

Beijing's Central Role in Global Artificial Intelligence Research

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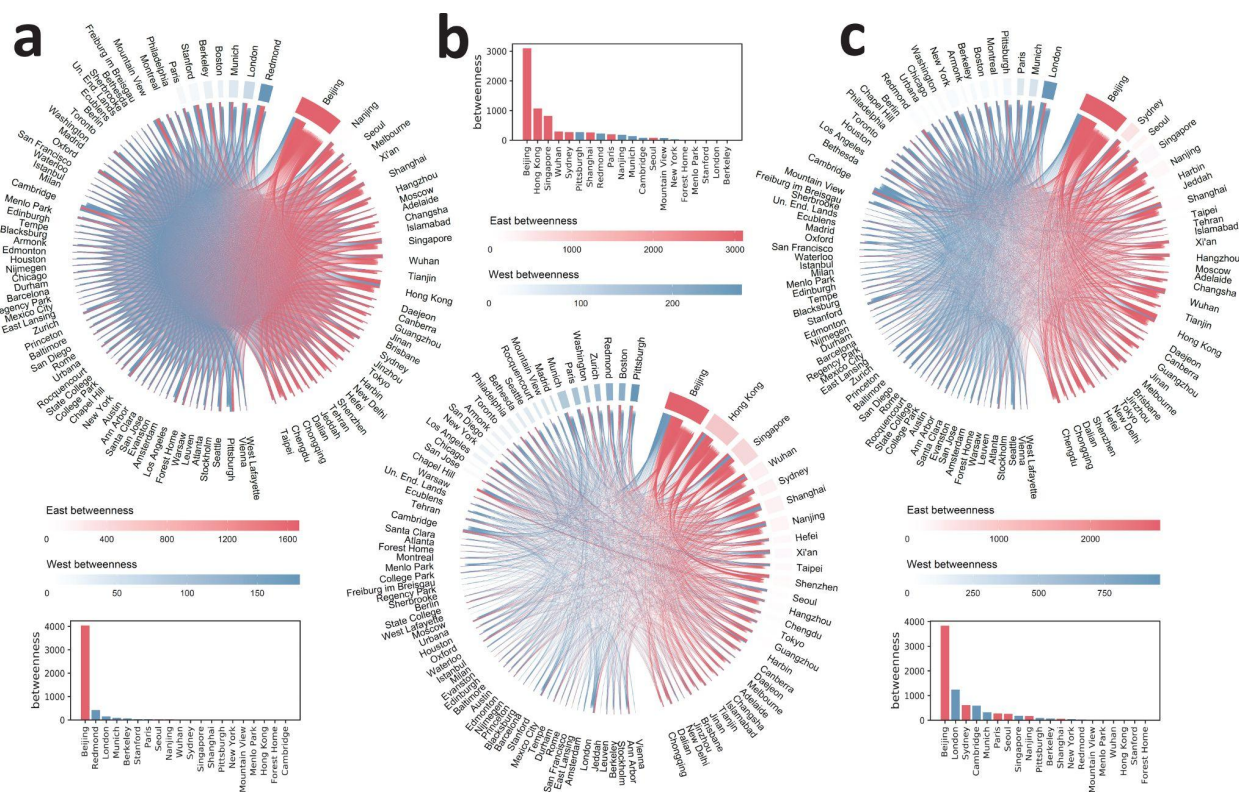
Extended Abstract

Nations worldwide are mobilizing to harness the power of Artificial Intelligence (AI) given its massive potential to shape global competitiveness over the coming decades [1,2,3,4]. By analyzing more than two million AI papers published over decades, we were able to compare cities in terms of their AI research, focusing on the number of papers they produce, the number of citations they receive, and the number of AI scientists they house. Beijing has been the most productive city since 2002, the most impactful since 2007, and the one with the largest AI workforce for the past two decades. To understand the dependencies between Eastern and Western cities, we started off by studying the impact network of the most impactful cities worldwide. We found that (i) all cities cite themselves far more frequently than they cite others; (ii) top Eastern cities exert a relatively small impact on top Western cities; and (iii) Beijing cites other cities the most, regardless of whether their location lies in the East or the West, suggesting that its research builds on knowledge produced across the globe. We compared the observed citation patterns to those expected under a baseline model in which citations occur randomly. This analysis revealed a substantial dependency of Western cities on other Western cities, as they cite each other far more frequently than expected by chance.

Next, we analyzed the migration of AI scientists between the top cities from 2013 to 2017. We found that migration mostly takes place from an Eastern city to another Eastern city. When studying the network of collaborations across cities, we found that East-East collaborations are far more frequent than their East-West or West-West counterparts. Motivated by these observations, we set out to identify the cities bridging East and West. To this end, we proposed a version of betweenness centrality that only considers the shortest paths starting in the East and ending in the West, or vice versa. Using this measure, we analyzed the impact network, the migration network, and the collaboration network of the most impactful cities in AI worldwide. The results of our betweenness-based analysis are depicted in Figure 1. In all three networks, Beijing has by far the highest betweenness centrality. Taking a closer look at each network we find that in regards to impact (Figure 1a), Beijing's betweenness is four times greater than the sum of the betweenness of all other cities combined. This finding highlights the vital role that Beijing plays in transitioning knowledge between the East and the West. Intuitively, when a paper w in the West cites a paper b in Beijing, which in turn cites a paper e in the East, the paper b can be thought of as a bridge through which the knowledge in e is transitioned to w . Moving on to the migration network (Figure 1b), Beijing's betweenness is three times greater than the city with the second-highest betweenness, suggesting that Beijing acts as the hub through which scientists in the East can reach the West and vice versa. Finally, in terms of collaboration (Figure 1c), Beijing's betweenness is greater than the sum of the betweenness of all remaining cities. This can be interpreted as Beijing being the city where Eastern and Western AI scientists most frequently share a coauthor, effectively connecting both parts of the world.

Finally, we tracked the center of mass of AI research, which weighs the locations of different cities by their output, be it AI impact, AI productivity, or AI workforce. The three centers of mass have all been drifting towards the East since 1990, with Beijing contributing significantly towards this phenomenon. Taken together, these findings underscore the growing role of the East in general, and Beijing in particular, in shaping the global AI landscape.

To conclude, nations are racing to dominate the field of AI given its disruptive and transformative potential [1]. Our study has shown that dependencies matter, so competition may not be the right approach to understand the evolution of AI. China's capital already plays a critical role in AI research not only as a hub of knowledge creation but also as a bridge between East and West in terms of citations, collaborations, and scientists' migrations. More often than any other city, Beijing seems to pick scholarly knowledge from one side of the globe, build on it, and then introduce it to the other side, acting as a gateway through which knowledge flows in both directions. Whereas researchers from prominent cities on the West Coast of the U.S. largely collaborate with scientists in other Western cities, Beijing-based researchers collaborate with scholars located in both East and West, possibly tapping into tacit knowledge and resources available to scientists across the globe. Also, more often than any other city, Beijing sees AI scientists passing through from one side of the world to the other; those scientists probably leave traces of their expertise and technical know-how along the way. Taken together, these findings highlight Beijing's central role in global Artificial Intelligence research.



References

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