Identifying the Collaboration Styles of Research Students

Harry Rolf
Australian National University
Canberra, Australia
harry.rolf@anu.edu.au

ABSTRACT

Today engaging in collaboration is an important factor affecting the success of research students. Having insight into the social dynamics of collaboration can enhance their decision making when engaging with researchers, projects and institutions. This poster presents a visual analytic method for exploring and interpreting the social dynamics of collaboration using co-authorship information on research publications. A study investigating collaboration by research students at the University of Tasmania demonstrates its effectiveness. Results provide insight into the roles of co-authors, revealing the presence of functional research teams with different styles of collaboration.

KEYWORDS

Collaboration; Social networks; Research students; Teams

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Scientometrics; Network analysis; Decision making

INTRODUCTION

Engaging in collaboration is an essential part of research that enhances the chances of impact, innovation and success (Fortunato et al., 2018). For research students (and graduates) collaborations can give them and their work greater visibility and access to networks which can lead to information, new ideas and career opportunities (Horta & Santos, 2016). Collaboration also benefits the organisation(s) involved by developing and sustaining networks for inter-organisational engagement and knowledge transfer – generating greater value from the research training process (Thune, 2009). While bad collaboration can damage reputations and careers (Youtie & Bozeman, 2014).

Insight into the social dynamics of collaboration can enhance reasoning and decision making by research students when engaging with researchers, projects and institutions. This poster presents a visual analytic method for the exploration and interpretation of collaboration using proven social network visualisation and analysis techniques. The results of a study investigating collaboration by research students at the University of Tasmania demonstrate the methods effectiveness.

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DATA & METHOD

Inferring collaboration from co-authorship

Co-authorship of research publications was used as proxy for collaboration. A co-author network was created from a sample of (n=1216) publications by research students at the University of Tasmania from 2007-2015, metadata was retrieved from Elsevier's Scopus abstract and citation database. The Gephi software package (version 0.9.2) was used for the visualisation and statistical analysis of the co-author network (Bastian, Heymann, & Jacomy, 2009).

Identifying teams and co-author roles

An information-theoretic clustering algorithm was used to decompose the co-author network into clusters of closely interconnected co-authors (Rosvall & Bergstrom, 2007). The algorithm was chosen because the clusters that it generates have been found to detect functional research teams (Velden, Haque, & Lagoze, 2010).

Collaboration by co-authors in a cluster was characterised using three aspects of communication: Energy – the number and the nature of exchanges among co-authors; Engagement - the distribution of energy among co-authors and Exploration – communication by co-authors to co-authors outside of their cluster (Pentland, 2012). In this study Energy was approximated by a co-author's weighted degree (the number and strength of links with other co-authors), Engagement as the variation of a co-author's weighted degree compared to other co-authors in their cluster (in-degree), and Exploration as the distribution of a co-author's weighted degree to other clusters (out-degree).

The Engagement (in-degree) and Exploration (out-degree) of co-authors in a cluster was used to categorise them into a series of seven universal roles (R1 to R7) based on their pattern of intra- and inter-cluster connections. (R1) ultra-peripheral, co-authors with all their links within their cluster. (R2) peripheral co-authors, with most links within their module. (R3) non-hub connector, co-authors with many links to other clusters. (R4) non-hub kinless, co-authors with links homogeneously distributed among all clusters. (R5) provincial hubs, co-authors with most links within their

clusters. (R6) connector hubs, co-authors with many links to most of the other clusters. (R7) kinless hubs, co-authors with links homogeneously distributed among all clusters (Guimera, Sales-Pardo, & Amarl, 2007).

RESULTS

The resulting co-author network graph contained 3024 co-authors (n=779 research students) with 26414 links between them, the graph decomposed into 277 clusters. The network's giant component (the largest connected group of co-authors) contained 83% of all co-authors and 162 clusters, with an average clustering coefficient of 0.87 and a graph density of 0.007. The low density and high level of clustering among co-authors reveals a dispersed network of many tightly interconnected clusters.

The networks role – role connection profile is indicative of a stringy-periphery class of network (Guimera et al., 2007). Ultra-peripheral (R1) co-authors are highly connected to one another (69.85% of all links), many provincial (R5) and connector (R6) hub co-authors are directly connected to one another but less connected to R1 co-authors than would be expected by chance (2.48% of all links). The presence or absence of roles in a cluster and co-author Engagement (Figure 1) reveal different styles of collaboration. Within the clusters research students occupy bonding (homophilic) non-hub roles (R1-R3) acting as local organisers while non-students tended to occupy the hub roles (R4-R7) acting as bridges, brokers and gatekeepers to clusters of co-authors.

DISCUSSION

This poster has demonstrated a visual analytic method for exploring and interpreting the social dynamics of collaboration. The method was able to describe collaboration by research students at the University of Tasmania and revealed the presence of different styles of collaboration within clusters that detect functional research teams.

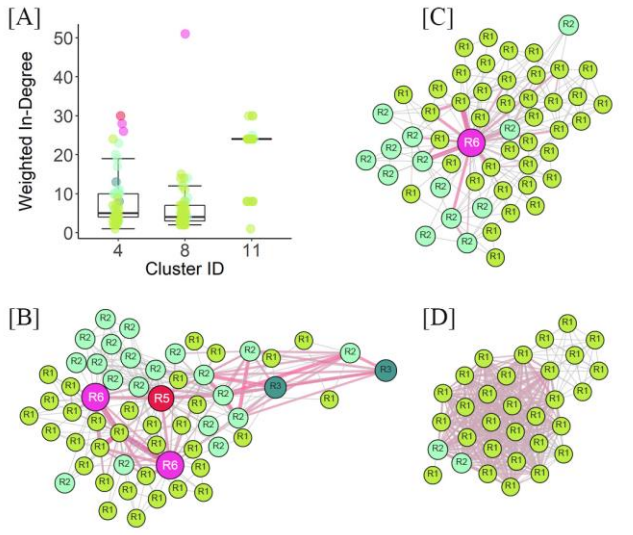

Figure 1: Presents the collaboration profiles for clusters 4, 8 and 11. [A] Shows a boxplot of the variation in Engagement for the three clusters; [B] Shows Cluster 4 which has a distributed profile with multiple hubs; [C] Shows Cluster 8 which has an ego-centric profile with a single dominant hub; [D] Shows Cluster 11 which has an equal contribution profile with no hubs.

Future work should investigate the extent to which this cartographic representation of collaboration maps to an institutions policies, physical research environment and the experience of co-authors.

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REFERENCES

Bastian, M., Heymann, S., & Jacomy, M. (2009). Gephi: an open source software for exploring and manipulating networks. *Third International AAAI Conference on Weblogs and Social Media*.

Fortunato, S., Bergstrom, C. T., Börner, K., Evans, J. A., Helbing, D., Milojević, S., … Barabási, A.-L. (2018). Science of science. *Science*, *359*(6379), eaao0185. https://doi.org/10.1126/science.aao0185

Guimera, R., Sales-Pardo, M., & Amarl, A. N. L. (2007). Classes of complex networks defined by role-to-role connectivity profiles. *Nature Physics*, *3*(1), 63–69. https://doi.org/10.1038/nphys489

Horta, H., & Santos, J. M. (2016). The Impact of Publishing During PhD Studies on Career Research Publication, Visibility, and Collaborations. *Research in Higher Education*, *57*(1), 28–50. https://doi.org/10.1007/s11162-015-9380-0

Pentland, A. S. (2012). The new Science of Building Great Teams. *Harvard Business Review*, *90*(4), 60–69.

Rosvall, M., & Bergstrom, C. T. (2007). An information-theoretic framework for resolving community structure in complex networks. *Proceedings of the National Academy of Sciences*, *104*(18), 7327–7331. https://doi.org/10.1073/pnas.0611034104

Thune, T. (2009). Doctoral students on the university-industry interface: A review of the literature. *Higher Education*, *58*(5), 637–651. https://doi.org/10.1007/s10734-009-9214-0

Velden, T., Haque, A., & Lagoze, C. (2010). A New Approach to Analyzing Patterns of Collaboration in Co- authorship Networks - Mesoscopic Analysis and Interpretation. *Scientometrics*, *85*(1), 219–242. https://doi.org/10.1007/s11192-010-0224-6

Youtie, J., & Bozeman, B. (2014). Social dynamics of research collaboration: norms, practices, and ethical issues in determining co-authorship rights. *Scientometrics*, *101*(2), 953–962. https://doi.org/10.1007/s11192-014-1391-7