

The role of institutional prestige, gender, and number of citizenships in ballet masters' careers

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SUMMARY

The role teachers play in spreading and preserving knowledge directly impacts the growth and development of their students. In the context of ballet, a ballet master maintains and evolves the technical standards of students that impact the art form's legacy. In recognizing the importance of these individuals in the ballet realm, this study explores the characteristics, including institutional prestige, gender, and number of citizenships, that affect a ballet master's career and overall influence. We hypothesized that ballet masters affiliated with prestigious institutions, male ballet masters, and ballet masters with a higher number of citizenships would be more likely to achieve higher levels of influence and success in their careers. Utilizing structured data from Wikidata, our study employed network analysis, correlational analysis, and statistical methods to test this hypothesis. The results indicate that connections to prestigious institutions and higher numbers of citizenships enhance a ballet master's career. Although the research found no statistically significant relationship between gender and number of awards, male ballet masters had a significantly higher number of webpage links, and our data add to the ongoing research about gender's role in the work industry. The study results can offer insights into how certain professional characteristics can contribute to success in other artistic fields beyond ballet and can be used to explore whether the same relationship holds true for other important roles in the ballet community.

INTRODUCTION

Teachers play a crucial role in shaping students' growth and knowledge (1). Good teachers are able to make students passionate, driven, and motivated to learn more (2). As such, an increasing number of studies have focused on identifying the qualities that make a teacher effective. For instance, some studies suggest that common personal characteristics of good teachers include a sense of humor, enthusiasm, and being well organized (3, 4). Other studies that looked at teachers' educational backgrounds showed that students who are taught by highly qualified teachers have higher success in their learning endeavors compared to those taught by less qualified teachers (5, 6). Similarly, another study found that there is a relationship between professors with academic degrees and better student performance in math and science classes (7). Overall, these studies suggest that a teacher's background and personal characteristics can potentially affect their ability to teach well. This raises important questions about the characteristics of good teachers in other domains,

such as the arts, where such relationships remain largely unexplored.

Ballet is a performing art formalized by King Louis XIV in France that emerged from a centralized social system relying on social connections and hierarchies driving the career development of the dancers (8, 9). Ballet masters, who are responsible for training dancers, may gain influence from being part of prestigious institutions. Prestige is defined by the respect earned by an institution based on its history and reputation in its field (10). As such, prestigious ballet institutions may enhance a ballet master's career in multiple ways: providing access to collaborative projects, better resources, and recognition within the professional ballet community. Research shows that in many fields, including the arts, the prestige of one's educational background can open doors to more professional opportunities compared with non-prestigious backgrounds (11, 12). A recent study also highlighted how the prestige of ballet academies influences dancers' career success, underscoring the long-term impact of institutional affiliation on career trajectories (13). We sought to further explore this domain by exploring the relationships between a ballet master's success, influence, and the specific demographics they carry. In this study, success was measured by the number of awards and links a ballet master had, while influence was assessed through their centrality within their career networks.

This study used centrality, which refers to an individual's prominence within a network based on their connections and influence relative to others, to indicate the influence level of a ballet master (14). Higher centrality indicates that a ballet master is more interconnected within their professional network and is provided with more opportunities and resources to influence others. This concept ties directly to institutional prestige, as affiliation with prestigious institutions often expands an individual's network and increases their visibility within the field. We explored whether the institutional prestige of a ballet master's affiliations increases their influence (centrality) within the ballet community. We hypothesized that ballet masters associated with prestigious institutions are more likely to have a higher centrality in their local network.

Beyond looking at the educational background of ballet masters, we also analyzed whether their gender and number of citizenships impacted their career. One study showed that individuals who exhibit "masculine" traits are statistically more likely to achieve career success compared to those who display "feminine" traits (15). Furthermore, another study found that women are statistically given fewer opportunities and receive lower pay wages despite having similar qualities as their male counterparts (16). We aim to add to this complex discussion of the role of gender in careers by analyzing this

relationship in the realm of ballet (15, 16).

Besides gender, we explored how the number of citizenships a ballet master holds correlates with their influence. In this context, citizenships refer to the number of legal nationalities an individual possesses, which may enable them to work internationally with fewer restrictions. International work experience has been shown to correlate positively with career success (17, 18). This may be because being exposed to different communities allows an individual to broaden their skills, interact with more people, or expand their professional network.

For assessing the relationship of both gender and number of citizenships on a ballet master's success, we used the number of awards and links affiliated with the ballet master. Awards are defined as formal recognitions or honors received by the ballet master for their contributions to the field of ballet. The ballet masters' professional 'links' are defined as the physical hyperlinks on a ballet master's Wikipedia page, which represent their associations with other prominent ballet individuals. These links serve as a measure of the ballet master's ability to establish and sustain formal affiliations or collaborative connections within the ballet community. We hypothesized that ballet masters who are male and have a higher number of citizenships will have more awards and links.

Our findings indicate that ballet masters from prestigious institutions tend to have higher centrality within their networks. This indicates that institutional prestige provides substantial advantages in building a ballet master's career. We also find that more citizenships correlate with higher numbers of awards and webpage links, indicating that career success and influence are positively impacted by exposure to different countries. Our hypothesis that males had an advantage in career success and influence was partially supported: male ballet masters had a statistically significant higher number of links than female ballet masters ($p < 0.05$), but the difference in the number of awards between genders was not statistically significant ($p > 0.05$). Ultimately, this paper helps identify correlations of institutional prestige, gender, and number of citizenships on career success and influence, adding to the knowledge of social factors that explain how careers in the performing arts evolve and shape the art form.

RESULTS

Relationship between prestige and centrality

By exploring the prestige influence on a ballet master's network centrality, we aimed to reveal more about the qualities of influential ballet masters in the ballet community; specifically, how their careers are impacted by the prestige of their affiliations. These findings can help contribute to the lack of knowledge of how careers in ballet are shaped and formed.

We used data extracted from Wikidata to test our hypotheses (19). We used the number of awards received and the number of Wikipedia links presented to quantify the concept of prestige. These metrics were selected because awards are direct indicators of recognition by peers and the public, while links can reflect the visibility and connectivity of the institution (20-22). As such, by using the ranking based on the number of awards and links, we ranked the top 20 most prestigious institutions according to the dataset by awards and links (**Table 1**).

To compare the success and effectiveness of ballet

Institution	Normalized Prestige
Mariinsky Theatre	1.9
Russian Institute of Theatre Arts	1.7
New York City Ballet	1.0
Bolshoi Theatre	0.77
Vaganova Academy of Russian Ballet	0.74
Navoi Theater	0.57
New York University	0.55
Ballet Russe de Monte Carlo	0.51
Bolshoi Kamenny Theatre	0.50
School of American Ballet	0.50
Ballets Russes	0.40
Saint Petersburg Conservatory	0.36
Bolshoi Theatre of Belarus	0.34
American Ballet Theatre	0.34
White Oak Dance Project	0.34
National Ballet of Canada	0.34
Baryshnikov Arts Center	0.34
Hamburg State Opera	0.33
National Opera of Ukraine	0.32
Yerevan Opera Theater	0.32

Table 1: Top 20 prestigious ballet institutions. Rankings are determined using our scoring system, which normalizes the total number of awards and professional links held by ballet masters at each institution. The list is ordered from highest to lowest prestige value.

masters within prestigious institutions to those who are not, we used network centrality to measure influence and recognition. Prior studies show that someone's position and connections within a network affect their creative careers, their productivity, and their success (13, 23-25). Thus, the centrality metrics provided a framework for measuring the professional influence and connectivity achieved by a ballet master.

We constructed a professional network for each ballet master that included all connections with students and teachers available in the dataset (**Figure 1**). In this network, we measured the centrality of each ballet master and compared the average centrality measures of ballet masters from prestigious institutions against those from non-prestigious institutions.

We used different measures of centrality (betweenness, closeness, and eigenvector) to calculate the average centrality of ballet masters from various types of institutions. Betweenness centrality quantifies how often a node (individual) acts as a bridge along the shortest path between other nodes, indicating its role in connecting different parts of the network. Closeness centrality measures how quickly a node can access all other nodes in the network, reflecting their overall reachability. Eigenvector centrality assesses a node's influence based on its connections to other influential nodes (14, 35, 36). We found that the average centrality across all three different measures of centrality was higher for individuals who were part of prestigious institutions compared to those who were not. Those within prestigious institutions had a 2.31 higher betweenness centrality, a 0.0014 higher closeness centrality, and a 2.11e-05 higher eigenvector centrality than those not in the top 20 institutions (**Table**

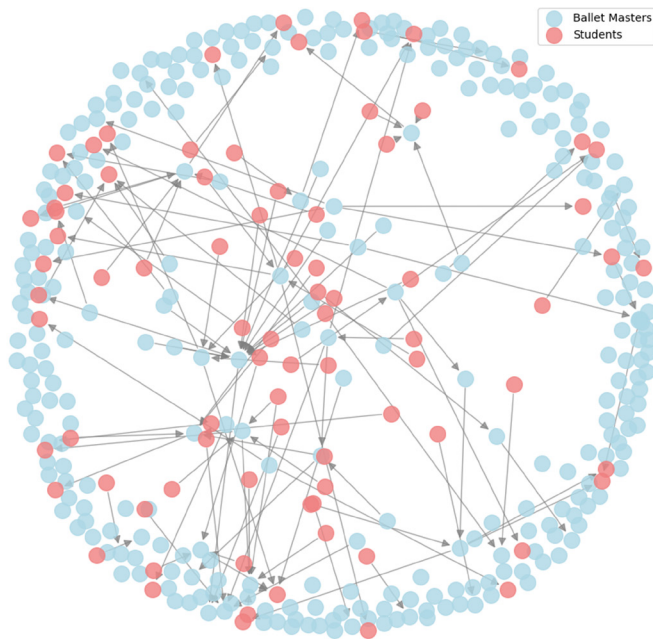


Figure 1: Directed network of ballet masters. Blue nodes represent ballet masters, while red nodes represent students. Arrows connecting blue nodes (masters) with red nodes (students) indicate a master-student relationship. The graph consists of 383 nodes and 114 edges. This network visualization highlights the structural influence of institutional prestige on network centrality. Note: Variations in arrow direction are a result of automatic layout rendering; all edges represent student-teacher relationships.

2). We did not perform formal statistical testing on these centrality comparisons; while the results suggest a consistent trend across all three centrality measures, formal statistical testing would be necessary to confirm the significance of these differences.

Relationship between gender and career

In this study, links were used to measure career influence and awards were used to measure career success. An analysis of the distribution of awards and network links by gender revealed that, on average, male ballet masters received 3.88 awards per individual, while female ballet masters had a slightly higher mean of 4.67 awards per individual. A two-sample t-test showed that this difference was not statistically significant ($p > 0.05$, **Figure 2A**). In contrast, males exhibited a significantly higher mean of 9.15 links per individual associated with their Wikipedia page compared to females, who averaged 6.15 links per individual. A two-sample t-test showed that this difference was statistically significant ($p < 0.05$, **Figure 2B**).

Relationship between number of citizenships and career

We observed that the number of citizenships had a positive correlation with the number of awards and links. Our results revealed that the number of citizenships and number of awards were significantly correlated ($p < 0.001$, **Figure 3**). Moreover, the number of citizenships and the number of links were also significantly correlated ($p < 0.003$, **Figure 3**). In both findings, a higher number of citizenships correlated with a higher number of awards and links.

DISCUSSION

Our work found that the prestige of ballet masters' affiliated institutions impacts their ability to achieve centrality within their ballet network. Through an aggregated scoring method, we ranked the top 20 prestigious ballet institutions based on the data extracted from Wikidata. By using network analysis to compare the average centralities of ballet masters within these top institutions to those who were not, we found that their centrality in their networks was correlated with the prestige of their affiliated institutions. We found that the average amongst all three centrality measures was higher for those affiliated with the top 20 prestigious institutions compared to those not affiliated with a prestigious institution.

Ballet masters with a higher betweenness centrality score play a crucial role in spreading knowledge across the network. Ballet masters with a high closeness centrality indicate they can quickly interact or spread information to others and, thus, can easily influence due to their proximity to others. Lastly, those with a high eigenvector centrality have connections to other important individuals in the network. According to these centrality metrics, our results show that masters in prestigious institutions have an overall higher influence within the ballet world. Whether this relationship is because ballet masters have more opportunities to connect, gain recognition, or develop better skills remains unknown, and more research that analyzes these mechanisms can be done in the future to provide more context to our findings.

Additionally, a higher number of citizenships is correlated with a higher number of awards and links. This may be explained by the benefits of having international work experience. Ballet masters who can live in different countries can gain broader skills, develop a wider range of connections, and have more opportunities for career advancement. These explanations serve as foundational ideas that can be further explored through more data. Future analyses could incorporate variables such as the duration of time spent working abroad, the number of institutions a ballet master has been affiliated with, and the diversity of their professional collaborations. Collecting longitudinal data on career trajectories—such as when and where ballet masters receive awards or change affiliations—could reveal whether international exposure directly contributes to career success over time.

Though our data did not find a statistically significant difference between genders in the number of awards ($t = -1.52$, $p > 0.05$), male ballet masters had a statistically significant higher mean number of links per individual than female ballet masters (9.15 vs. 6.15 links per individual; t

Centrality Type	Average Centrality of Ballet Masters in Top 20 Institutions (Prestigious)	Average Centrality of Ballet Masters not in Top 20 Institutions (Not Prestigious)	Difference of Average Centralities (Prestigious – Not Prestigious)
Betweenness Centrality	4.01	1.70	2.31
Closeness Centrality	0.0018	0.00042	0.0014
Eigenvector Centrality	2.28e-05	1.70e-06	2.11e-05

Table 2: Average centrality of ballet masters from prestigious institutions compared to those from non-prestigious institutions. Metrics are based on a sample size of 383 ballet masters. Note that all three centrality types are higher for those in the prestigious column than those in the non-prestigious column. No formal statistical testing was performed on these comparisons.

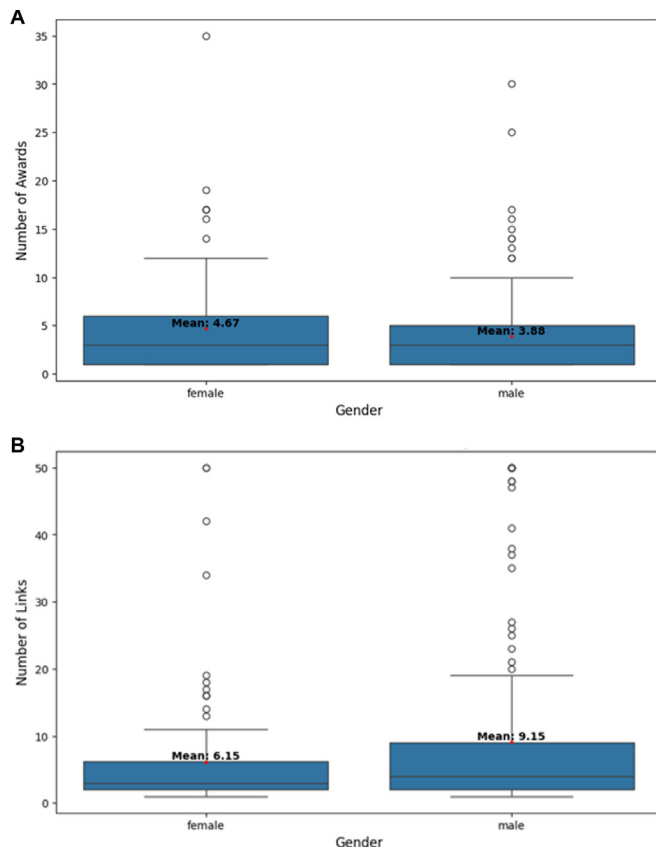


Figure 2: Distribution of number of awards or links by gender.

A) Box plot showing the distribution of the number of awards received by ballet masters, categorized by gender. A two-sample t-test was conducted, yielding a t-statistic of -1.52 and a p-value > 0.05. Sample sizes: female (n = 115), male (n = 189). **B)** Box plot showing the distribution of the number of webpage links associated with each ballet master, categorized by gender. A two-sample t-test was conducted, yielding a t-statistic of 2.02 and a p-value < 0.05. Sample sizes: female (n = 96), male (n = 150).

= 2.02, $p < 0.05$). As mentioned before, being male in the work industry has been shown to have advantages for career opportunities and success (15, 16). Based on this statistically significant difference in links, our findings suggest that male ballet masters have higher visibility and recognition compared to female ballet masters.

There are multiple limitations within this study. Firstly, the data was extracted from a public domain where users can edit and delete data. This introduces the possibility of inaccuracies and missing values within the dataset. For example, some ballet masters may have received awards that are not reflected in Wikidata, leading to underreporting of their achievements. This can cause the ranking of prestigious institutions to be inaccurate if the numbers of awards and links are incorrectly reported. Given that this study relies on a single source, future research could improve data accuracy by compiling information from multiple open-source platforms or cross-referencing Wikidata with other databases. Additionally, this study only incorporates students and teachers within the network of ballet masters. Further studies can incorporate other important individuals in the ballet world, such as choreographers, costume designers, and directors. Having a larger network would help provide

a more holistic view of the ballet networks and enhance the accuracy of centrality measures. Also, more research can be done to investigate what specific mechanisms enhance a master's professional development; for example, whether the prestige of the institution helps with recruitment, gaining quality skills, or a higher access to resources for the ballet master.

While this work uses network centrality as a measure of influence and success, future studies could account for broader dimensions of the ballet world to provide a more comprehensive analysis. Artistic contributions such as choreography, repertoire innovation, and performance legacy—as well as qualitative indicators like a ballet master's capacity to mentor, inspire, and shape the artistic direction of institutions—could serve as valuable measures of impact. Incorporating these elements would allow future research to capture the multifaceted nature of influence in the ballet community beyond structural network metrics.

Similarly, ranking the prestige of institutions based solely on awards and links overlooks other important factors that contribute to an institution's prestige. More comprehensive data on an institution's quality of training, faculty expertise, alumni success, and historical significance would provide a fuller picture of what makes an institution truly prestigious.

Based on these limitations, there are multiple opportunities for future research. Incorporating qualitative methods, such as interviews with ballet masters, students, and other professionals, could provide better insights into how institutional prestige is perceived within the ballet community as well as its effect on career decisions. Another possible study could analyze personal characteristics that common ballet masters exhibit. Achieving success in the ballet world is complex; there are other factors, such as personal traits, income, and ethnicity, which could correlate with higher influence levels. Lastly, while our research focuses on ballet, similar studies could compare the influence of institutional

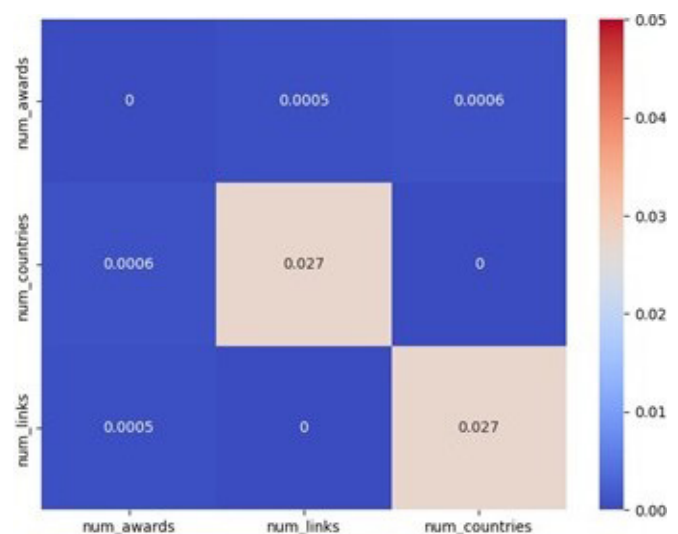


Figure 3: P-value matrix for number of citizenships, links, and awards. The matrix displays the p-values for each relationship, calculated using a Pearson correlation test with a sample size of 383 ballet masters. "num_awards" represents the number of awards a ballet master has received, "num_countries" indicates the number of citizenships held, and "num_links" refers to the number of webpage links associated with the ballet master.

prestige across different art forms and whether the findings of this study are applicable to other creative fields.

Another consideration that may influence our findings relates to historical and definitional factors within the ballet profession. Women were formally excluded from professional leadership roles in ballet for much of its early history, which means that the number of female ballet masters in our dataset is likely lower for earlier time periods. This historical limitation could partially account for the gender imbalance observed in our data and could have influenced measures of network centrality and visibility. Furthermore, the title “ballet master” itself has evolved over time. Because our dataset relies on Wikidata’s classification of “ballet master,” these historical and linguistic shifts could introduce inconsistencies in how individuals were categorized. Future research could address this by controlling for historical period and changes in terminology so that it accurately assesses how gender affects professional influence in ballet.

In summary, our findings show that specific characteristics of ballet masters correlate with career success and influence. We find that those affiliated with prestigious institutions tend to have higher average centralities within their professional networks. This trend suggests that institutional prestige may play an important role in enhancing a ballet master’s visibility and influence within the ballet community. We also find that higher numbers of citizenships correlate with higher numbers of awards and links, illustrating the advantages of international experience on ballet masters’ careers. We hope that this work will provide more data-driven analysis in the performing arts and shed light on the underlying factors that correlate with career success and influence.

MATERIALS AND METHODS

Dataset

Open-access structured data from Wikidata was used (19). The data was extracted using the Wikidata Query Service, which implements the SPARQL query language to retrieve the data (26). Data for all entities registered as ballet masters (wd: Q805253) was collected (19). In the Wikidata system, each entity is labeled with a unique identifier, known as a QID. For the purposes of this research, information on ballet masters’ gender (wd: P21), employer (wd: P108), students (wd: P802), teachers (wd: P1066), and awards received (wd: P166) was retrieved. The dataset was processed and cleaned using R (Version 4.3.2) with the tidy (Version 1.3.1), dplyr (Version 1.1.4), and stringr (Version 1.5.1) packages (27-30). Specifically, observations with no name associated with their QID and any duplicates were removed.

The final dataset contained 651 ballet masters. Our dataset had 37.8% females and 62.2% males. The distribution of birth years ranged from 1505 to 2000, with most masters born in the 1930s (**Appendix 1**).

Link data collection

To collect information on the number of links associated with each ballet master, the requests library (Version 2.31.0) for web crawling in Python (Version 3.11) and the Wikidata tool that provides the number of affiliated links per page were used (31, 32; **Appendix 1**). A Python script was developed to systematically crawl the Wikipedia pages of each ballet master, and the number of links (i.e., references and links to the particular ballet master) associated with each page

was collected. These links were treated as representations of public visibility and online presence, contributing to social recognition.

Prestige ranking of institutions

Prestige was calculated based on the total number of links and awards associated with each ballet master in an institution. The term institution was used to represent the employer of the ballet masters. The Min-Max method was applied to normalize the numbers of awards and links, yielding the normalized prestige of each institution. The formula used was:

$$x' = \frac{x - \min(x)}{\max(x) - \min(x)} \quad (\text{Equation 1})$$

The sum of the normalized metrics—awards and links—was combined to calculate a ‘normalized_prestige’ score for each institution. This composite score reflected the overall prestige of the institution based on the recognition their ballet masters have received. The employers were then ranked in descending order according to their prestige scores. The top 20 institutions with the highest normalized prestige scores were identified.

Network construction and centrality analysis

Network science was employed to objectively assess the value of social connections—an especially relevant approach in ballet, where individual careers often depend on institutional affiliations. Network centrality analysis was used to quantify ballet masters’ influence within the professional community.

A directed graph was constructed using the NetworkX library (Version 3.2.1) for Python (33). Nodes in the graph represented individual ballet masters, students, and teachers, and directed edges captured student-teacher relationships. To assess influence within professional networks, three key centrality metrics were employed: betweenness, closeness, and eigenvector centrality. These metrics were selected to provide insights into each ballet master’s role in connecting others, accessing the broader network, and wielding influence via well-connected peers.

For the node v , the betweenness centrality was determined by the equation (14):

$$C_B(v) = \sum_{s \neq v \neq t} \frac{\sigma_{st}(v)}{\sigma_{st}} \quad (\text{Equation 2})$$

Where σ_{st} represented the total number of shortest paths from node s to node t , and $\sigma_{st}(v)$ is the number of those paths that pass through node v . This centrality measured how frequently a ballet master lay on the shortest paths connecting other nodes in the network. A higher centrality would indicate that the ballet master acted as a bridge within the network and thus was highly influential.

For the node v , the closeness centrality $C_C(v)$ was defined by the equation (35):

$$C_C(v) = \frac{1}{\sum_{t \neq v} d(v, t)} \quad (\text{Equation 3})$$

The term $d(v, t)$ represented the shortest path distance in between the nodes v and t . Closeness centrality showed how quickly a node can access all other nodes in the network. High closeness centrality suggested that a ballet master can reach others in the network faster, illustrating their accessibility to others.

For the node v , the eigenvector centrality $C_E(v)$ was defined as the solution to the following equation (36):

$$C_E(v) = \frac{1}{\lambda} \sum_{t \in N(v)} C_E(t) \quad (\text{Equation 4})$$

The term λ is a constant (the eigenvalue) and the term $N(v)$ represents the group of neighbors of node v . Eigenvector centrality measures a node's influence within the network by considering the number of its connections and the significance of the nodes it is linked to. It is suggested that ballet masters with a high eigenvector centrality are connected to other influential individuals, which in turn suggests their position of significant influence.

Statistical analysis

To statistically examine gender and citizenship effects, a two-sample t-test was performed to compare the average number of awards and the average number of links between male and female ballet masters. Pearson's correlation coefficients were applied to evaluate whether the number of citizenships was associated with award and link frequency. P-values were calculated using Python's SciPy library (Version 1.11.4) to assess statistical significance (34). Values below 0.05 were considered statistically significant, while values above 0.05 were not. No formal statistical testing was performed on the centrality comparisons between prestigious and non-prestigious institutions.

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APPENDIX

Coding for all data analysis is available in our GitHub repository: <https://github.com/qandela/balletmaster>.