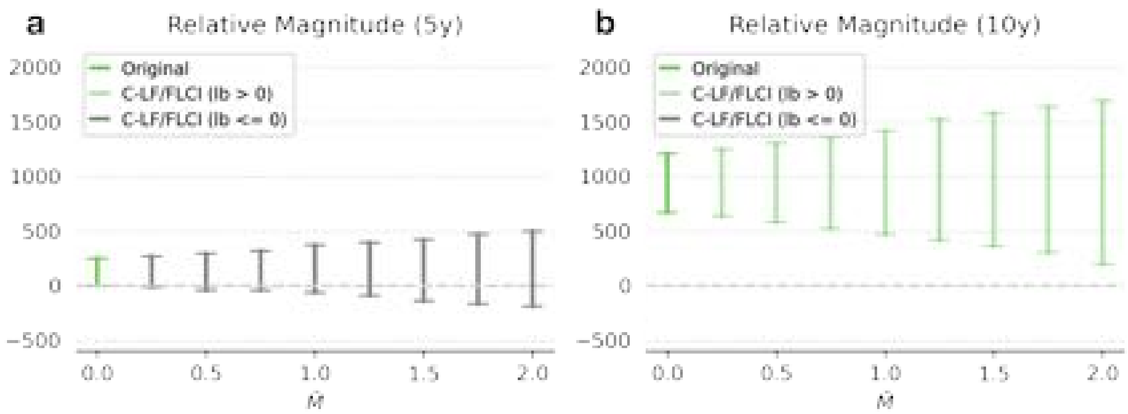


Figure SI 13: Relative Magnitude, test for 5-year and 10-year effect on citations.a 5-year effect on citations. **b** 10-year effect on citations. Where green bars shows the effect remains significant, while the grey bars shows the significance is no longer there.

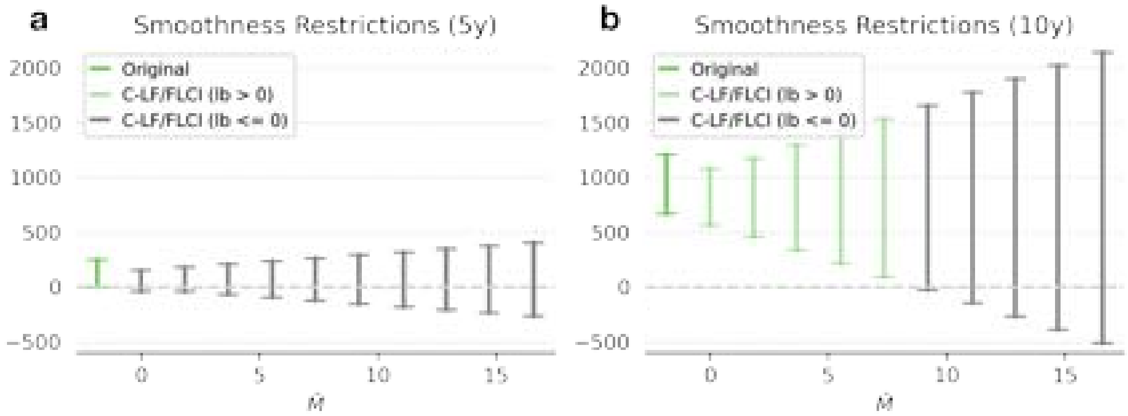


Figure SI 14: Smoothness restrictions, test for 5-year and 10-year effect on citations. **a** 5-year effect on citations. **b** 10-year effect on citations. Where green bars shows the effect remains significant, while the gray bars shows the significance is no longer there.

This is the similar with smoothness restriction, where the breakdown value is $\bar{M} = 0$ for 5-year effect and $\bar{M} = 9.21$ for 10-year effect.

5 Venue effect in science and art

In the next sections we discussed our main findings, explaining the effect upon exposure, variation of venue impact and the heterogeneity of such impact across various groups.

5.1 The venue effect: effect upon exposure

To quantify the impact of exposure to prestigious venues, we calculated the ATT for both scientists and artists who accessed these venues early in their careers. Specifically, we examined the long-term impact on future solo exhibitions and group exhibitions for artists, and on citations and productivity for scientists. This analysis highlights how early engagement with prestigious venues can shape career trajectories over time.

Tables SI 7 and SI 8 detail the ATT for solo and group exhibitions among artists who participated in AV1, a top art venue. The results show a significant and progressively increasing positive effect on both solo and group exhibitions over time. These findings suggest that early participation in a prestigious venue like AV1 can lead to a substantial boost in artist's individual recognition and expanded collaborative opportunities.

Similarly, Tables SI 9 and SI 10 show the ATT for citations and productivity among scientists who secured early publications in the top science venue (SV1, *Nature*). The findings highlight a significant positive effect on future citations and research productivity, with particularly pronounced impacts in later cohorts. These results underscore that early publication in a prestigious journal such as SV1 is associated with a substantial increase in scholarly impact and enhanced, sustained research output over time.

Furthermore, we expanded our analysis to include the broader range of venues outlined in Tables SI 1 and SI 5. In science, we looked at three dimensions of career success: citations, productivity, and number of grants. Our findings indicate that the boost in productivity from listed venues is universal, while the impact on grants and citations is more nuanced and varied by venue. In the realm of art, we observed that the increase in art market performance through participation in art fairs is significant only for AV1, but not for other venues. Our analysis also revealed that top venues demonstrate differential impacts based on their prestige. The specific effects of other prominent venues, such as SV2 and SV3 in science, and

Table SI 7: Average Treatment Effect on the Treated (ATT) for Solo Exhibitions

Cohort	ATT	Std. Err.	z	$P >\| z \|$	95% Conf. Interval
1	0.0434805	0.0223626	1.94	0.052	-0.0003495 to 0.0873105
2	0.0528217	0.0233949	2.26	0.024	0.0069686 to 0.0986747
3	0.0368602	0.0240359	1.53	0.125	-0.0102492 to 0.0839697
4	0.0377393	0.0259236	1.46	0.145	-0.01307 to 0.0885486
5	0.0917968	0.0283735	3.24	0.001	0.0361858 to 0.1474078
6	0.2179467	0.049631	4.39	0.000	0.1206718 to 0.3152216
7	0.3451936	0.0696229	4.96	0.000	0.2087352 to 0.4816521
8	0.4500096	0.0899149	5.00	0.000	0.2737795 to 0.6262396
9	0.5709145	0.1109292	5.15	0.000	0.3534973 to 0.7883317
10	0.6227474	0.1326954	4.69	0.000	0.3626692 to 0.8828257
11	0.7164322	0.1552865	4.61	0.000	0.4120763 to 1.020788
12	0.7916897	0.1785449	4.43	0.000	0.4417481 to 1.141631
13	0.9176271	0.2012485	4.56	0.000	0.5231872 to 1.312067
14	1.011305	0.2232172	4.53	0.000	0.5738075 to 1.448803
15	1.107726	0.2427365	4.56	0.000	0.6319708 to 1.58348

AV2 in the arts, further show their significant influence on individuals' future career performance in citations and exhibitions (Figure SI 16). These findings emphasize that while prestigious venues broadly contribute to career advancement, the extent of their impact varies, highlighting the importance of venue-specific prestige and influence in shaping long-term professional trajectories.

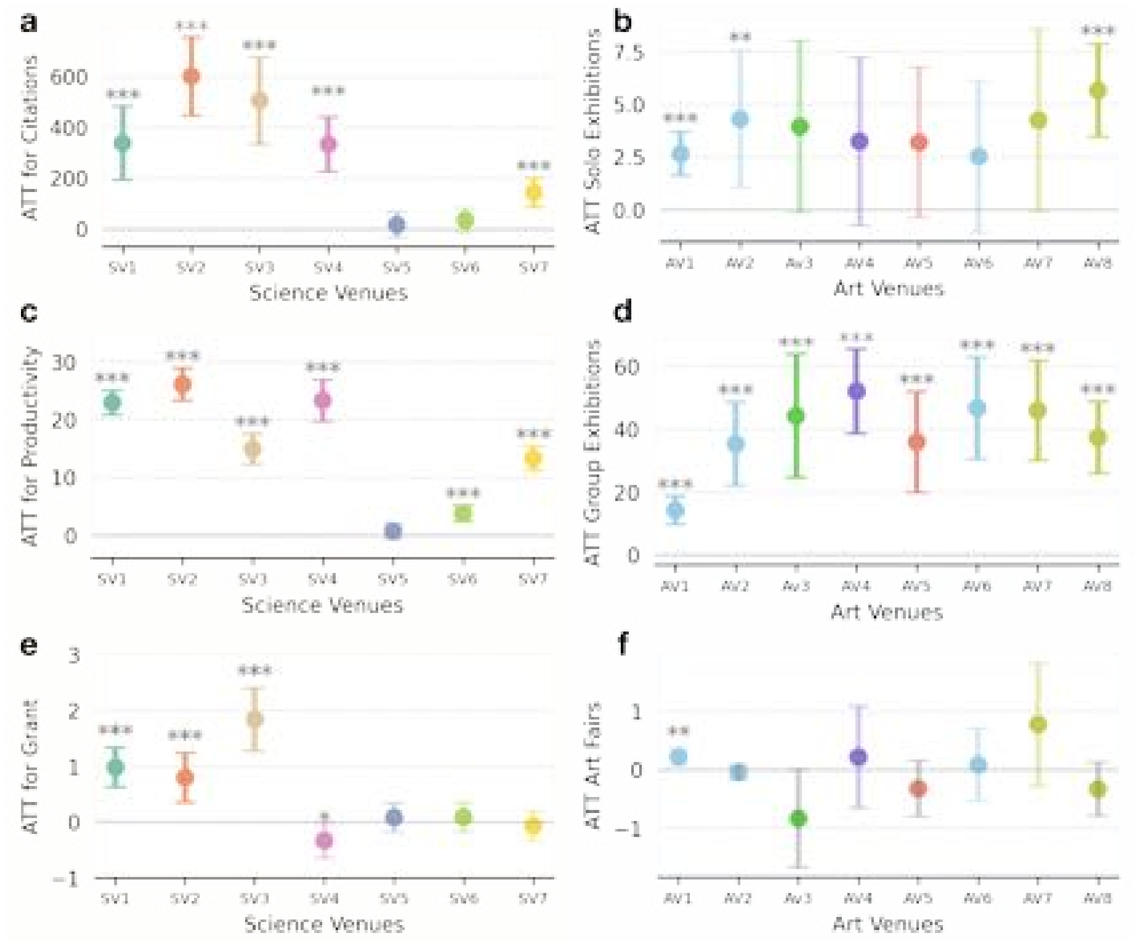


Figure SI 15: Effect of having access to arts and science venues. **(a,c,e)** Effect of publishing in science venues on future citations, productivity, and grants. **(b,d,f)** Effect of participating in art venues like biennials on future solo/group exhibitions and art fairs.

Table SI 8: Average Treatment Effect on the Treated (ATT) for Group Exhibitions

Cohort	ATT	Std. Err.	z	$P >\mid z \mid$	95% Conf. Interval
1	0.0808435	0.0564797	1.43	0.152	-0.0298547 to 0.1915417
2	0.1370142	0.065636	2.09	0.037	0.00837 to 0.2656583
3	0.243259	0.0719004	3.38	0.001	0.1023369 to 0.3841812
4	0.1125388	0.0758454	1.48	0.138	-0.0361155 to 0.261193
5	0.2302671	0.0810834	2.84	0.005	0.0713466 to 0.3891877
6	0.7051904	0.1625197	4.34	0.000	0.3866576 to 1.023723
7	1.27164	0.2468262	5.15	0.000	0.7878699 to 1.755411
8	1.768339	0.3503667	5.05	0.000	1.081633 to 2.455045
9	2.318053	0.4472171	5.18	0.000	1.441524 to 3.194583
10	2.788965	0.5433192	5.13	0.000	1.724079 to 3.853851
11	3.309274	0.6461006	5.12	0.000	2.04294 to 4.575608
12	3.819694	0.7500309	5.09	0.000	2.34966 to 5.289727
13	4.383481	0.8520504	5.14	0.000	2.713493 to 6.053469
14	4.927331	0.9553665	5.16	0.000	3.054847 to 6.799815
15	5.489305	1.061287	5.17	0.000	3.40922 to 7.56939

Table SI 9: Average Treatment Effect on the Treated (ATET) for Citations

Exposure	ATET	Std. Err.	z	$P >\mid z \mid$	95% Conf. Interval
-4	7.888383	3.093446	2.55	0.011	[1.825341, 13.95143]
-3	8.064015	3.405436	2.37	0.018	[1.389483, 14.73855]
-2	12.94150	3.958298	3.27	0.001	[5.183380, 20.69962]
-1	18.46639	4.602749	4.01	0.000	[9.445170, 27.48761]
0	18.00483	5.322943	3.38	0.001	[7.572056, 28.43761]
1	36.63492	10.78469	3.40	0.001	[15.49730, 57.77253]
2	64.20181	16.88927	3.80	0.000	[31.09944, 97.30418]
3	106.7065	23.68647	4.50	0.000	[60.28183, 153.1311]
4	162.3771	31.24301	5.20	0.000	[101.1419, 223.6123]
5	231.9471	39.90284	5.81	0.000	[153.7390, 310.1552]
6	323.8074	49.88491	6.49	0.000	[226.0348, 421.5800]
7	433.6566	60.87751	7.12	0.000	[314.3389, 552.9744]
8	563.8856	73.02456	7.72	0.000	[420.7601, 707.0111]
9	696.5248	84.27361	8.27	0.000	[531.3515, 861.6980]
10	841.6303	97.31984	8.65	0.000	[650.8869, 1032.374]

Table SI 10: Average Treatment Effect on the Treated (ATT) for Productivity

Cohort	ATT	Std. Err.	z	$P >\| z \|$	95% Conf. Interval
1	1.581649	0.1315123	12.03	0.000	[1.32389, 1.839409]
2	1.915073	0.1418984	13.50	0.000	[1.636958, 2.193189]
3	2.333464	0.1584781	14.72	0.000	[2.022852, 2.644075]
4	2.766208	0.1589278	17.41	0.000	[2.454715, 3.077701]
5	4.65626	0.1823988	25.53	0.000	[4.298765, 5.013755]
6	8.811817	0.3575462	24.65	0.000	[8.111039, 9.512595]
7	12.61149	0.5355363	23.55	0.000	[11.56186, 13.66112]
8	16.40629	0.7060828	23.24	0.000	[15.02239, 17.79019]
9	20.19121	0.8796173	22.95	0.000	[18.46719, 21.91523]
10	24.12453	1.070611	22.53	0.000	[22.02617, 26.22289]
11	28.05814	1.266047	22.16	0.000	[25.57673, 30.53954]
12	31.76757	1.444341	21.99	0.000	[28.93672, 34.59843]
13	35.36721	1.625708	21.75	0.000	[32.18088, 38.55354]
14	38.99457	1.799712	21.67	0.000	[35.4672, 42.52194]
15	42.61306	1.973322	21.59	0.000	[38.74542, 46.4807]

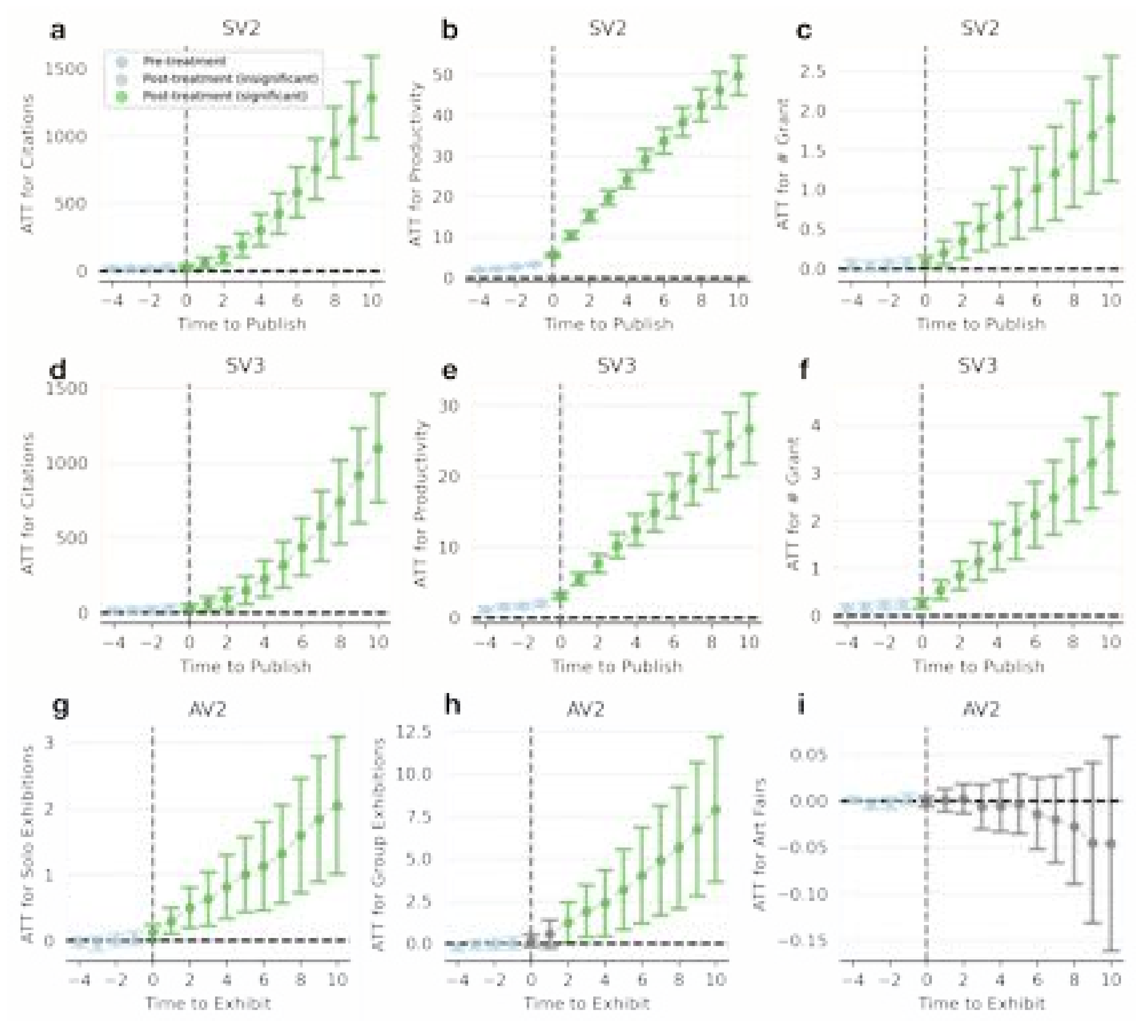


Figure SI 16: Venue effect in art and science. **(a-f)** Venue effect of publishing in the top scientific journals SV2 and SV3, future citations, productivity, and number of grants. **(b, d)** Venue effect of participating in the top biennial AV2 on solo/group exhibitions and art fairs.

5.2 Venue effect in science: Pre-venue publications' citations

The heterogeneous difference-in-differences framework relies on the parallel trends assumption and the absence of unobserved confounders—most importantly, research quality—which is inherently difficult to guarantee.

Thus, to further control for such confounders, including the research quality channel (1) in Figure SI 17, we focused on a new design that examines pre-venue publications—papers whose scientific quality and resource inputs are fixed prior to venue

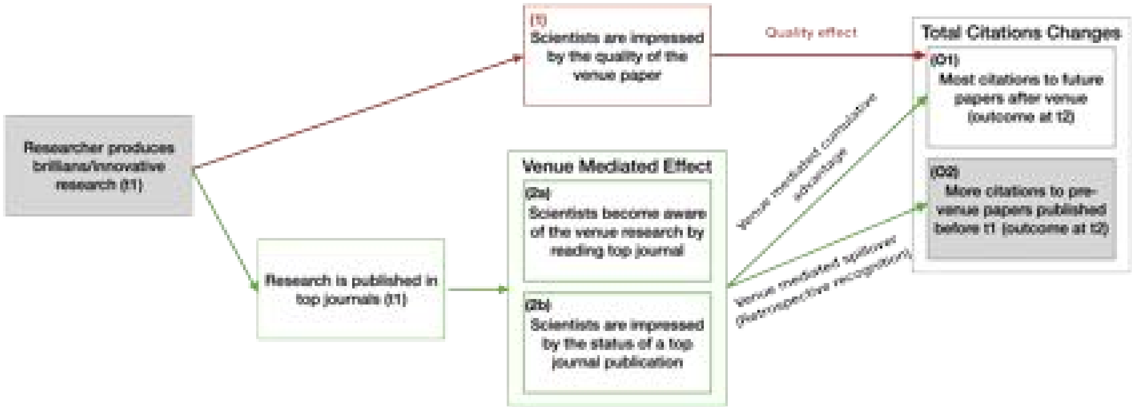


Figure SI 17: DAG for our pre-venue citations design. Pre-venue citations isolate status spillovers (status signaling + dissemination of venue work on pre-venue publications), holding research quality constant, as a partial estimation of the overall venue mediated effect.

access. As highlighted in the DAG, changes in citations to pre-venue papers provide a clean estimate for status-mediated spillovers: because these papers were produced before venue publication, post-access increases in their citations cannot be attributed to contemporaneous improvements in research capacity or paper quality. Building on this measure, we re-estimate our effect with heterogeneous difference-in-differences on citation trajectories for pre-venue publications. As shown in Figure SI 18, we find a consistent pattern across SV1–SV3: citations to pre-venue papers rise sharply following authors' publications to a top journal. Although they only account for a partial portion of the overall post-venue citation gains outside the focal venue paper (10-year ratio for SV1: 11.4%, SV2: 18.8%, SV3: 32.5%), the post-treatment trend remains positive and statistically significant, indicating venue-mediated spillovers.

Taken together, these findings reveal a clear venue effect on the future citations of pre-venue work. In line with the mechanism in paths (2a)–(2b), access to a prestigious journal appears to redirect scientific attention toward an author's earlier research—work whose intrinsic quality has not changed—consistent with a status-based spillover rather than a quality-driven response.

5.3 Venue effect in science: "Twin-research" pair

We construct a "twin research" dataset by starting with over 3,000 Nature (SV1) papers categorized as physics, published between 2000 and 2010 and forming 13,250 candidate twin pairs that meet five bibliometric filters: (1) published within one year of each other, (2) no overlapping authors, (3) at least 50% overlap in forward citations, (5) each cited by ≥ 5 papers, and (6) at least 10 mutual forward citations [25]. We then validate similarity with the DeepSeek-V3 language model: using a structured

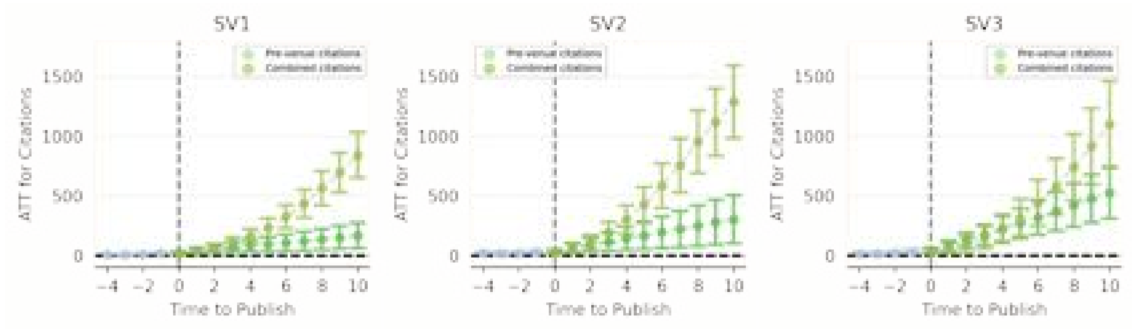


Figure SI 18: ATT for pre-venue works' citations (venue-mediated spillover) & overall citations (overall venue mediated effect) of SV1, SV2 and SV3. ATT for pre-venue work's citations (10-yr): SV1: 167, SV2: 303, SV3: 525 (all p $-$ values < 0.001), which accounts for partial estimate of ATT of overall citations excluding the focal paper (10-yr): SV1: 841, SV2: 1288, SV3: 1089.

prompt, we keep only pairs labeled "twin research" with confidence ≥ 0.9 on a 0–1 scale. These steps yield 561 Nature focal papers paired with 1,399 twin papers from other journals. Restricting to physicists with at least one year of post-publication observation in Dimensions and excluding large collaborations (team size > 20) results in a final, validated set involving 2,111 SV1-published authors and 361 control authors. The workflow is summarized in Figure SI 19.

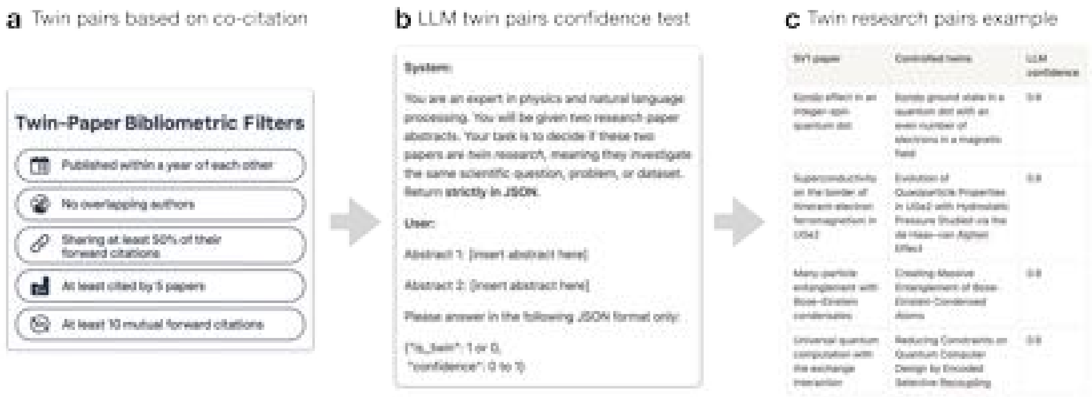


Figure SI 19: ATT for citations, SV1 published papers versus twin research.

Finally, we replicate the analysis using a heterogeneous difference-in-differences design again on SV1 (Nature)–published authors and their matched twin-paper counterparts (Figure SI 20). The estimates show a sharp post-publication divergence: ATTs for both citations and productivity rise monotonically from the publication year onward, with confidence intervals excluding zero across most post-treatment years, while pre-treatment trends remain flat and near zero, supporting the design's identifying assumptions. Effects on grant counts are smaller and imprecisely estimated. Taken together, the results indicate again that publishing in top journals like SV1 is associated with sizable and persistent downstream effects in citations, productivity, and grants between groups of research with comparable research focus.

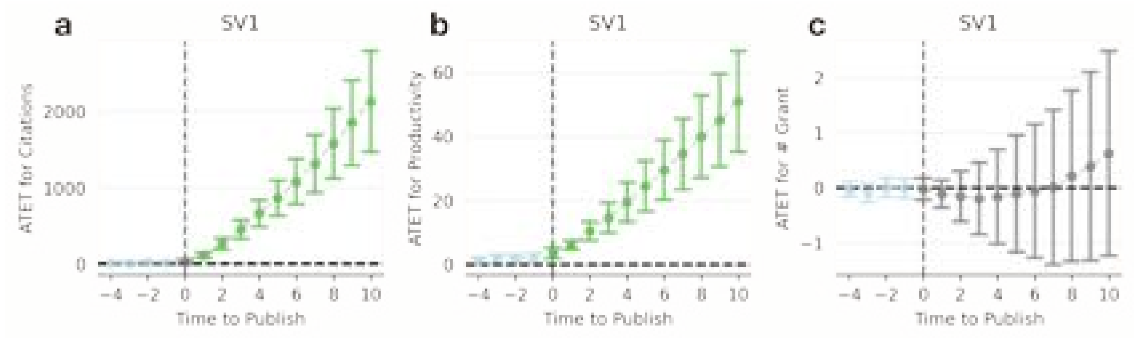


Figure SI 20: Twin research design: from co-citation network to LLM-based identification. The dataset was constructed through a two-step process. First, candidate twin papers were identified based on temporal proximity, shared authorship, and high citation and co-citation overlap. Second, we applied an LLM-based textual similarity check with confidence scoring to verify conceptual alignment. Finally, pairs passing both the co-citation and LLM similarity criteria were retained.

5.4 Venue effect in science: Incorporating reviewer scores from ICLR

Further, We exploited the ICLR review process, which generates quasi-random variation in acceptance near the decision threshold. This design shows more randomness among papers whose acceptance hinges on threshold score differences, making them effectively comparable in latent quality. By comparing "close accept" and "close reject" submissions, we examine research of very similar quality, thereby tightening identification of the venue effect. Moreover, we show that the distributional balance of our matched sample closely resembles that of the near-threshold ICLR submissions, reinforcing that unobserved differences are plausibly limited.

- **Reviewer Scores as Proxies for Paper Quality in ICLR:** First, we extend our study using the ICLR dataset covering all submissions (all tracks and decisions), with Reviewer scores, meta-reviews, and full PDFs. This setting lets us address concerns that baseline estimates conflate research quality with venue effects via two complementary strategies: Fuzzy Regression Discontinuity Design (RDD) comparing submissions near acceptance cutoffs to leverage quasi-random variation, and comparing these results with heterogeneous difference-

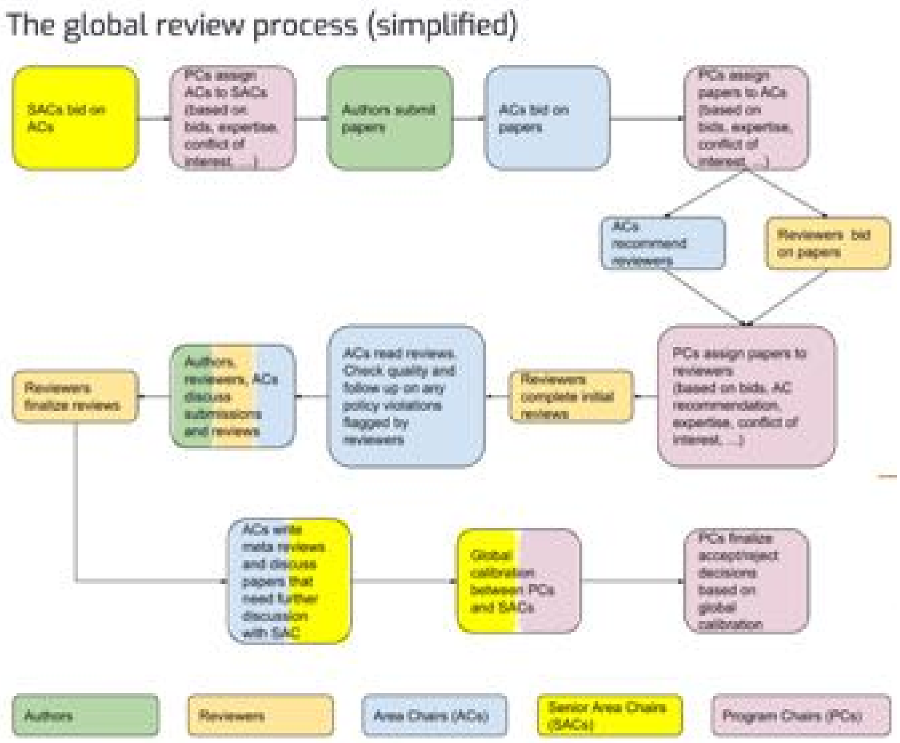


Figure SI 21: Global review process for conference venues with ICLR as an example.

in-differences estimates across author groups within score intervals confirms the consistency of our findings.

- **Credibility of Reviewer Scores in the ICLR Review Process:** As in Figure SI 21, it summarizes why Reviewer assessments are credible quality proxies: SACs and ACs coordinate multiple independent reviews and meta-reviews, and final average Reviewer scores carry substantial weight in acceptance decisions. Because acceptance is monotone but not deterministic in score, the score induces a fuzzy threshold: papers just above and just below the cutoff have near-identical assessed quality but different acceptance probabilities, as Figure SI 22a shows. Specifically, in the interval around the threshold, [5.5, 6.5] near the 6.0 cutoff, the probability of acceptance jumps discontinuously from approximately 29% to 94%. This discontinuity creates quasi-random assignment of acceptance status among submissions of nearly identical assessed quality. We therefore use the mean Reviewer score as the running variable and acceptance as the fuzzy treatment, leveraging quasi-experimental variation around the cutoff. This combination of granular quality measurement and local discontinuity strengthens our ability to isolate the role of venue status beyond what is feasible in other domains.

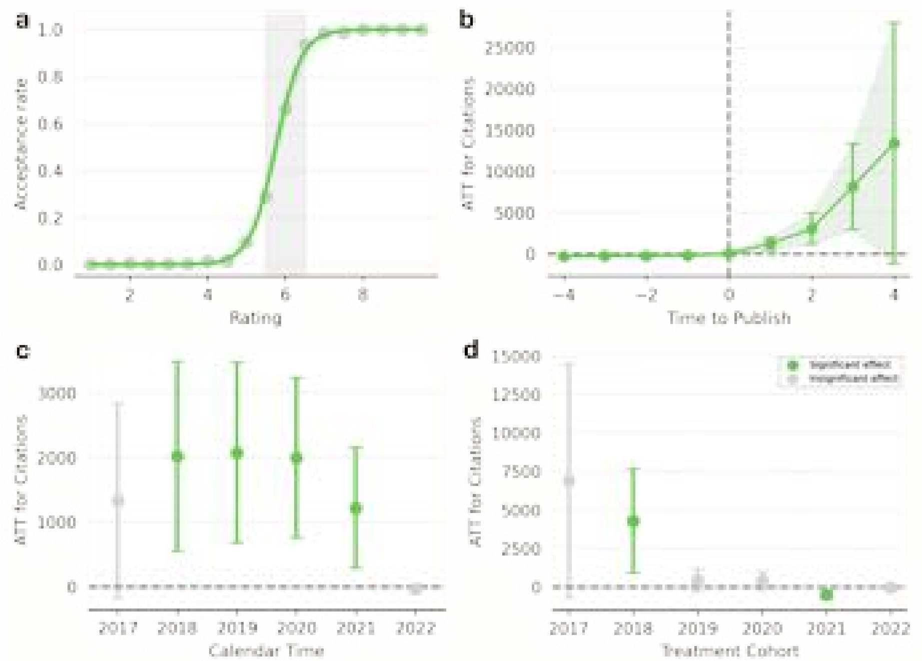


Figure SI 22: heterogeneous difference-in-differences: ICLR accepted/rejected papers.

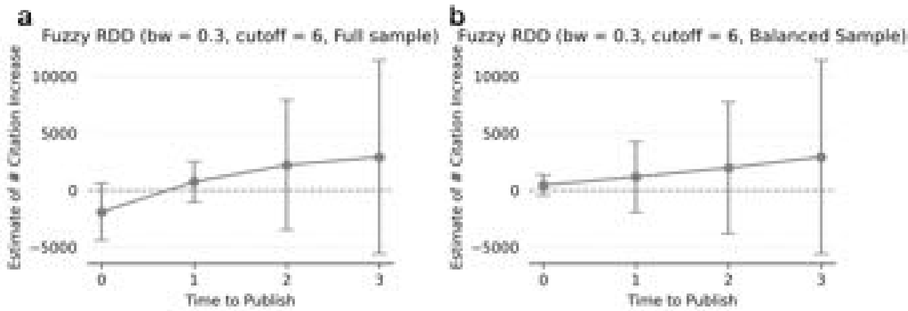


Figure SI 23: Estimates of acceptance effect on cumulative citations (ICLR).

- **Venue Effects from Near-Threshold ICLR Submissions**: we replicated the heterogeneous difference-in-differences estimates around the ICLR acceptance cutoff (bandwidth 0.3, cutoff 6). As in Figure SI 22b-d, by comparing within-author trajectories before and after venue access, it shows statistically significant and positive effects even in a younger venue like ICLR. Further, we estimate a fuzzy RDD around the ICLR acceptance cutoff (bandwidth 0.3, cutoff 6), using both a full unbalanced sample and a balanced sample requiring at least three years of follow-up. Although estimates have limited significance due to the limited number of near-threshold submissions, point estimates are consistently positive (Figure SI 23), and results converge across specifications. Together with planned sensitivity analyses (Oster's δ bounds and gamma-value assessments), this design complements the main analysis and reinforces the interpretation that observed effects reflect recognition amplification rather than underlying differences in research quality.

5.5 Beyond physics: Venue effect across different disciplines

In this section, we extended our analysis to a selection of journals venues from: chemistry, biology, and Social Science to evaluate the impact of publishing in these venues on future career citations and publications. The selection criterion for these journals are summarized in Table SI 3, Table SI 2, and Table SI 4.

In terms of biology and chemistry journals, we examine both multidisciplinary top and historic venues (Nature, Science, PNAS) and more recent field-flagship journals like Cell and Nature Chemistry. As shown earlier in Table SI 3 and Table SI 2, we report both the journal impact factors (JIF 2023) and the number of unique authors across these venues.

We observed statistically significant post-publication boosts in future citations for biologists publishing in Nature, Science, PNAS, and Cell, as well as for chemists publishing in both the top multidisciplinary science venues and more recent field-flagship venues such as Nature Chemistry. These results as in Figure SI 20, reinforce the generalizability of the venue-effect pattern across disciplines. Consistent with our findings in physics, we also document clear temporal variation in the magnitude of these effects though with different timing: in biology, the citation impact of publishing in Nature and other top venues becomes markedly stronger only after the late 1980s, and 1990s for chemistry as in Figure SI 24.

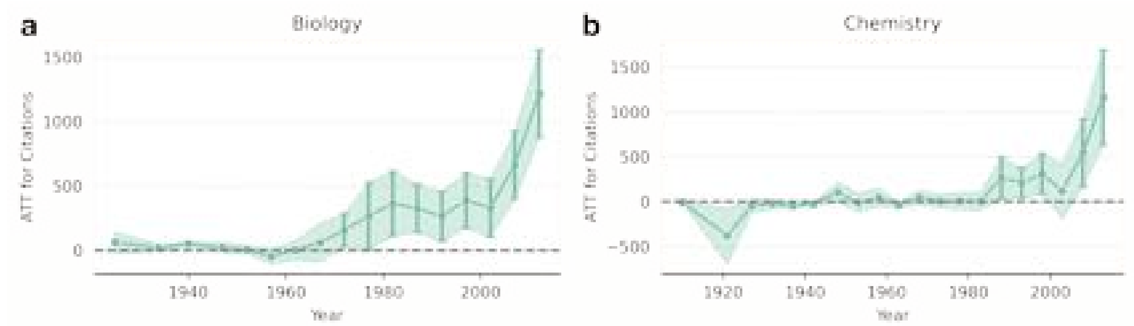


Figure SI 24: ATT for citations upon accessing top venues in biology (left) and chemistry (right). The effect becomes prominent for biology after the 1980s and for chemistry after the 1990s.

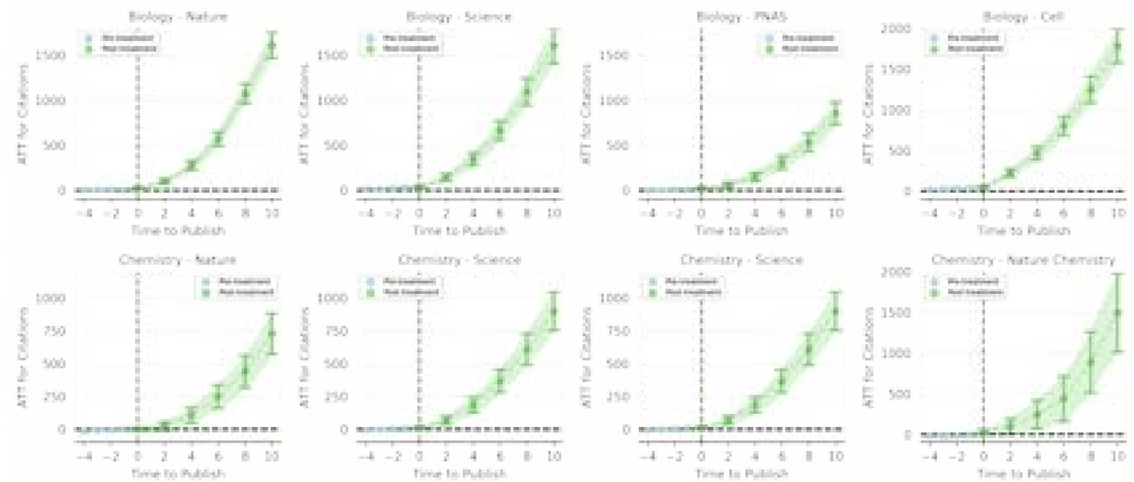


Figure SI 25: ATT for citations upon accessing top venues in biology and chemistry. These two fields show similar significant growth to what has been observed for physicists and social scientists (5-year effect of SV1 (*Nature*) on citations for physicists: 800+, for social scientist: 500+, for biologists: 1600+, for chemists: 700+.)

Other than STEM subjects, in terms of social science journals (SSV1–SSV6) as illustrated in Figure SI 27, our results reveal a boost in future citations for the top journal, SSV1; however, this significant effect is not consistently present across other sociological venues. Furthermore, even for SSV1, the positive impact appears limited in magnitude, significance, and duration. The citation growth following publication in SSV1 remains statistically significant (Figure SI 27a), but the observed boost in productivity shows a notable level of significance only within the first five years post-publication (Figure SI 27g). The citation effect of SSV1 begins to rise after the 2000s and becomes pronounced only for cohorts entering after 2010 (Figure SI 26).

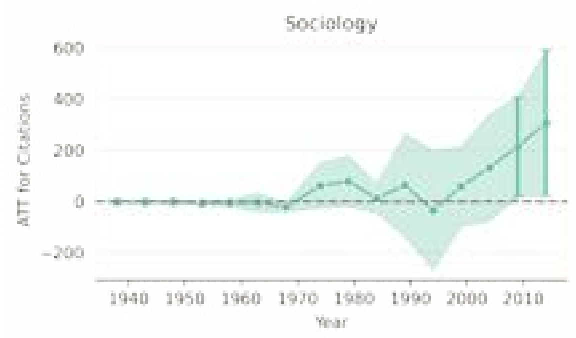


Figure SI 26: Effect of having access to SSV1 (ASR) by cohort, showing a pronounced increase in impact for cohorts entering after the 2000s.

Furthermore, we replicated the analysis of temporal variation and effect heterogeneity for biology, chemistry, and sociology, as shown in Figure SI 28, Figure SI 29, and Figure SI 30. These results reveal consistent patterns, with men, late-career and western scientists constantly receiving consistent and prominent benefits from venue effects. In STEM fields like physics, biology and chemistry, Asian scientists also show a significant boost in future citations, while this effect is limited for Sociology. Regions like South American and African either observed a limited growth, also lacking of data points to estimate the effect.

5.6 Venue effect: Not-yet treated comparison

As Callaway and Sant'Anna [23] pointed out, there is an option to use comparisons involving the "Not-yet treated" group—those who will eventually receive the treatment but have not yet done so. By leveraging this approach, the average effect of participating in the treatment for units in a specific group can be accurately identified up until the point when the last treated group "effectively" starts their treatment.

In applying this method to scientific publication venues, we considered that all authors in the dataset were potential candidates for similar prestigious venues, while the control group consisted of individuals who had not yet published in such venues but were expected to do so in the future. Our findings documented a similar positive effect on future citations and productivity following publication in top-tier venues,

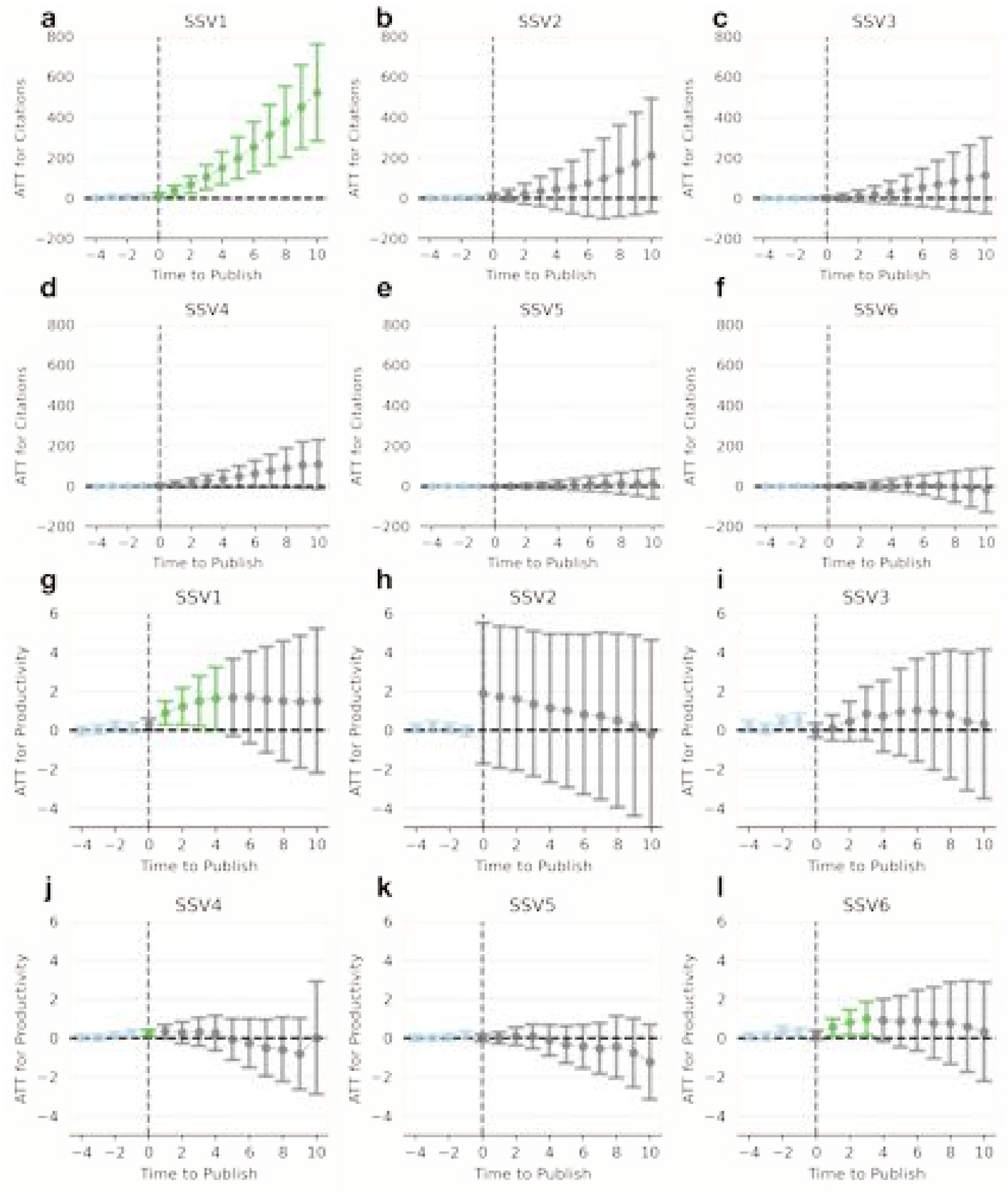
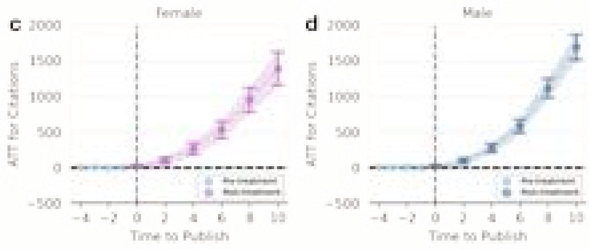
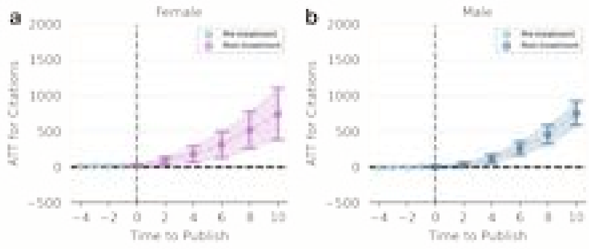


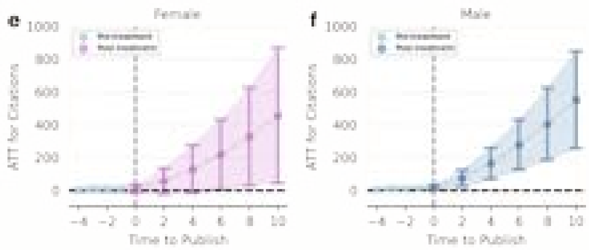
Figure SI 27: Effect of having access to social science venues after 1990 (sociology) in citations and productivity. **(a-f)** Effect of publishing in social science journals SSV1-6 on future citation growth. **(g-i)** Effect of publishing in social science journals SSV1-6 on future productivity growth.



(A) Biology

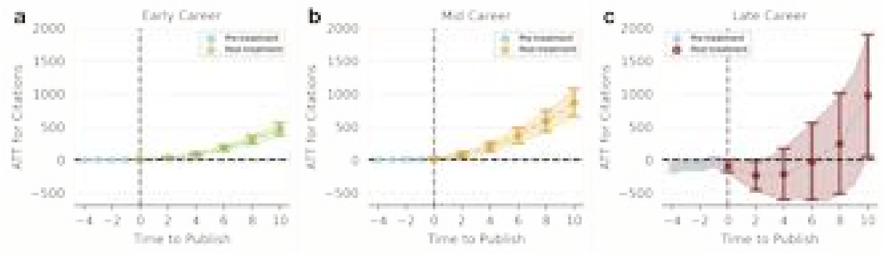


(B) Chemistry

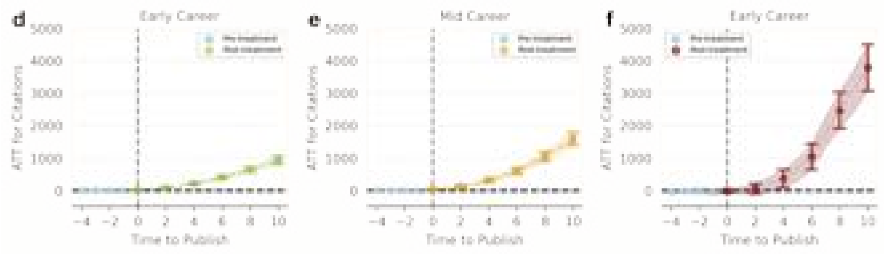


(C) Sociology

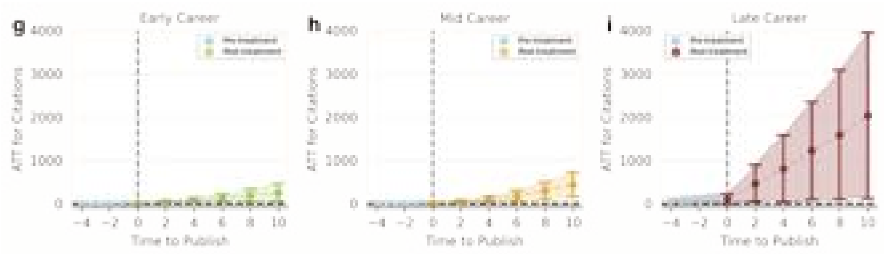
Figure SI 28: Average treatment effects (ATT) by gender. (A)(a,b) Heterogeneity of effects by gender for researchers working in biology (10-year ATT: 1684.88 for women, and 1387.06 for men). (B)(c,d) Heterogeneity of effects by gender for researchers working in chemistry (10-year ATT: 743.24 for women, and 758.69 for men). (C)(e,f) Heterogeneity of effects by gender for researchers working in sociology (10-year ATT: 455.51 for women, and 551.29 for men). Women researchers in general experience less citation boost compare to men.



(A) Biology

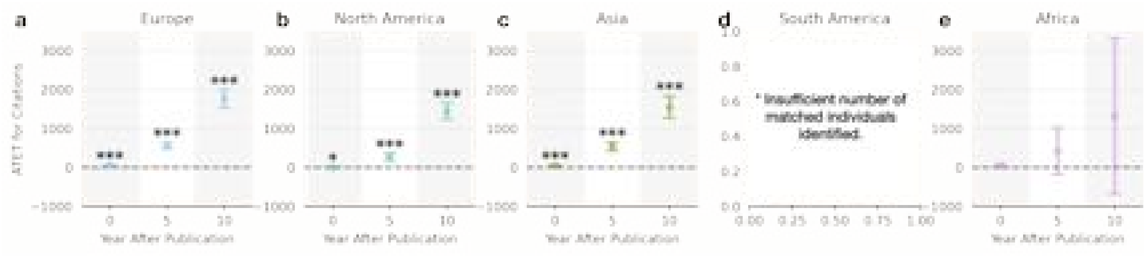


(B) Chemistry

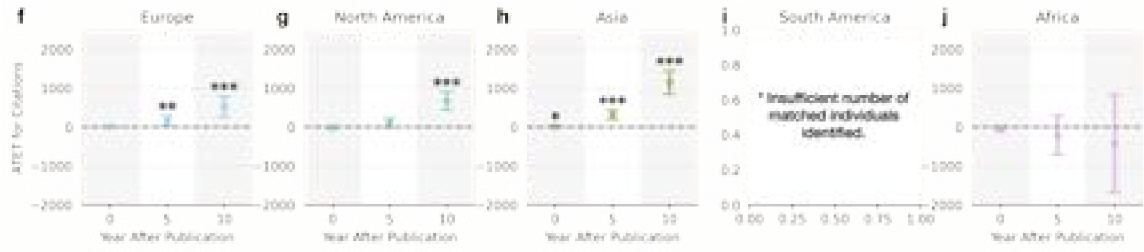


(C) Sociology

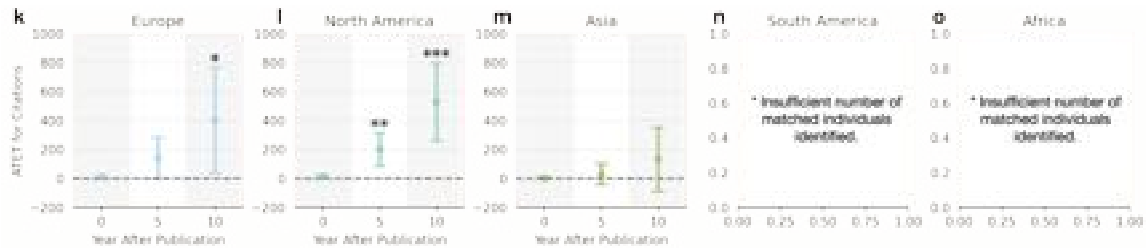
Figure SI 29: Average treatment effects (ATT) by career stages. (a-c) Heterogeneity by career stages for researchers working in biology (10-year ATT: 945.10 for early-career, 1591.40 for mid-career, and 3787.32 for late-career). (d-f) Heterogeneity by career stages for researchers working in chemistry (10-year ATT: 466.87 for early-carrer, and 867.85 for mid-career, and 976.25 for late-career). (g-i) Heterogeneity by career stages for researchers working in sociology (10-year ATT: 251.34 for early-career, and 439.39 for mid-career, 2033.51 for late-career). Late career researchers in general experience more citation boost compare to early and mid career.



(A) Biology



(B) Chemistry



(C) Sociology

Figure SI 30: Average treatment effects (ATT) by regions. (a-e) Heterogeneity by regions for researchers working in biology (10-year ATT: 1768.34 for Europe, 1446.56 for North America, 1552.65 for Asia, 1317.06 for Africa. Samples are too limited for effect estimation of South America). (f-j) Heterogeneity by regions for researchers working in chemistry (10-year ATT: 525.42 for Europe, 675.87 for North America, 1150.25 for Asia, -422.01 for Africa. And samples are too limited for effect estimation of South America). (k-o) Heterogeneity by regions for researchers working in sociology (10-year ATT: 403.70 for Europe, 528.92 for North America, 131.89 for Asia. Samples are too limited for effect estimation of South America and Africa).

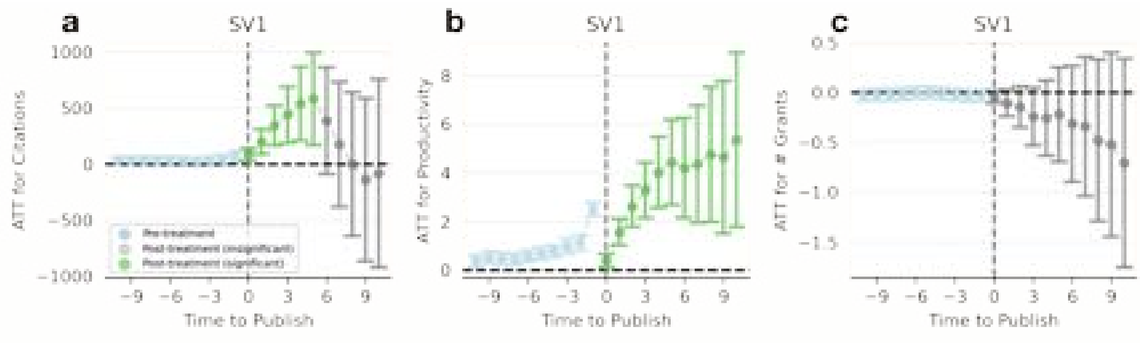


Figure SI 31: Documenting the venue effect in science using the not-yet treated control group. By estimating the ATT following participation in prominent science (a-d) and art venues (f-i), for science we find an evident positive effect primarily on immediate citation growth within the observation window 1990-2005. **a-c** show the ATT for publication in SV1, capturing its impact on future outcomes: **a** citations, **b** productivity, and **c** the number of grants.

reinforcing the robustness of the observed venue impact (Figure SI 31). While this approach strengthens comparability by verifying parallel trends among future top-venue publishing scientists, it cannot fully isolate venue effects from the quality of the treated work itself. Still, the persistent and steep post-treatment differences we observe are important in their own right, as they reflect real-world amplification dynamics.

5.7 Venue effect in science: authors from WoS

we now replicate our entire workflow using Web of Science (WoS) data from 1945 up to 2017. This allows us to demonstrate that Dimensions is not the sole viable data source and that our findings remain robust even under an alternative documentation of authors and publications. Following the same gender-identification procedure used in prior work [2], we re-constructed researchers' productivity, citation profiles, affiliations, and demographic attributes (with the exception of grants, which are not available in this dataset). Starting from over 1.07 million authors publishing in physics journals (as classified by WoS Core Collection Subject Areas), and restricting the sample to physicists with reliably available affiliation information after 2000, we now recalculate effect of publishing in SV1, SV2, and SV3, and obtain highly consistent estimates as in Figure SI 32. We continue to observe a substantial and statistically robust post-publication boost associated with publishing in SV1 (Nature, 10-year ATT: 3446.79), SV2 (Science, 10-year ATT: 3678.82), and SV3 (PNAS, 10-year ATT: 2793.43). While the estimates in WoS are larger in scale compared to Dimensions, reflecting the post-2000 restriction, the effects remain statistically robust.

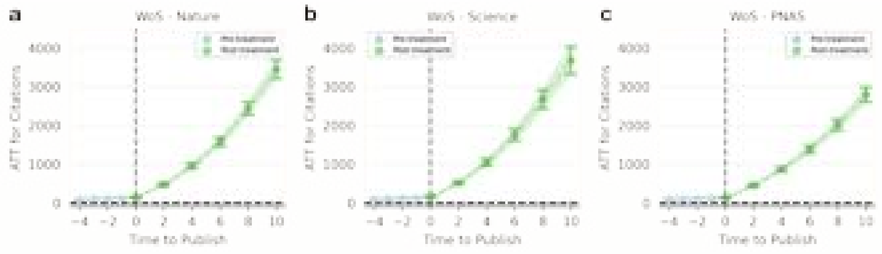


Figure SI 32: Average treatment effect (ATT) on citations and productivity for authors publishing in physics journals. (a) SV1 (Nature), 10-year ATT: 3446.79; (b) SV2 (Science), 10-year ATT: 3678.82; (c) SV3 (PNAS), 10-year ATT: 2793.43.

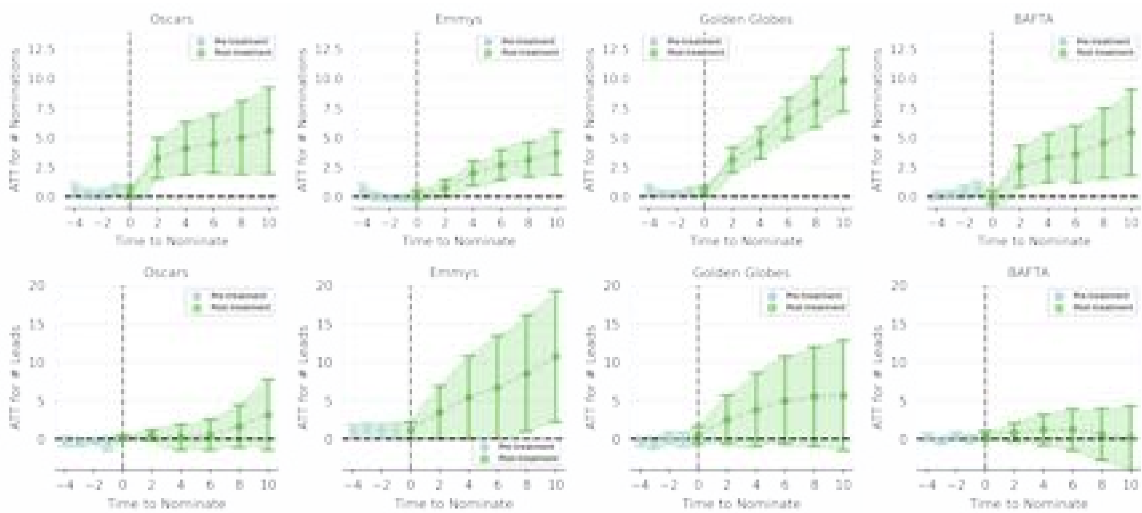


Figure SI 33: ATT for top movie awards on future nominations and future leading roles.

5.8 Venue effect in performing arts

We gathered additional data of venues and performers' profiles in the film and performing arts domain, where gatekeeping operates through access to major festivals and award systems rather than journals or biennales. Specifically, we curated a dataset from IMDb of performers and their participation in top-tier awards, the Oscars and BAFTAs (primarily film), the Emmys (television), and the Golden Globes (a hybrid platform recognizing both).

We assembled a panel of over 3,800 nominees (including 1,100 winners) for major acting awards and tracked two longitudinal dimensions for each individual: (i) productivity and visibility (measured by the number of leading film roles) and (ii) recognition (subsequent nominations, excluding those tied to the focal award-winning work). As shown in Figure SI 33, we again observe a post-award boost in both visibility and recognition, indicating that elite venues in the film industry similarly shape performers' subsequent careers. This effect is especially evident in future nominations, which display both an immediate increase following award receipt and a sustained upward trend thereafter. While the statistical significance for changes in leading-role counts is modest due to sample size limitations, the direction of effects remains consistent with our broader framework: award recognition enhances future opportunities, with stronger effects in television awards, where the network dynamics of status circulation are more fluid than in film. This extension reinforces our argument that status benefits operate across creative systems, and that their magnitude and persistence vary with institutional gatekeeping structures.

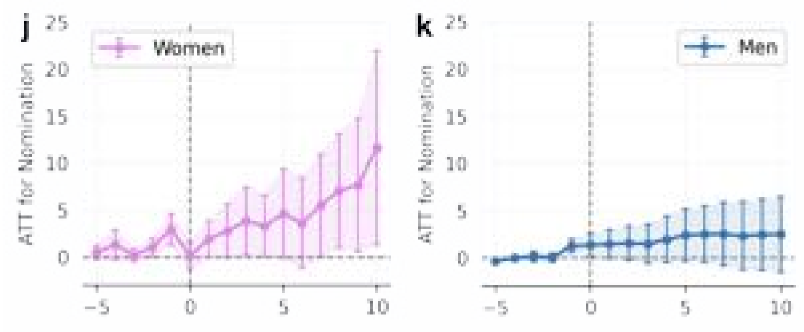


Figure SI 34: ATT for nominations, upon Oscars awards for performers by gender.

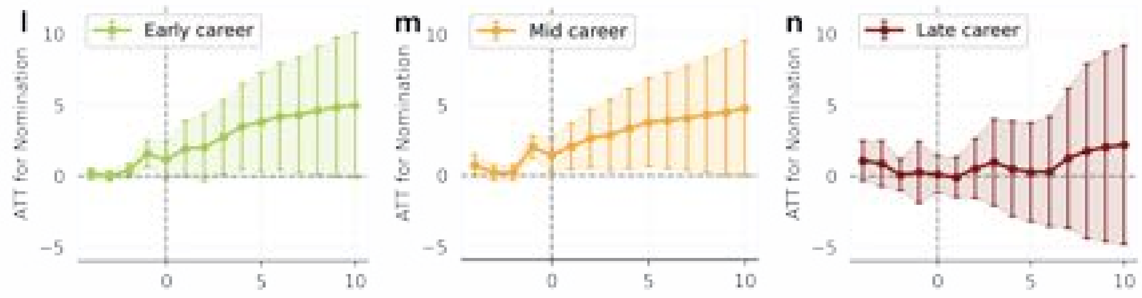


Figure SI 35: ATT for nominations, upon Oscars awards for performers by career stages. Early career: < 10**yr, mid:** $10 - 30$**yr, late:** > 30**yr.**

Then we examine the heterogeneity of effects by gender and career stages as in Figure SI 34 and SI 35, while noting the smaller sample, we find that women (early and mid-career) winners experience larger post-award gains in recognition (future nominations/credits) than men. Interpreted through gatekeeping theory, this aligns film with art biennials and contrasts with science. In both film and art biennial contexts, gatekeeping consecrates the individual, the performer or artist through curatorial or

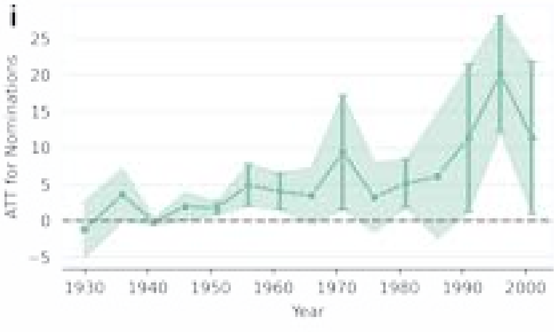


Figure SI 36: ATT for nominations by different cohort, upon Oscar award winning.

academy selection embedded in publicity-intensive circuits (press, agents, galleries, and award campaigns). Such socially mediated processes, grounded in Bourdieu's notion of symbolic capital and consecration of cultural production [26], can counteract baseline market biases and yield larger marginal gains for historically underrepresented groups, illustrating a status reallocation dynamic rather than the purely cumulative effect observed in science [27], [28]. These results reinforce the domain-specific mechanisms behind the observed gender divergence.

And we also observed the effect by different cohorts for Oscars winning, which the magnitude of effect become prominent also after 1990s, though with limited significance since the lack of sample for nominees compared to biennial participation (in Figure SI 36).

5.9 Venue effect for different novelty groups

In this section, we discuss the nature and novelty of creators' output, and for highlighting Galenson's framework of conceptual versus experimental innovators, as well as the role of atypical combinations [29].

We followed Uzzi et al and measured tail novelty (the frequency of atypical reference pairings) and median conventionality (the central tendency of z-scores in the reference co-occurrence distribution) [29]. As shown in Figure SI 37, we find that tail novelty alone is not a significant predictor of authors' long-term citation gains. In contrast, high median conventionality, papers that effectively balance novel elements with a stable, canonical knowledge base, is strongly associated with higher post-publication citation growth. This pattern holds consistently across both scientific venue comparisons (SV1 and SV2), where authors publishing in venues characterized by high median conventionality (median $z > 0$) exhibit systematically greater citation accumulation over the decade following publication. This result aligns with prior findings that impactful scientific work often integrates novelty within established

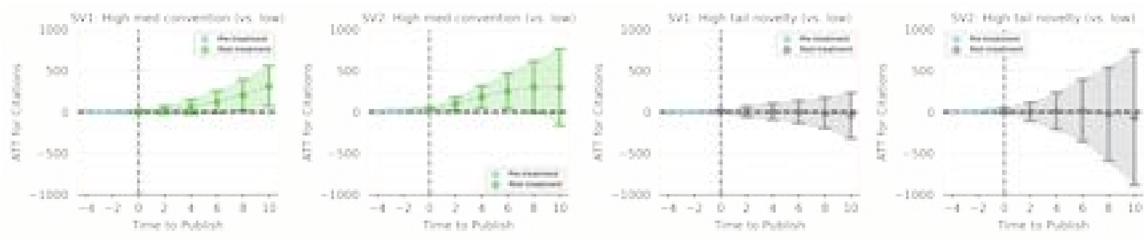


Figure SI 37: ATT for paper novelty and conventionality comparison upon SV1 and SV2 publication.

cognitive structures rather than maximizing novelty alone [29], [30].

5.10 Variation of venue effect

To investigate the impact of less prestigious venues on career development in science and the arts, other than the top venues SI 11, we also analyzed the effects of publishing in scientific venues SV4 to SV7 and participating in art venues AV3 to AV5. In science, our analysis revealed that the impact of publishing in these high-volume, lower-tier journals on future citation growth was generally limited. Specifically, only SV4 (the top disciplinary venue for decades) demonstrated a steady and positive boost to future citations (Figure SI 38a), while the other venues showed negligible effects. In the arts, participation in less prestigious biennials similarly did not result in a significant increase in solo exhibitions, highlighting an overall insignificant boost in individual recognition (Figure SI 38c). Interestingly, we observed that the top disciplinary physics journal (SV4) has consistently produced a small positive effect on future citations since its inception in 1958 (e.g., (2000 ATT: 188, p-value< 0.001)). In contrast, the professionally important but lower-impact venues SV5 (2000 ATT: 41, p-value$=0.138$), SV6 (2000 ATT: 71, p-value$=0.047$), and SV7 (2000 ATT: 160, p-value< 0.001) showed effects that were less pronounced or statistically insignificant, underscoring that the observed citation gain is primarily associated with publication in top-tier journals (Figure SI 38a).

However, we observed some positive effects on overall productivity and group exhibitions. Authors publishing in SV4 to SV7 and artists involved in AV3 and AV5 experienced steady growth in future productivity (Figure SI 38b) and an increase in group exhibitions, particularly after the 1990s (Figure SI 38d). These findings indicate that while less prestigious venues may not substantially enhance individual acclaim, they can contribute to increased collaborative opportunities and sustained career activity.

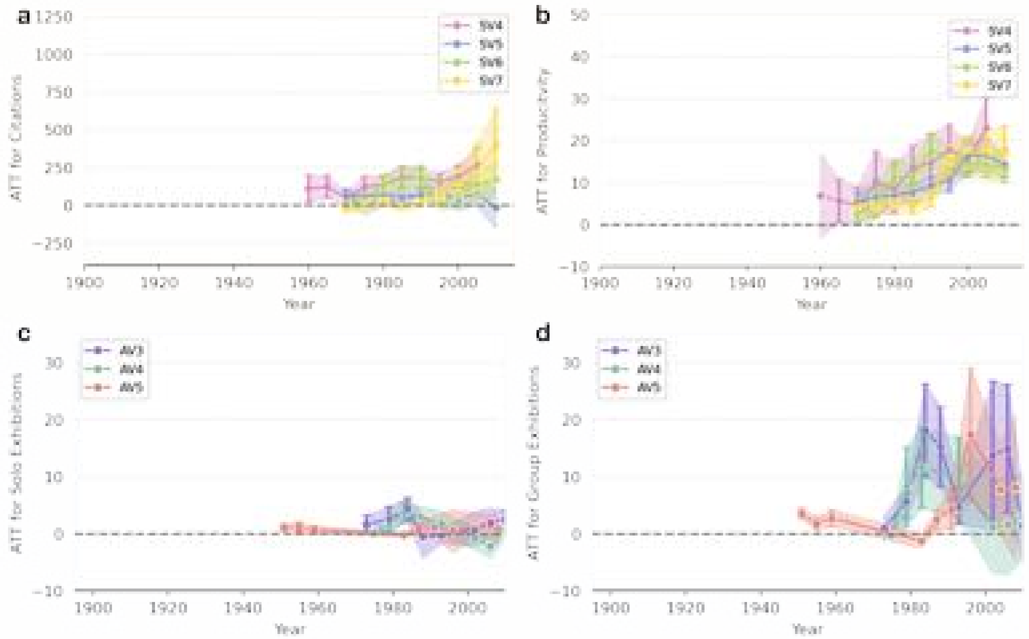


Figure SI 38: Variation of venue effect in science and arts. **a** ATT of citations by cohort for SV4-7, with SV4 displaying a steady and positive boost to citations. **b** ATT of productivity by cohort. SV4-7 observed steady growth of future productivity. **c** ATT of solo exhibitions by cohort for AV3, AV4 and AV5 are highly variable. **d** ATT of group exhibitions by cohort, where the positive effect of AV3 and AV5 is also observed after the 1990s, whereas not for AV4.

Table SI 11: ATT Over Treatment Cohorts for Nature on Citations

Cohort	ATT	Std. Err.	z	$P >\| z \|$	95% Conf. Interval
1910	4.045455	2.860568	1.41	0.157	[-1.561156, 9.652065]
1920	32.43885	18.5536	1.75	0.080	[-3.925526, 68.80323]
1925	-7.731272	15.81607	-0.49	0.625	[-38.73019, 23.26765]
1930	-99.1386	78.75381	-1.26	0.208	[-253.4932, 55.21603]
1935	3.788561	9.236291	0.41	0.682	[-14.31424, 21.89136]
1940	0.947239	16.65953	0.06	0.955	[-31.70484, 33.59932]
1945	36.68493	21.49455	1.71	0.088	[-5.443617, 78.81347]
1950	7.989909	45.6559	0.18	0.861	[-81.494, 97.47382]
1955	-34.83791	31.85553	-1.09	0.274	[-97.2736, 27.59779]
1960	20.95315	23.01164	0.91	0.363	[-24.14883, 66.05513]
1965	5.082439	34.6884	0.15	0.884	[-62.90557, 73.07045]
1970	62.61051	36.70657	1.71	0.088	[-9.333039, 134.5541]
1975	12.97348	32.14771	0.40	0.687	[-50.03487, 75.98184]
1980	-18.28131	27.9247	-0.65	0.513	[-73.01272, 36.4501]
1985	51.54866	35.08722	1.47	0.142	[-17.22103, 120.3184]
1990	142.0892	56.96879	2.49	0.013	[30.4324, 253.746]
1995	414.2338	83.13255	4.98	0.000	[251.297, 577.1706]
2000	315.6175	88.69348	3.56	0.000	[141.7815, 489.4535]
2005	416.337	73.33575	5.68	0.000	[272.6016, 560.0725]
2010	589.5349	127.267	4.63	0.000	[340.0961, 838.9737]
2015	766.3255	475.9361	1.61	0.107	[-166.4921, 1699.143]

5.11 Normalized citations effect

The concept of normalized citation counts is based on the idea of adjusting the number of citations for papers published in the same journal and year to account for differences in citation norms across fields and time periods. Similar to normalizing by year and papers published in a journal from the same Journal Citation Report [31] as in previous research [32], we normalize by year and papers in the same venue, enabling a more granular comparison. We then aggregated each author's normalized citation counts across all their publications for a given year. This method helps control for the inherent variability in citation practices by comparing each paper to a comparable group of papers published at the same time and in the same journal. In other words, this approach provides a more accurate measure of an individual's relative citation impact, accounting for journal-specific and time-specific citation behavior. As in Figure SI 39, we still observe the top venues showing the significant in citations, especially SV1 and SV2. Though SV3 has limited magnitude, but still we observe the significance, again showing the robustness of this effect.

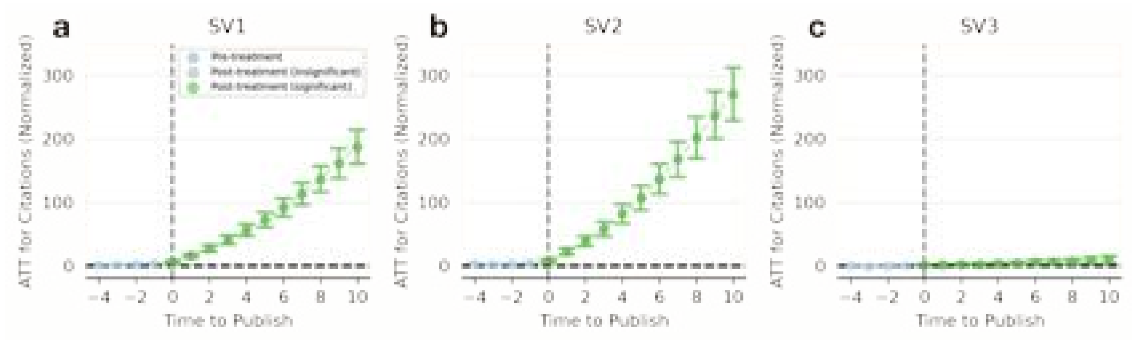


Figure SI 39: Venue effect on normalized citations. **a** Venue effect upon publishing in the top scientific journals like SV1. **b** Venue effect upon publishing in the top scientific journals like SV2. **c** Venue effect upon publishing in the top scientific journals like SV3; the magnitude of the effect is limited compared to SV1 and SV2.

5.12 Effect heterogeneity of venues: Pairwise comparisons

In this section, we present comparative analyses of treatment effect sizes and their statistical significance. We focus on differences among authorship roles (Table SI 12), gender (Table SI 17, Table SI 18), career stages (Table SI 14, Table SI 13, Table SI 15, Table SI 16), and regional representation within high-status venues. These comparisons reveal nuanced heterogeneity in the influence of venue exposure on citation outcomes.

Table SI 12: Pairwise Comparisons of ATT of Citations Across Authorship

Cohort	Comparison	Difference	z-score	p-value	Venue
5	First vs Middle	27.018	2.328	0.020	SV1
10	First vs Middle	215.736	2.251	0.024	SV1
15	First vs Middle	635.938	2.883	0.004	SV1
5	Last vs Middle	11.922	0.624	0.532	SV1
10	Last vs Middle	39.688	0.250	0.803	SV1
15	Last vs Middle	354.169	1.106	0.269	SV1
5	First vs Middle	4.286	0.211	0.833	SV2
10	First vs Middle	242.631	1.531	0.126	SV2
15	First vs Middle	923.726	2.785	0.005	SV2
5	Last vs Middle	9.031	0.341	0.733	SV2
10	Last vs Middle	122.629	0.525	0.599	SV2
15	Last vs Middle	664.720	1.570	0.117	SV2
5	First vs Middle	6.864	0.280	0.780	SV3
10	First vs Middle	-35.536	-0.172	0.863	SV3
15	First vs Middle	150.456	0.334	0.738	SV3
5	Last vs Middle	102.033	3.070	0.002	SV3
10	Last vs Middle	549.819	2.097	0.036	SV3
15	Last vs Middle	1244.521	2.186	0.029	SV3

Specifically, when carrying out pairwise comparisons for regional representations, we analyzed approximately 200 pairwise comparisons. To control for the false discovery rate (FDR) when carrying out multiple hypothesis testing, we applied the Benjamini-Hochberg (BH) procedure (Equation 4). The BH-adjusted p-value is calculated as:

$$p_{\text{adjusted},i} = \min\left(\frac{p_i \cdot m}{i}, 1\right), \tag{4}$$

where p_i represents the i-th smallest p-value among the m tests, and i is its rank in ascending order. We report the results of both unadjusted and BH-adjusted p-values (Table SI 19, Table SI 20, Table SI 22, Table SI 21).

Table SI 13: Comparisons of ATT of Productivity Across Career Stage upon SV1

Cohort	Comparison	Difference	z-value	p-value
5	Mid vs Early	1.087	3.033	0.002
10	Mid vs Early	4.965	2.458	0.014
15	Mid vs Early	9.055	2.366	0.018
5	Late vs Mid	0.947	1.461	0.144
10	Late vs Mid	10.347	2.610	0.009
15	Late vs Mid	18.737	2.706	0.007
5	Late vs Early	2.034	3.287	0.001
10	Late vs Early	15.313	3.989	0.000
15	Late vs Early	27.792	4.166	0.000

Table SI 14: Comparisons of ATT of Citations Across Career Stage Upon SV1

Cohort	Comparison	Difference	z-value	p-value
5	Mid vs Early	9.318	1.042	0.297
10	Mid vs Early	63.104	0.860	0.390
15	Mid vs Early	167.730	0.912	0.362
5	Late vs Mid	28.760	1.339	0.180
10	Late vs Mid	249.112	1.630	0.103
15	Late vs Mid	485.325	1.416	0.157
5	Late vs Early	38.078	1.880	0.060
10	Late vs Early	312.216	2.199	0.028
15	Late vs Early	653.055	2.038	0.042

Table SI 15: Comparisons of ATT of Solo Exhibitions Across Career Stage Upon AV1

Cohort	Comparison Type	Difference	z-value	p-value
5	Mid vs Early	-0.042	-0.686	0.493
10	Mid vs Early	-0.501	-1.824	0.068
15	Mid vs Early	-0.482	-0.974	0.330
5	Late vs Mid	-0.000	-0.005	0.996
10	Late vs Mid	-0.124	-0.339	0.734
15	Late vs Mid	0.082	0.104	0.917
5	Late vs Early	-0.042	-0.500	0.617
10	Late vs Early	-0.626	-1.651	0.099
15	Late vs Early	-0.401	-0.501	0.616

Table SI 16: Comparisons of Group Exhibitions Across Career Stage Upon AV1

Cohort	Comparison Type	Difference	z-value	p-value
5	Mid vs Early	0.020	0.116	0.908
10	Mid vs Early	0.917	0.844	0.399
15	Mid vs Early	1.551	0.741	0.459
5	Late vs Mid	-0.175	-0.896	0.370
10	Late vs Mid	-2.825	-1.392	0.164
15	Late vs Mid	-4.515	-1.055	0.291
5	Late vs Early	-0.155	-0.741	0.459
10	Late vs Early	-1.907	-0.930	0.352
15	Late vs Early	-2.964	-0.692	0.489

Table SI 17: Comparisons of ATT of Citations Between Gender Upon SV1

Cohort	Comparison Type	Difference	z-value	p-value
1	Men vs Women	12.405	1.537	0.124
2	Men vs Women	17.862	1.951	0.051
3	Men vs Women	20.384	1.825	0.068
4	Men vs Women	25.957	1.910	0.056
5	Men vs Women	31.894	1.959	0.050
6	Men vs Women	71.064	2.120	0.034
7	Men vs Women	110.077	2.103	0.036
8	Men vs Women	151.002	2.067	0.039
9	Men vs Women	197.740	2.067	0.039
10	Men vs Women	252.447	2.073	0.038
11	Men vs Women	313.671	2.080	0.038
12	Men vs Women	377.347	2.078	0.038
13	Men vs Women	436.174	2.022	0.043
14	Men vs Women	486.771	1.997	0.046
15	Men vs Women	538.669	1.938	0.053

Table SI 18: Comparisons of ATT of Solo Exhibitions Between Gender Upon AV1

Cohort	Comparison Type	Difference	z-value	p-value
1	Men vs Women	-0.075	-1.000	0.318
2	Men vs Women	-0.076	-1.012	0.312
3	Men vs Women	-0.148	-1.898	0.058
4	Men vs Women	-0.072	-0.839	0.401
5	Men vs Women	-0.158	-1.702	0.089
6	Men vs Women	-0.383	-2.417	0.016
7	Men vs Women	-0.550	-2.529	0.011
8	Men vs Women	-0.646	-2.277	0.023
9	Men vs Women	-0.753	-2.146	0.032
10	Men vs Women	-0.819	-1.943	0.052
11	Men vs Women	-0.830	-1.692	0.091
12	Men vs Women	-1.131	-2.045	0.041
13	Men vs Women	-1.334	-2.165	0.030
14	Men vs Women	-1.404	-2.083	0.037
15	Men vs Women	-1.408	-1.928	0.054

Table SI 19: Comparisons of ATT of Citations Across Regions Upon SV1

Cohort	Comparisons	Difference	z-value	p-value	BH-adj p-value
5	Asia vs Africa	-9.348	-0.375	0.708	0.916
10	Asia vs Africa	-258.971	-0.693	0.488	0.916
15	Asia vs Africa	269.018	0.341	0.733	0.916
5	Asia vs South America	-30.529	-0.397	0.691	0.916
10	Asia vs South America	-87.390	-0.151	0.880	0.943
15	Asia vs South America	18.765	0.014	0.989	0.989
5	Europe vs Africa	-31.553	-1.422	0.155	0.563
10	Europe vs Africa	-470.891	-1.314	0.189	0.567
15	Europe vs Africa	-277.990	-0.389	0.697	0.916
5	Europe vs Asia	-22.205	-1.418	0.156	0.563
10	Europe vs Asia	-211.920	-1.552	0.121	0.563
15	Europe vs Asia	-547.008	-1.375	0.169	0.563
5	Europe vs North America	0.740	0.068	0.946	0.978
10	Europe vs North America	30.395	0.363	0.717	0.916
15	Europe vs North America	214.041	1.062	0.288	0.786
5	Europe vs South America	-52.734	-0.693	0.488	0.916
10	Europe vs South America	-299.310	-0.526	0.599	0.916
15	Europe vs South America	-528.243	-0.404	0.687	0.916
5	North America vs Africa	-32.293	-1.451	0.147	0.563
10	North America vs Africa	-501.286	-1.402	0.161	0.563
15	North America vs Africa	-492.032	-0.694	0.488	0.916
5	North America vs Asia	-22.945	-1.455	0.146	0.563
10	North America vs Asia	-242.315	-1.799	0.072	0.563
15	North America vs Asia	-761.050	-1.954	0.051	0.563
5	North America vs South America	-53.474	-0.703	0.482	0.916
10	North America vs South America	-329.705	-0.580	0.562	0.916
15	North America vs South America	-742.285	-0.568	0.570	0.916
5	South America vs Africa	21.182	0.270	0.787	0.920
10	South America vs Africa	-171.582	-0.257	0.797	0.920
15	South America vs Africa	250.253	0.170	0.865	0.943

Table SI 20: Comparisons of ATT of Productivity Across Regions Upon SV1

Cohort	Comparisons	Difference	z-value	p-value	BH-adj p-value
5	Asia vs Africa	-0.015	-0.004	0.997	0.997
10	Asia vs Africa	3.402	0.169	0.866	0.934
15	Asia vs Africa	23.507	0.894	0.372	0.689
5	Asia vs South America	-1.273	-0.681	0.496	0.744
10	Asia vs South America	-14.175	-1.034	0.301	0.603
15	Asia vs South America	-37.856	-1.366	0.172	0.493
5	Europe vs Africa	0.968	0.264	0.792	0.913
10	Europe vs Africa	6.681	0.336	0.737	0.913
15	Europe vs Africa	27.800	1.088	0.277	0.593
5	Europe vs Asia	0.983	1.497	0.134	0.493
10	Europe vs Asia	3.279	0.820	0.412	0.689
15	Europe vs Asia	4.293	0.569	0.570	0.799
5	Europe vs North America	1.998	5.306	0.000	0.000
10	Europe vs North America	8.799	4.038	0.000	0.001
15	Europe vs North America	13.913	3.467	0.001	0.005
5	Europe vs South America	-0.290	-0.161	0.872	0.934
10	Europe vs South America	-10.896	-0.818	0.414	0.689
15	Europe vs South America	-33.563	-1.243	0.214	0.493
5	North America vs Africa	-1.029	-0.281	0.779	0.913
10	North America vs Africa	-2.118	-0.107	0.915	0.947
15	North America vs Africa	13.887	0.544	0.586	0.799
5	North America vs Asia	-1.015	-1.626	0.104	0.493
10	North America vs Asia	-5.520	-1.415	0.157	0.493
15	North America vs Asia	-9.620	-1.294	0.196	0.493
5	North America vs South America	-2.288	-1.278	0.201	0.493
10	North America vs South America	-19.695	-1.481	0.139	0.493
15	North America vs South America	-47.477	-1.761	0.078	0.493
5	South America vs Africa	1.258	0.310	0.757	0.913
10	South America vs Africa	17.577	0.738	0.460	0.727
15	South America vs Africa	61.364	1.662	0.097	0.493

Table SI 21: Comparisons of ATT of Group Exhibitions Across Regions Upon AV1

Cohort	Comparisons	Difference	z-value	p-value	BH-adj p-value
5	Asia vs Africa	2.333	2.069	0.039	0.325
10	Asia vs Africa	5.969	1.150	0.250	0.615
15	Asia vs Africa	-2.708	-0.298	0.765	0.919
5	Asia vs South America	0.042	0.076	0.939	0.972
10	Asia vs South America	-0.540	-0.133	0.894	0.972
15	Asia vs South America	-2.643	-0.329	0.742	0.919
5	Europe vs Africa	2.146	2.035	0.042	0.325
10	Europe vs Africa	3.255	0.699	0.484	0.855
15	Europe vs Africa	-8.285	-1.024	0.306	0.615
5	Europe vs Asia	-0.187	-0.449	0.654	0.919
10	Europe vs Asia	-2.713	-1.108	0.268	0.615
15	Europe vs Asia	-5.577	-1.249	0.211	0.615
5	Europe vs North America	-0.017	-0.077	0.938	0.972
10	Europe vs North America	0.309	0.238	0.812	0.936
15	Europe vs North America	0.840	0.333	0.739	0.919
5	Europe vs South America	-0.145	-0.386	0.700	0.919
10	Europe vs South America	-3.253	-0.970	0.332	0.623
15	Europe vs South America	-8.220	-1.190	0.234	0.615
5	North America vs Africa	2.162	2.021	0.043	0.325
10	North America vs Africa	2.947	0.620	0.536	0.893
15	North America vs Africa	-9.125	-1.100	0.272	0.615
5	North America vs Asia	-0.170	-0.374	0.709	0.919
10	North America vs Asia	-3.022	-1.147	0.251	0.615
15	North America vs Asia	-6.417	-1.328	0.184	0.615
5	North America vs South America	-0.128	-0.307	0.759	0.919
10	North America vs South America	-3.561	-1.020	0.308	0.615
15	North America vs South America	-9.060	-1.267	0.205	0.615
5	South America vs Africa	2.291	2.058	0.040	0.325
10	South America vs Africa	6.508	1.147	0.251	0.615
15	South America vs Africa	-0.065	-0.006	0.995	0.995

Table SI 22: Comparisons of ATT of Solo Exhibitions Across Regions Upon AV1

Cohort	Comparisons	Difference	z-value	p-value	BH-adj p-value
5	Asia vs Africa	0.953	1.754	0.079	0.298
10	Asia vs Africa	1.467	0.642	0.521	0.826
15	Asia vs Africa	0.647	0.214	0.831	0.971
5	Asia vs South America	-0.175	-0.784	0.433	0.777
10	Asia vs South America	0.422	0.458	0.647	0.882
15	Asia vs South America	1.347	0.815	0.415	0.777
5	Europe vs Africa	0.947	1.810	0.070	0.298
10	Europe vs Africa	0.156	0.071	0.943	0.971
15	Europe vs Africa	-2.162	-0.772	0.440	0.777
5	Europe vs Asia	-0.006	-0.037	0.971	0.971
10	Europe vs Asia	-1.311	-1.946	0.052	0.298
15	Europe vs Asia	-2.808	-2.334	0.020	0.298
5	Europe vs North America	-0.029	-0.401	0.688	0.898
10	Europe vs North America	-0.041	-0.128	0.898	0.971
15	Europe vs North America	-0.352	-0.597	0.551	0.826
5	Europe vs South America	-0.180	-1.070	0.285	0.712
10	Europe vs South America	-0.890	-1.344	0.179	0.596
15	Europe vs South America	-1.461	-1.220	0.222	0.626
5	North America vs Africa	0.976	1.855	0.064	0.298
10	North America vs Africa	0.197	0.089	0.929	0.971
15	North America vs Africa	-1.810	-0.638	0.523	0.826
5	North America vs Asia	0.023	0.144	0.886	0.971
10	North America vs Asia	-1.270	-1.771	0.077	0.298
15	North America vs Asia	-2.456	-1.915	0.056	0.298
5	North America vs South America	-0.151	-0.852	0.394	0.777
10	North America vs South America	-0.848	-1.202	0.229	0.626
15	North America vs South America	-1.109	-0.868	0.385	0.777
5	South America vs Africa	1.128	2.058	0.040	0.298
10	South America vs Africa	1.045	0.458	0.647	0.882
15	South America vs Africa	-0.701	-0.232	0.817	0.971

5.13 Effect heterogeneity: Career stage and long-run trajectories

Based on earlier observation in Figure 5.13, we saw that within the first 10 years after publication, mid-career scientists experience larger venue effects than early-career scientists. This pattern suggests that short-run estimates may not fully capture the potential long-term gains for early and mid-career researchers, who still have substantial runway in their careers. Motivated by this, we extend our analysis to examine whether the benefits of publishing in top venues continue to accumulate beyond the 10-year window, and to assess how early- and mid-career scientists may differentially benefit from prestigious venues over the long run.

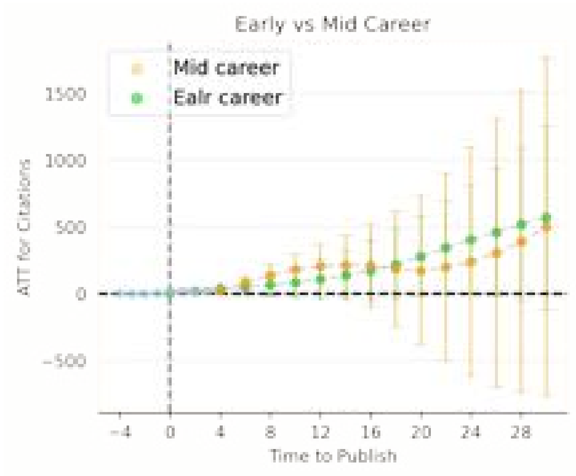


Figure SI 40: ATT for citations, of having access to SV1, which mid and late career scientists are all having at least 30-year post-venue trajectories. 10-year ATT for early-career: 84.37, mid-career: 213.53, which mid-career scientists experience more growth; 20-year ATT for early-career: 277.94, mid-career: 238.57, which early-career scientists now show more growth.

Here we include longer career trajectories, focusing in particular on scientists who were at early and mid-career stages at the time of treatment, as these groups have substantially more runway for long-term growth. Specifically, we retained individuals with at least 30 subsequent career years following their first publication in a top venue, representing about 8.6% of the sample with career lengths extending beyond 30 years. As shown in Figure SI 40, the effect within the first 10 years remains strongest for mid-career authors, consistent with the main analysis. However, beyond roughly 18 years after publication, the early-career group continues to exhibit steady citation growth, whereas mid-career scientists' benefit reaches a plateau. This pattern is in line with our intuition: early-career access to top venues relates to similar cumulative advantages in the long run, as these individuals have more time to capitalize on the reputational and collaborative benefits of early recognition.

5.14 Effect heterogeneity across subregions

In our previous analysis as shown in Figure 6, we identified a significant venue effect in art and science for European, North American, and Asian artists/scientists. To build on these findings, we focused on a more recent time window, examining venues occurring after 1999. This narrowed scope allowed us to better capture evolving trends in venue impacts. Our results revealed positive trends and statistically significant effects for South American artists/scientists, as depicted in Figure SI 41.

For scientists, we did both the original institutes (first affiliation when scientist started to publish) as well as the current affiliations where we show as in Figure 6. They suggests similar trends for regions like Asia and South America (Figure SI 42a, Figure SI 43), whereas the current affiliations show the most evident changes across the years.

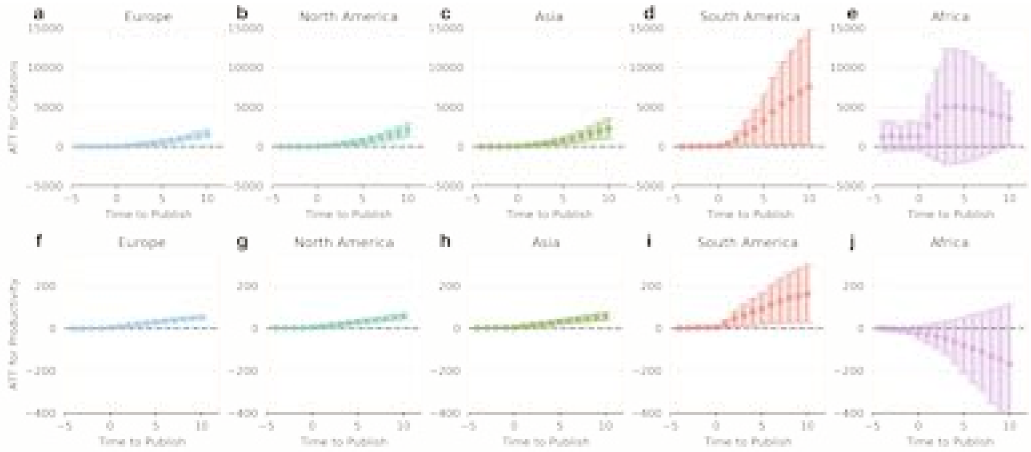


Figure SI 41: ATT for publications and citations after Nature publications, later than 1999. The post-treatment effect is even larger, demonstrating that Nature has an increasing influence on advancing scientists' careers. South American scientists now show a positive effect, in contrast to the previous decreasing trend in Figure 5 j.

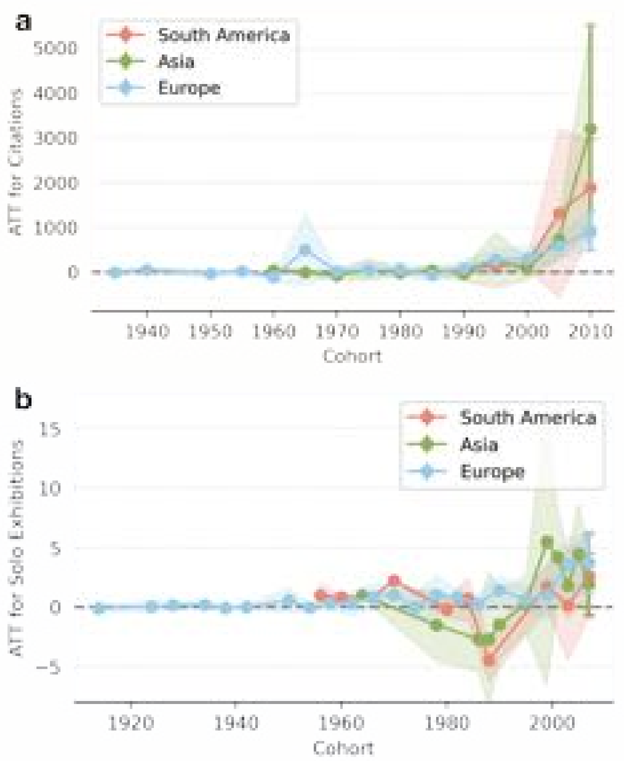


Figure SI 42: Variability in the effects across regions.a Asian affiliated scientists observed a rapid growth after 1995, and South American affiliated scientists observed a positive effect after 2000. **b** Variation of marginal effects on solo exhibitions upon AV1 Participation. Asian artists observed similar growth after 1995. Mean (circles) and 95% confidence intervals (bars). The filled area is also 95% confidence intervals.

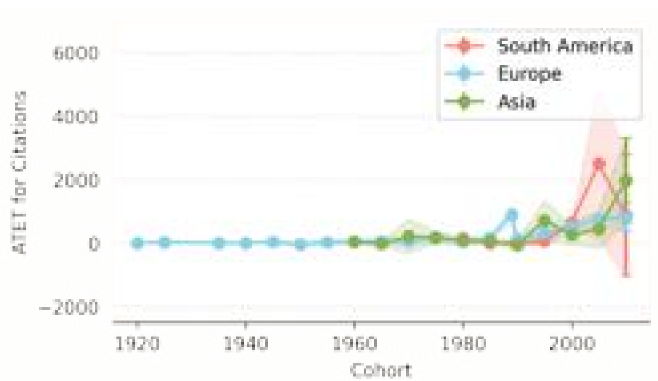


Figure SI 43: Variability in the effects on citations effect across original institutions. Where we observe a growth of citation effect for regions like Asia and South America.

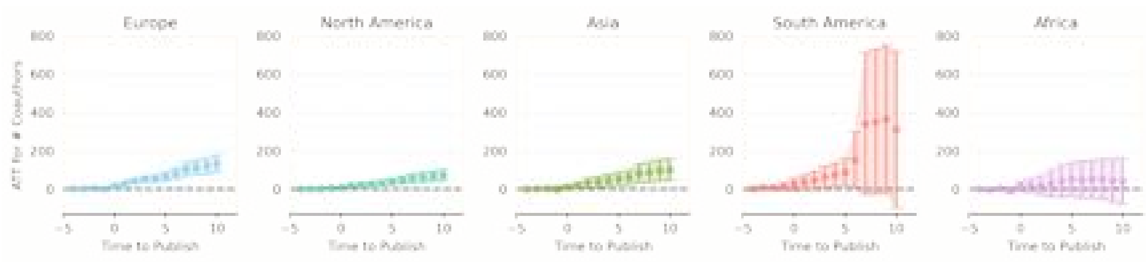


Figure SI 44: Variability in the science venue effects on the number of coauthors. a,b,c Effect on the number of coauthors for European, North American, and Asian affiliated scientists is significant.**d,e** Effect on the number of coauthors for South American, African, and Oceania affiliated scientists: the effect remains positive for South American scientists, though not significant, and shows a decreasing trend for African scientists but with limited magnitude.

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