This paper employs the concept of “invisible colleges” to explore the processes through which spaces of critical urban theory are imbricated within a gendered power nexus. It assesses the degree of dominance in hegemonic knowledge production by clusters of scholars, their co-authors, and academic mentors and mentees. Using the example of critical urban theory, we use network graphs to map these concentrated hidden geographies understood collectively as “invisible colleges”. The resultant visualizations reflect the dominance of key scholars and their similarities (e.g. doctoral education, academic mentors, current institutional affiliations, etc.). These heretofore unmapped networks of connectivity provide insight into the masculinized spaces of critical urban theory bringing to the fore important topics for consideration. These include the politics of citation and “double dipping”, or frequent publication in the same journal outlets. In bringing attention to invisible colleges, a concept that has largely escaped attention in urban studies and geography, we highlight the usefulness of visibility as a technology of equity. En route, the paper describes and visualizes some of the impacts of the proliferation of uneven knowledge production through the coalescing of factors such as path dependency, cumulative advantage, expected inequality and the Matthew and Matilda Effects.

**Keywords:** invisible college; gender; knowledge production; exclusion; citation; critical urban studies

**Haciendo el Hiper-Visible invisible: la producción de conocimiento y el nexo de poder de género en los estudios urbanos críticos**

Este documento usa el concepto de ”universidades invisibles” para explorar los procesos a través de los cuales los espacios de la teoría urbana crítica están imbricados dentro de un nexo de poder de género. Evalúa el grado de dominio en la producción de conocimiento hegemónico por grupos de académicos, sus co-autores y mentores académicos y aprendices. Usando el ejemplo de la teoría urbana crítica, usamos gráficos de red para mapear estas geografías ocultas concentradas entendidas colectivamente como ”universidades invisibles”. Las visualizaciones resultantes reflejan el predominio de académicos clave y sus similitudes (por ejemplo, educación de doctorado, mentores académicos, afiliaciones institucionales actuales, etc.). Estas redes de conectividad no mapeadas hasta ahora proporcionan
una visión de los espacios masculinizados de la teoría urbana crítica y ponen de relieve temas importantes para su consideración. Estos incluyen la política de citas y “doble inmersión”, o la publicación frecuente en los mismos puntos de venta de revistas. Al llamar la atención sobre las universidades invisibles, un concepto que en gran medida ha escapado a la atención en los estudios urbanos y la geografía, destacamos la utilidad de la visibilidad como tecnología de equidad. En ruta, el documento describe y visualiza algunos de los impactos de la proliferación de la producción desigual de conocimiento a través de la fusión de factores como la dependencia de la trayectoria, la ventaja acumulativa, la desigualdad esperada y los efectos de Matthew y Matilda.

Palabras clave: colegio invisible; género; producción de conocimiento; exclusión; citación; estudios urbanos críticos

Introduction

Several months ago, while scrolling through various sources in an effort to procrastinate updating a syllabus for a critical urban theory course, I (Author 1) came across two articles that caught my attention. The first was on the news and culture website Slate which (surprise!) professed that an astonishingly small number of elite universities produce a majority of America's professors. Framed by the authors Warner and Clauset (2015), as “The Academy’s Dirty Little Secret”, the article went on to describe how the top ten universities produce three times as many professors as those ranked 11 through 20. The second piece was a review of an academic book aimed at popular audiences. Based on interviews with scholars and university leaders, the author explores why top-ranked departments continue to favor research on the United States (Wagner 2008) at the expense of other regions. Returning to course planning after a quick scan of Google Scholar (and the subsequent syllabus, which to some extent was a reflection of that search engine), it was evident that I was unwittingly propagating the practice of overrepresentation. Critical urban theory seemed, on the surface at least, to be narrated by a relatively small group of male authors with certain scholars disproportionally cited over others. This is not to say that there are not important exceptions and caveats to this somewhat pedestrian observation. Yet, a question that my colleague and I had already been concerned with presented itself anew: what kinds of processes and power relations are at work in the uneven production of knowledge?

The short vignette above is not a shocking revelation. After all, an increasing amount of scholarship in geography has focused on the exclusion, marginalization and erasure related to both producers of knowledge and knowledge production more generally (Mahtani, 2014; Peake and Sheppard, 2014; Monk, 2012; c.f. Walker and Frimpong Boamah, 2017: for a review of "lop-sided" geographies). Mott and Cockayne’s recent paper in Gender, Place and Culture (2017) on the politics of citation is particularly effective at laying out the landscape of oppression working to bolster particular bodies and voices through the identification of “white heteromasculinism”. Others have shown that men in academia rely on homosocial practices and tend to have stronger and wider networks in geography resulting in the placement of early career researchers within their network (Moss-Racusin et al., 2012; Berg, 2004; Wright, 2009; Storme et al., 2017). To be sure, isolating practices by men is not to deny the power geometries that operate within academia, nor to confine such practices to male academics. Oppression exists within gender categories, i.e. women oppress other women and so on. It is also crucial to recognize that oppression is itself intersectional. We all carry multiple identities and we do not suggest that gender oppression is originary or trumps other forms of exclusion. Gender is not easily separable from other identity features such as race, sexuality and nationality (Runyan, 2018). Less covered, and what we have an on-going interest in, are the contours and characteristics of networks wherein power is distributed asymmetrically. In this case, we seek to make visible some of the mechanics of how particular knowledges become codified through privileged associations.

In prior research, we sought to write in absent elements currently elided in the valuation of research products (Walker and Frimpong Boamah 2017). Rather than relying on formalized indicators of
authorship and scholar affiliation, we emphasized the multiple geographies involved across research processes. Our maps illustrated how data is “extracted” in one place (often in the Global South) and “processed” elsewhere (often in the Global North). That countermapping, what we call a “chromatographical” framework, attempts to represent the “silent side” of knowledge production by conceptualizing actors, field sites, and research products as a multiplicity of inter-scalar interactions. The project of recognizing sites that are formally “off the map” is taken up in this paper but in a slightly different register. We pursue our interest in making the invisible hyper-visible all the while guided by larger empirical and conceptual questions. These include the following: the what and where of data blank spots; how to “methodologize” equity; and ways to go beyond addressing underrepresentation to account for adverse incorporation within knowledge production.

Starting from the premise that scholarship is never as individual as the individual would like to think, or as Deleuze and Guattari say (Manning and Massumi, 2014), one writing alone is already a crowd, this paper employs the concept of “invisible colleges” (de Solla Price and Beaver, 1966; Lievrouw, 1990; Zuccala, 2006; de Solla Price, 1963) to explore the processes through which spaces of critical urban theory are imbricated within a gendered power nexus. We assess the degree of dominance in hegemonic knowledge production by clusters of scholars, their co-authors, and academic mentors and mentees (understood collectively as invisible colleges) using network graphs to visualize these concentrated hidden geographies. To use a metaphor from physical geography, our intent is to capture the tributaries of the tributary. The resultant representations reflect the dominance of key scholars and their similarities (e.g. doctoral education, academic mentors, current institutional affiliations, etc.).

These heretofore unmapped networks of connectivity provide insight into the masculinized spaces of critical urban theory. What follows aims first, to visualize and codify the “imperceptible” swirling around the “perceptible” and, second, to distill some provocations worthy of more sustained discussion. This includes looking to invisible colleges as important and overlooked spatial sites of struggle, and extends to the politics of citation and “double dipping”, or frequent publication in the same journal outlets, a practice which calls into question the double-blind review process. Related to our ultimate goal of providing an in-depth analysis of how and why power and gender asymmetries persist, is the push to be more reflexive at the disciplinary scale. This stands in contrast to the conventional uniscalar approach which casts reflexivity as an entirely personal matter. We focus in this paper more modestly on particular geographies of uneven knowledge; visualizing and representing the “what”. The “why” will be taken up in later research.

Our major objectives are threefold: (1) to bring attention to the gendered aspects of “invisible colleges”, a concept that has largely escaped attention in geography; (2) to highlight the usefulness of visibility as a technology of equity though our examples/visualizations; and, (3) to describe some of the impacts of the proliferation of uneven knowledge production through the coalescing of factors such as path dependency, cumulative advantage, expected inequality and the Matthew/Matilda Effects.

Knowledge Production in the Invisible College

The literature on invisible colleges has a long history dealing broadly with communication, knowledge growth, and collaboration in science (c.f. de Solla Price, 1971; de Solla Price, 1986; de Solla Price, 1963; Lievrouw, 1990; Crane, 1972; Bartle, 1995; Lingwood, 1969). The term was first used in 17th century Europe to refer to those who did not belong to formal institutions but nonetheless shared scientific interests. de Solla Price’s work (1963; de Solla Price, 1986) identifies invisible colleges as “groups of elite, mutually interacting and productive scientists from geographically distant affiliates who exchange information to monitor progress in their field” (1986; 56 ). Some researchers have characterized invisible colleges as “innovation cliques” (Van Rossum, 1973), as “social circles” made up of a variety of geographically dispersed schools (Crane, 1980), and even exclusive

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1 This paper takes a slice of the interdisciplinary field of critical urban studies which encompasses aspects of critical human geography.
societies that seek to stifle the representation of a variety of paradigms (Paisley, 1968). Articulations by de Solla Price initially developed around a firm binary between art and science which relied on an essentialized perspective of the scientist as one who needs recognition from his or her peers. Much of this work is predicated upon organized formal interactions characterized by the intentionality of its members.

Like others more recently (Lievrouw, 1990; Glänzel, 2001; Gherardini and Nucciotti, 2017), we deviate from interpretations which center on intentionality, although we would concur with de Solla Price in his discussion of how people within these groups are in touch with their networks and have the power to confer prestige on one another (de Solla Price 1963). Lievrouw’s (1990) work broadens the invisible college to emphasize the duality of structures of scholarship, (for example published documents) and the social processes of informal behaviors and communication. This is in line with the modern evolution of the invisible college as Crane (1972), who codified the term in its contemporary usage, describes it. Although there are many interpretations, we are partial to Zuccala’s (2006; 2004) definition which draws heavily on Lievrouw’s extensive research:

An invisible college is a set of interacting scholars or scientists who share similar research interests concerning a subject specialty, who often produce publications relevant to this subject specialty and who communicate both formally and informally with one another to work towards important goals in the subject, even though they may belong to geographically distant research affiliates (Zuccala, 2004: 11).

In geography, there is a lack of engagement with invisible colleges in explicit terms although there are some important exceptions (Brunn and O’Lear, 1999; Gatrell, 1984; Andersson and Persson, 1993; Gould, 1991). Lievrouw (1990) laments the lack of information and research related to invisible colleges attributing it to the fact that researchers tend to focus on the products of scholarship rather than the process of scholarship. Nevertheless, productive attempts to identify this structuring of knowledge seeking to capture the interactions of the scholarly community within a specific research area have been addressed through the lens of bibliometric research (e.g. Bayer et al., 1990; Kretschmer, 1997).

Undoubtedly, attending to the intricacies of knowledge production necessitates an ethnographic intervention, a task that is beyond the scope of this paper. Nevertheless, we would argue that the construct of invisible colleges brings to light a much needed focus on how and where scholarship emerges more so than simply documenting citational practices or assigning intentionality to exclusion (although those have been helpful devices). For our purposes, the invisible colleges we are describing are not so much about calculated strategic positionings as they are part of an accepted informal practice associated with rigorous research. In other words, this is less about pointing fingers and more about examining the emergent and unseen processes contributing to hegemonic patterns of knowledge production. A useful if imperfect analogy might be the informal economy — which performs enormous and varied functions within “the economy” but the multiplicity of which is rarely accounted for in formalized metrics. There is an equivalence assumed between a citation and a publication, i.e., that it is the work of the author and co-author. The idea of an invisible college (and the associated “electronic invisible college” concept described by Brunn and O’Lear (1999)) disrupts this facile association by isolating the networks, the resources and the connectivities that are able to be mobilized and input into a research product. Even Lievrouw concedes the usefulness of bibliometric analysis for its ability to provide “a systematic glimpse of the communication acts that produced the documents in the first place” (1990: 68).

Matthew and Matilda

Residing within the invisible college is an effort to lay hold of cumulative advantage, or how some people are better positioned to produce particular forms of scholarship. The processes through which opportunities accumulate for individuals and their networks and organizations provide a segue into a discussion of gender as it relates to scientific knowledge production.
The persistent elision of the contribution of particular actors has been perhaps somewhat ironically named after a man. Although the Matthew Effect, so dubbed by Merton (1968) does not specifically refer to the sex or gender of excluded scholars, the phenomenon refers to how acknowledgement of scientific work is skewed in favor of some over others. In short, the Matthew Effect describes the over-recognition of the well-established. It implores the exploration of how trained capacity, structural location, and resources accrue such that gaps between the recognized and the unrecognized widen.

In 1993, Margaret Rossiter introduced the concept of the Matilda Effect for the systematic underrecognition of female scientists (Rossiter, 1993). The term aims to capture both the bias in acknowledging the achievements of women scientists as well as a host of other understudied phenomena including: the misallocation of recognition, the denial of credit, and simply ignoring contributions of women. Both the Matthew and Matilda Effects refer to the natural sciences.

There is a long-standing feminist critique of geographic knowledge production and we will not recount that in depth here. These crucial contributions include varied aspects of the politics of knowledge. Although certainly not an exhaustive list, these range in topic from the marginalization of women (c.f. Domosh, 1991; Kobayashi, 2006; Maliniak et al., 2013; Monk, 2012; Maddrell, 2012) to the “vanity fair” of citation cartels (Franck, 1999) which (un)wittingly coalesce in network infrastructures that perpetuate underrepresentation (c.f. Anonymous, 2002; Berg et al., 2014; Gutiérrez and Lopez-Nieva, 2001). Postcolonial scholars in particular have provided rich coverage of debates related to imperialist practices within the academy (c.f. Jazeel, 2016; Koopman, 2008; Louis, 2007; Noxolo, 2009) as well as the experiences of being marginalized in multiple ways (c.f. Gilmore, 2002; Mahtani, 2014; Mahtani, 2006; Tolia-Kelly, 2017). Critical urban scholarship, the focus of this paper, has grappled with the issues referenced above and has likewise addressed the lack of diversity in both bodies and perspectives (c.f. Bondi and Rose, 2003; Derickson, 2016; Derickson, 2018; Peake, 2016b; Peake, 2016a).

Knowledge production as it relates to the urban is, therefore, also a story about the politics (and geography) of recognition. How urban theory is constituted is often a tale of spatial concentration and thus the invisible college is to some degree a microcosm of long rehearsed discussions of hierarchies between the metropole and periphery and the global vs. the ordinary city (cf. McFarlane, 2010; Roy, 2013; Robinson, 2006). The invisible college can work to agglomerate resources operating as a sort of “primate city”. Rather than a simple reflection of “the field”, or a mirror of the multiple research agendas and epistemologies in operation, critical urban studies is an effect of a multiplicity of factors, which often go unremarked upon. What many indictments of the inequality of knowledge production have in common, although perhaps it remains implicit, is a push towards uncovering, valuing, acknowledging, and making the “unseen” seen. While the intervention in this paper is primarily empirical, it turns on our larger project of operationalizing visibility as a technology of equity. It is a “visualizing” methodology which continuously opens up the “distinctly ideological edifice” (Jazeel, 2018: 408) of critical urban theory to new viewings. Our visualizations suggest the overrepresentation of the well-established at the expense of an acknowledgement of the depth and breadth of available scholarship. Disclosing the multiple sides of the concepts, categories, images and representations that have heretofore stabilized subdisciplinary formations can symbolically remunerate the unaccounted for. Therefore, the invisible college and our subsequent examples work as a sort of double exposure producing ghost images.

Tracing the Ghost: Materials and Methods

As a proof of concept and given our disciplinary interest and expertise, we considered critical urban theory/studies scholarship to illustrate our argument. Following methodology employed in Scientometric studies, the Google Scholar database and the Publish or Perish software were used to collect indexed references or published peer-reviewed articles and books related to two search terms, “critical urban theory” and “critical urban studies”. A total of 997 and 980 indexed references were returned respectively.
for the searches on critical urban theory and critical urban studies. For both search results, references with 50 or more citations were selected and merged into one complete database of indexed references on critical urban theory and critical urban studies. The research team later cleaned the database by removing double entry references, creating columns to list the lead authors, co-authors and their institutional affiliations according to what was listed on the published articles or books. The total number of indexed references in the final database was 125, which included peer-reviewed articles and books. It should be noted that some, although few, of the indexed references in our database were single-authored papers or books. However, we will discuss indexed-references as though they were all co-authored.

The team used the initial database (125) to collect additional data for our network graph and subsequent analysis using three steps, which involves three actors—lead authors (A), co-authors (B), and doctoral academic supervisors (S). We collected data on the institutional affiliations and gender of these actors. In the first step, for each of the indexed reference in our initial database, the lead authors, co-authors, and their institutional affiliations were used to create an initial network graph illustrated using the example in Figure 1a using the Cytoscape software (Shannon et al., 2003), which is a social network analysis software. In this figure, the institutional affiliation of the lead author (A1) and co-author (B1) are respectively listed on the peer-reviewed paper/book as A1Up and B1Up, where p represents the listed institutional affiliation of the author. There are instances where the lead and co-authors have the same institutional affiliation, which is represented in Figure 1b.

![Figure 1a. Lead authors & co-authors with different institutional affiliations](image1a)

![Figure 1b. Lead authors & co-authors with the same institutional affiliations](image1b)

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² An academic field focused on the analysis of scholarly content. Most often studies are done using bibliometric methods which measure the impact of publications.

³ A program that retrieves and analyzes academic citations across a variety of data sources and then presents associated metrics including: total number of papers, total number of citations, and multiple indexes which seek to evaluate impact.
The second step involved collecting data on the institutions where these lead authors and co-authors received their doctoral degrees, their doctoral academic supervisors, and the gender of the lead authors, co-authors, and their supervisors. Illustrated in Figure 2a, we build on the network graph in Figure 1a as follows:

- lead author A1 with institutional affiliation A1Up (based on the institution listed on the paper/book in the database)
- the doctoral academic supervisor(s) of the lead author (SA1)
- the institution where the lead author received her/his doctoral degree (A1Ud), where d represents the institution where the author’s doctoral degree was awarded.
- co-author B1 with institutional affiliation B1Up (based on the institution listed on the paper/book in the database)
- the doctoral academic supervisor(s) of the co-author (SB1)
- the institution where the lead author received her/his doctoral degree (B1Ud)

Two issues are worth noting regarding the methodology and data visualization. First, we are mainly interested in the cluster of colleges emerging from studying the network of the top cited critical urban studies/theory scholars, along with their gender, the institutions they have been affiliated with (i.e. where they were trained or received their PhD and the listed institutions on their publications) and who trained them (their doctoral supervisors). As a result, almost all of the authors and co-authors had more than one institutional affiliation. For instance, an author or co-author could have had more than one peer-reviewed paper in the 125 references analyzed and each of the peer-reviewed papers could have different institutional affiliations listed for the author/co-author probably because the person had at some point changed institutions. To simplify the entire network graph for visual presentation and analysis, the team developed two primary categories, illustrated in Figure 2b, to capture who and what is involved in the invisible college producing critical urban studies/theory scholarship. This delineates: (a) the scholars (lead authors, co-authors, and their PhD supervisors), and (b) the institutions (institutional affiliations of the scholars and where they received their doctoral degree).

![Figure 2a. Lead authors/co-authors, PhD supervisors, and institutional affiliations](image)

![Figure 2b. Simplified network graph showing scholars and universities](image)

Based on this information, we present three visualizations best understood when taken together. Figure 3 is a network graph comprised of raw data which provides a sketch of the invisible colleges imbricated in the production of critical urban studies. In Figure 4 (shown in the results and discussion section), we refine our visualization to show the specific dominant university within the node. Figure 5 (also shown in the results and discussion section)
charts the institutional affiliations of the top cited critical urban studies papers.

![Figure 3. Final network graph showing the invisible college (scholars and universities) in producing critical urban studies/theory knowledge](image)

Power Nodes

Although networks are a foundational spatial concept, their adoption (e.g. Jessop et al., 2008; Bercovitz and Feldman, 2011), within geography has been varied. Mann (2006) and Castells (2011) have been particularly influential in this regard showing how different kinds of networks are constitutive of social power. Network analyses are effective at illustrating how a favorable position becomes a resource that produces further gains.

![Figure 4. Dominant 'colleges' in producing critical urban studies/theory scholarship](image)

A network approach to analyzing invisible colleges conveys the relationality of power and the inherent systemic inequality in knowledge production. Put differently, “The most prolific man[author] is also by far the most collaborating...” (de Solla Price and Beaver, 1966: 1014) and these collaborative networks reveal who is involved and by extension who is excluded. Even though they did not employ social network analysis, as employed in this paper, de Solla Price notes how the systemic dominance of authors and/or institutions in producing specific knowledge (see Figure 4) is a function of their networks: “They [invisible colleges] are just the hierarchical elite resulting from an expectable inequality...They are highly connected with each other for within their small number they contain the greater part of the action” (de Solla Price, 1971: 75).

Those caught up in the productive web of the invisible college are poised for success by means of path-dependency, cumulative advantage and expected inequality. Imagine a traditional college lecture hall with a large desk at the front of the room. Long tables and chairs bolted to the floor are built outward in upward circular rows similar to a small stadium. Each seat has a fixed position in relation to the desk. On the first day of class, the professor instructs students to choose their seat for the semester. A few weeks in, the professor places a trash can on top of the desk. Each student is given a wad of crumpled up paper and told...
that they will be given up to 5 bonus points if they can make a basket with the paper ball. They have five chances. It quickly becomes clear that those with the most favorable position (perhaps those closest or seated with a good angle) are likely to make the most baskets. Some students will be highly represented basket-wise (the Matthew Effect) while future students who have the “best” seats will probably continue to make more baskets (cumulative advantage) given that the room’s structure remains unchanged (path dependency and expected inequality).

Power works in analogous ways within the invisible college as reflected in Figures 4 and 5. The dominant colleges/universities in Figure 4 are based on the number of critical urban studies/theory authors and co-authors in the 125 indexed references analyzed who (1) listed these colleges as their institutional affiliation on the published papers analyzed and (2) received their doctoral degree from these colleges. Figure 5 presents the top colleges based only on the former measurement (i.e. institutional affiliations of the authors and co-authors). Figure 5 is akin to what might be tracked or measured in a publication like US News and World Report. In other words, this is a visible indicator that we may be familiar with. Figure 4 operates a bit differently by exploring largely unseen or unstudied indicators which reflect the invisible infrastructures leading to nodal concentrations. So, Figure 4 tracks not just the static output but the more dynamic processes of affiliation (where the scholar got their doctoral degree) which potentially sets in motion future connectivities.

Figures 4 and 5 show similar results in terms of the dominant 10 colleges with the exceptions of Columbia University, Johns Hopkins University, and the University of Minnesota. These colleges remain dominant because the authors/co-authors depend on each other for financial and professional support. That is, the elite and hierarchical nature of these invisible colleges “has a basis in the financial and economic as well as professional dependence of one author upon another” (de Solla Price and Beaver, 1966: 1013). This is manifested through, for instance, authors publishing with specific co-authors (e.g. their PhD supervisors, and/or authors from specific colleges) over the years. The production of critical urban studies could be above all, about resources shared, and the relationality of a small, closely-knit group of authors/co-authors by virtue of, for instance, who supervised them and/or where they received their doctoral training, their membership in the same associations (e.g. membership on editorial boards, professional associations), and their similarity in terms of gender, ethnicity, etc. (see Wagner, 2008). The question of who gets included or excluded in these close knit highly productive clusters becomes a function of path-dependence to some degree. In other words, the momentum of the invisible college overpowers some in the face of others leading to what de Solla Price (1971: 75) opines as “expected inequality”.

Colloquially at least, networks can connote (the

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4 In Figure 4, Colombia University is dropped in the top 10 and Johns Hopkins University and the University of Minnesota is added to the top 10 universities because we are not only interested in the static output of measuring the number of times a university is listed by authors on their publication (as represented in Figure 5) but also the more dynamic processes of measuring the number of times a university trains these scholars (where the scholar got their doctoral degree) which potentially sets in motion future connectivities. Based on institutional affiliations listed on publications of authors and co-authors alone, Colombia University is within the top 10 universities of the most cited critical urban studies scholars but Colombia University is not within the top 10 universities when we also account for which universities train these most cited scholars.
illusion of?) malleability, in their evocation of elasticity and ephemeral connections. Rather than hardened infrastructures, networks can be re-deployed and re-configured. The reality is that these networks and their subsequent nodes become hardened and fossilized through the normative process of the constitutive elements of academic research. For example, scholars are required to continually cite certain scholarship wherein the continuous interpellation of a canon works as a stabilizer/gate-keeper in relation to the production of new scholarship. Citation forms disciplines (Ahmed, 2013) and caught up within those citational structures is what we have noted above as the Matilda Effect. Our examples are confined to the formal practices of scholarship (citation) but there are multiple other practices such as name-dropping/micro-aggressions (x is so because so and so said so) which silence or exclude people whose interests differ.

As suggested, gender has played a role in what we have thus far mapped. Specifically, we analyzed the network of critical urban studies/theory scholars in Figure 4 to understand the gendered spaces within the invisible colleges (see Table 1). From the network of nodes, we analyzed a total of 46 female and 97 male authors and co-authors, 15 female and 40 male doctoral supervisors, and 18 female and 37 male doctoral supervisees.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female to male authors/co-authors</td>
<td>0.5</td>
</tr>
<tr>
<td>Female to male PhD supervisors of authors/co-authors</td>
<td>0.4</td>
</tr>
<tr>
<td>Female PhD supervisors to female PhD supervisees</td>
<td>0.8</td>
</tr>
<tr>
<td>Female PhD supervisors to male PhD supervisees</td>
<td>0.4</td>
</tr>
<tr>
<td>Male PhD supervisors to male PhD supervisees</td>
<td>1.1</td>
</tr>
<tr>
<td>Male PhD supervisors to female PhD supervisees</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Table 1: Ratio of female to male critical urban studies/theory scholars across multiple parameters

Table 1 suggests that females tend to co-author more with other females, as do males, and that there are minimum female-male co-authorships. However, female scholars (55%) tend to be supervised mostly by male doctoral supervisors while only 19% of male scholars were supervised by female doctoral supervisors. This is also not surprising since the network shows that there are about twice the number of male doctoral supervisors as female doctoral supervisors in critical urban studies/theory.

We want to be careful about drawing specific conclusions from Table 1 particularly since this intervention is not so much a corrective as a creative documentation of what many of us already know. These findings, therefore, reveal more questions than they answer about the systemic, structural factors underlying practices of knowledge production. For instance, the analysis calls into question the underlying homosocial supervision practices that produce disproportionately more dependent and path-dependent networks for male scholars even after completing their doctoral training. More research is needed and future analysis could explore issues such as: (1) the density of a scholar’s research collaboration network when supervised by male vs. female supervisors; (2) the total research funding available to a researcher supervised by male vs. female supervisors; and (3) whether female scholars, by virtue of their connection to a supervisor within these invisible colleges, gain benefits from these networks (i.e. the social capital of invisible colleges). In-depth interviewing and ethnographic work could shed more light on the role of “immaterial” infrastructures within these landscapes, but that is left to subsequent research.

Punking the System?

Finally, we looked at the publication outlets for the authors and co-authors with the most cited paper or book in the 125 indexed references gathered. Our analysis involved collecting data on the journals, which served as the most frequent outlets of publication for authors and co-authors of the top 10 most cited research outputs. We used the CVs, institutional profiles, and Google Scholar profiles of these authors and co-authors to collect data on the journals
these authors and co-authors have most frequently published in. The publication outlets were collected for the 14 authors and co-authors with publications in the top 10 most cited critical urban studies/theory scholarship. Only two are females, and almost all of them have at least two publications in the journals shown in Figure 6.

The sizes of journals in Figure 6 correspond with the frequency with which these 14 scholars have published in them. These scholars have most frequently published in Antipode, International Journal of Urban and Regional Research (IJU RR), Environment and Planning D, City, Annals of the Association of American Geographers, Urban Geography, and Urban Affairs Review. Our word cloud is effectively a visualization of “double-dipping” — or the practice of frequent publication in the same journal outlet. From our perspective, “double-dipping” is both constituted through and an effect of path-dependency, cumulative advantage and expected inequality. To return to our classroom example, the trash can is now the journal outlet. In our opinion, there is nothing unethical about publishing multiple articles in the same journal but it does call into question the double-blind review process. We bring it up specifically because it links up well with an illustration of power embedded within invisible colleges. What is more, almost all of the 14 scholars have served and/or continue to serve on the editorial boards (either as members or editors) on these journals where frequent publication occurs. Absent in-depth empirical analysis, we cannot comment as to whether there is a correlation between a scholar’s membership on editorial boards and the frequency of publication in that journal. However, from this paper’s standpoint, these double dipping findings beg the question of how practices of constituting journal editorial boards reinforce invisible colleges and/or the homosocial practices sometimes animating knowledge production. Does a scholar have a relatively higher chance of getting a paper published if s/he is a member or is included in the invisible college network of an editorial board member in any of these journals identified in Figure 6? Although we do not dig deeper here, it is possible to explore whether the increased frequency of publication in the identified journals by these 14 scholars occurred before or after membership on the journal’s editorial board.

Instead of any indictment of particular scholars, we are concerned with methodological approaches that interrogate the multiple geographies of invisibility and inclusion/exclusion. Visualization as a technique of equity, through the incorporation of the kinds of analyses depicted in this paper, provide insight into the multiple pitfalls and positionalities imbricated in the peer-review process which still remain a black box to some degree (see Crane, 1967; Hojat et al., 2003; Kassirer and Campion, 1994; Spender, 1981).

Conclusion

Up to this point, the scholarly practice of homophily (the tendency to form connections with others who are similar) and the ways in which it drives fields of study and issues of general concern have not been the object of deeper analysis within Human Geography or Critical Urban Studies. Concern for the uneven distribution of power within networks as reflected through knowledge production is important insofar as it reproduces, compounds and reifies all sorts of privileges and advantages. We argue that many of the processes upholding what we come to know as critical urban studies/

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5 We are aware that there are only so many top-tier disciplinary outlets and multiple other variable and realities which constrain the landscape of opportunities for publishing. We acknowledge that double dipping (not inherently negative) is certainly a structural problem which goes beyond the scale of the individual.
theory are invisible. Calling attention to varying degrees of dominance through multiple kinds of visualization attempts to address data blank spots, account for both misrepresentation and underrepresentation and offers an avenue to “methodologize” equity. All knowledge is entangled in politics; “scholarship space” (Gould, 1991) is no exception.

Our examples point to the overrepresentation of the well-established and the elision of women within the sub-discipline of critical urban studies. The Matthew/Matilda Effects and the discussion of path-dependency, cumulative advantage and expected inequality suggest that these practices are not isolated. The concept of “double-dipping” and our subsequent word cloud seeks to capture the unmapped connectivities bolstering knowledge production. Journal editors and editorial board members play significant roles in brokering information. All of these concepts taken together help to explain how networks solidify and perhaps take on an (invisible) life of their own.

The somewhat modest undertaking reflected in this paper continues our larger project of advancing alternative metrics by addressing methodological erasure within knowledge production. Immaterial infrastructures which foster dominance should be addressed in conceptual discussions that aim for true comparative urbanism. Some have gone so far as to suggest that the erasure of intellectual contributions acts as a form of structural violence (Bouka, 2018). We do not disagree; co-production matters as do practices of cooptation even though these can be difficult to excavate. Exposing the invisible college to light reminds us of the many factors left to be interrogated in the uneven production of academic knowledge. Some avenues for further research might include using exponential random graph models (Koskinen and Daraganova, 2013) to test how specific factors (e.g. gender, institutional affiliation, membership on same editorial boards, etc.) lend themselves to the emergence of invisible colleges.

Beyond the particular correctives delineated above, we must also recognize that as academics, we are all complicit in some form or another in the inequalities of knowledge production. The rich debates on urbanism have made conceptual strides along these lines. What remains less discussed is the methodological potential of visualizing the constitutive elements of critical urban studies.

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