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What we can learn from elite academic staff publication portfolios: a social network analysis

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Abstract

Purpose: To construct an understanding of *professional academic writing* network structures to inform organisational strategic investment in academic staff development.

Design: Longitudinal social network analysis is used to examine the personal-networks evident in the publication portfolios of a purposive sample of four international academics across each quartile of the SCOPUS defined area of *General Nursing's* Top 100 authors.

Findings: Trends in the publication portfolios of elite academics across gender, sector and geographic location are presented. In the first years of successful writing for publication authors collaborate within a single highly connected co-author network. This network will typically expand to include new co-authors, before additional separate co-author collaborations emerge (three- to four- years). Authors experience steady growth in co-author numbers four- to seven- years from first co-authored publication. After a period of rapid expansion, these collaborations coalesce into a smaller number of highly connected groups (eight- to ten- years). Most collaborations occur within the higher education sector and across multiple disciplines including medicine, social sciences and psychology. Male co-authors are disproportionately represented in what is a predominantly female profession.

Practical implications: The development of extended co-author networks, locally, internationally, and across the higher education sector, enable authors to attain the marker of achievement required by universities and government funding bodies, namely sustained output of academic publications. Identified trends support the inclusion of investment in academic time and resources in higher education institutions' strategic and operational plans to enable academic staff to develop interdisciplinary professional networks. In focusing this investment on gender equality, female academics will experience parity of opportunity in achieving their organisational and personal goals relating to *professional academic writing*. Medium term investment may be required before the impact of that investment becomes apparent.

Originality/value: This is the first example of social network analysis used to determine characteristics of *professional academic writing* portfolios over time. Findings inform the type and range of investment required to facilitate academic staff writing activities, specifically those publishing in the area of *General Nursing*.

Background

Writing for publication is core to academic life and is used as a marker of achievement by universities and government funding bodies to inform the selective allocation of research funding (Australian Research Council, 2015, Research Excellence Framework, 2020a),

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3 academic staff review (McKiernan et al., 2019), promotion (University of Manchester, 2019)
4 or tenure (McKiernan et al., 2019). While much has been written about supporting academic
5 writing in students (Adler-Kassner and Wardle, 2015), there is an assumption that because
6 staff can support students writing for assessment they are naturally equipped to write for
7 publication (Grant et al., 2010).
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13 Libraries have long supported writing within higher education, with initiatives ranging from
14 writing centres located in library services in the early noughties (Rader, 2001) to
15 contemporary narratives of libraries assisting staff in identifying journals that authors may
16 wish to publish in, editing manuscripts and creating bibliographies (Akers, 2019). At this
17 juncture it is important to distinguish between *academic writing* and *professional academic*
18 *writing*. Writing centres have typically focused on *academic writing*, defined as writing by
19 students in academic settings relating to assignments and theses for assessment. Broader
20 library services having focused on supporting the *professional academic writing* of higher
21 education staff for publication.
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28 Responding to the findings of their systematic review exploring the “publish or perish” culture
29 of universities and research institutes, Guraya et al (2016) suggest that universities have an
30 obligation to train staff in sound scientific writing. The most effective forms of writing skills
31 training in particular contexts remains unknown (Stylianou et al., 2017), though a lack of
32 confidence in their writing ability can preclude an academic’s decision to attend a writing
33 interventions (Noone and Young, 2019). Sword (2017) found that only 15% of academic staff
34 in their mixed methods study acquired *professional academic writing* skills through accredited
35 writing courses or institutional sponsored mentoring programmes; for the majority of
36 academics, skills development was achieved through reading books or attending occasional
37 academic development workshops (38%), or ad hoc, opportunistic, and noninstitutionalised
38 processes (47%). Multiple writing interventions exist to support academic staff on their
39 journey to published author including writing groups (Grant et al., 2010), promoting
40 motivation (Smith and Deane, 2014) through peer-formativity interviews (Murray and Thow,
41 2014), the use of specific software packages to provide an underlying structure for a piece of
42 academic writing (Smith and Deane, 2014), writing retreats (Dwyer et al., 2015), how-to-
43 guides (Belcher, 2019), and publisher provided author resources (Elsevier, 2020c, Taylor &
44 Francis, 2020, Wiley, 2020a) and webinars (Wiley, 2020b). Evaluation of these techniques are
45 typically drawn on anecdotal accounts or based on single case studies; although programmes
46 of this type can facilitate research outputs, their impact and sustainability are generally
47 limited (Kempenaar and Murray, 2018) suggesting that an alternative approach to
48 supporting the *professional academic writing* of university staff may be required.
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58 Recent estimates for the 2021 Research Excellence Framework suggest there will be a 43.8%
59 increase in the number of full-time equivalent staff included in Panel A: Medicine, Health and
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3 Life Sciences, from 13,611 full-time equivalent members of staff in 2014 to 19,573 full-time
4 equivalent members of staff (Research Excellence Framework, 2020c). The projected increase
5 partly reflects a move from a selective staff inclusion in 2014 (Stern, 2016) to submitting all
6 staff with 20% or more of their role being assigned to research in the 2021 census. These full-
7 time equivalents are projected to be 73 per cent of the total eligible population of 26,812
8 estimated by the Higher Education Statistics Agency (Higher Education Statistics Agency,
9 2019). It is unclear what proportion of 11,095 full-time equivalent nursing and allied
10 professionals academics' employed in the United Kingdom higher education sector in
11 2018/2019 (Higher Education Statistics Agency, 2019) will contribute to Panel A assessment
12 (see Table 1), though given the research intensity of disciplines such as medicine and
13 neuroscience also represented (Research Excellence Framework, 2020b) it seems unlikely
14 that publications from all full-time equivalent nursing academics will be assessed. Although
15 professional associations promoting excellence in higher education have called for the
16 processes, policies and practice of achievement markers to be refined (Advance HE, 2017),
17 publishing research papers remains a key marker of academic success. The question of what
18 facilitated *professional academic writing* is a complex one worthy of exploration.

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27 Originating in sociology, social network analysis facilitates the mapping of relationships and
28 information flows between people and information/knowledge entities (Borgatti et al.,
29 2018a). For example, Leonard and Bob are friends and they both work in the intensive care
30 units. Social network analysis enables researchers to integrate quantitative data with
31 qualitative and graphical data to construct a rich analysis of phenomena (Scott, 2017). Social
32 network analysis uncovers trends of interaction and determines the conditions under which
33 those trends arose (Quatman and Chelladurai, 2008).

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38 In the absence of an accepted framework of how academics acquire writing skills (Murray and
39 Thow, 2014), this study responds to the call for time series analysis to develop longitudinal
40 perspectives of academic community research outputs (Kumar, 2015). A network can be
41 understood as a web of relationships such as, in this instance, co-author relationships.
42 Personal-networks, commonly referred to as ego-nets, are constructed from a purposively
43 selected group of elite authors with the intention of exploring social structures between co-
44 authors, facilitating representations of relationships between co-authors. Designed with the
45 aim of understanding the social environment of individuals (Borgatti et al., 2018b), by
46 constructing and reflecting upon several personal-network cases it is possible to identify
47 general types of network structure including similarities and differences across individual
48 cases, to produce general theories (Crossley et al., 2015), achieving what Borgatti et al.
49 (2018b) propose is richer, more detailed data.

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56 In the absence of contemporary studies exploring why nursing research is not published
57 (Flanagan et al., 2016), it has been suggested that academic's writing activity is often informed
58 by a desire to enable positive change in care provision through publication in practice-based
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3 journals (Clark and Thompson, 2015). A focus on publishing in practice-based journals is in
4 tension with organisational expectations to publish in high impact journals, achieve high
5 citation rates and achieve a high *h*-index (Clark and Thompson, 2018). Disparity in writing
6 aspirations coupled with expectations of competence and a lack of a support system to
7 encourage, develop, and support writers (McGrail et al., 2006) can result in the process of
8 learning to write for publication being a demanding and stressful experience (Smith and
9 Deane, 2014). It can be difficult for inexperienced academic writers to know how to start
10 writing (Grant et al., 2010), their inexperience being a named barrier to writing for publication
11 (Dhakal and Tornwal, 2020); as a consequence, many seek to acquire writing skills through a
12 time consuming process of trial and error (Galipeau et al., 2015).
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21 This study moves beyond anecdotal accounts of initiatives to support for *professional*
22 *academic writing* to examine the characteristics of the *professional academic writing*
23 portfolios of academics publishing in the area of *General Nursing*. It seeks to determine
24 whether there are identifiable trends in publication profiles that can be used to inform
25 organisational strategic investment in the support provided to future academic staff seeking
26 to write for publication in *General Nursing*. Analysis is made of co-authors relationships, co-
27 author employer, country of co-author collaboration and gender.
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35 Design

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37 Social network analysis was used to identify and consider the significance of trends of co-
38 author collaboration on writing productivity and impact. Data were acquired from SciVal.
39 SciVal is an online bibliometric resource containing data on the research performances of
40 worldwide research institutions, disciplines and individuals, using the abstract and citation
41 database Scopus as its data source (Elsevier, 2020b). Authors were purposively sampled
42 (Williamson, 2017), one from each quartile of SciVal's Top 100 authors of the Scopus defined
43 area of *General Nursing* (Elsevier, 2020a). A full record of each author's publication history,
44 herein defined as a portfolio, provided an information-rich case for in-depth study.
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53 Inclusion criterion were that each author's employment included a minimum 50% in a higher
54 education institution within the last five years. Portfolios were purposively selected to cover
55 both qualitative and quantitative research projects. This acknowledged the inherent
56 differences in writing styles of narrative based qualitative studies (American Psychological
57 Association, 2020a) compared with the more routine and minimally burdensome reporting of
58 quantitative studies (American Psychological Association, 2020b). Longitudinal comparisons
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3 were made of changes in author collaboration trends from first publication to latest available
4 data to identify trends of central importance in the development of a *professional academic*
5 *writing* portfolio.
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10 Social network visualisations were generated to forefront network characteristics and trends
11 of interactions of potential significance (Quatman and Chelladurai, 2008). Acknowledging the
12 challenges inherent in drawing conclusions from large network visualisations, quantification
13 of network properties (Quatman and Chelladurai, 2008), including network size and
14 composition, was used to facilitate more precise interpretation and greater conceptual
15 understanding of network trends.
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21 Name ambiguity is a key consideration in the compilation of networks (Kumar, 2015),
22 particularly in analyses of publication portfolios where authors may have used multiple
23 versions of their name over the course of their writing career. To ensure the network analysis
24 in this study created a true representation of co-author relations, instances of co-author name
25 ambiguity *e.g. Grant, Maria J., Grant, MJ, Grant, M.J., Grant, Maria.*, were cross-checked in
26 terms of an author's previous, current and latter organisational affiliations, contact details
27 and recurring co-author collaboration. Disambiguated co-author details were merged to
28 create a single entity for an author prior to the inclusion of each publication in the network
29 analysis.
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37 Network compositions were analysed using categorical data for number of co-authors, co-
38 author employer, country of co-author collaboration and gender.
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43 This study received ethical approval from the Liverpool John Moores University Nursing and
44 Allied Health Research Ethics Committee on 12th June 2017: 17/NAH/018.
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49 Findings

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51 There were two male and two female authors entered in this analysis. Authors were drawn
52 from across the globe including Europe, North America and South East Asia and had *h*-indexes
53 ranging from 10 to 42; see Table 2. Portfolios included publications which contained a
54 combination of qualitative and quantitative publication. Portfolios ranged in size from 57 to
55 360 outputs published over periods between 12 and 18 years.
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3 A breakdown of additional areas in which outputs were published included medicine; social
4 sciences; biochemistry, genetics and molecular biology; and psychology (see Table 3).
5 Network size and gender differences were analysed for the full data set. For other analyses
6 the first 12 years from first co-authored paper were assessed for equivalence based on the
7 publication period of the least published author.
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10 11 12 13 14 Network Size

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16 In the first years of successful writing for publication authors publish within a single highly
17 connected co-author network. This network will typically expand to include new co-authors,
18 before additional separate co-author collaborations emerge after three- to four- years.
19 Authors experience a steady growth in co-author numbers between four- to seven- years
20 from first co-authored publication. A rapid expansion in network size occurs eight- to twelve-
21 years from first co-authored publication, increasing from between nine and 45 co-authored
22 publications in Year Seven of a portfolio to between 40 and 96 co-authored publications in
23 Year Nine; see Figure 1. Twelve years into their publication portfolios, the maximum number
24 of years for the least published author, the size of collaborative writing networks had
25 increased to between 106 and 151 co-authors.
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34 Component Analysis

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36 In social network analysis, components are maximally connected portions of a network
37 disconnected from others (Borgatti et al., 2018a, Tsvetovat and Kouznetsov, 2011). Within
38 the present study, components represent groups of co-authors connected only by the author
39 of the portfolio under analysis. Figures 2-5 present the growth of co-author networks with
40 each box representing a year of publication. Viewed from left to right, top to bottom, each
41 author begins their co-author *professional academic writing* in a single group of co-authors.
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48 Taking Q1_h42_M as an example, Year 1 of their publication record sees six co-authors in a
49 single highly connected component. Year 4 sees new co-authors joining the writing group and
50 increasing the component size. Year 6 sees the formation of a new co-author collaboration,
51 with both components increasing in size over the next two years. In Year 9, the two writing
52 collaborations join into a single entity and continue to expand in the next two years. From
53 Year 12 of Q1_h42_M's writing career, smaller but highly connected writing groups also
54 establish and grow.
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4 After a period of steady growth in their co-author networks, the portfolios in this analysis
5 experience a period in which the number of writing groups collaborations coalesce into a
6 smaller number of larger entities; see Figures 2-5. In three quarters of portfolios the
7 consolidation is followed by development of new components. Twelve years into their
8 publication portfolios those authors with the highest and lowest h -index worked with fewest
9 components; see Figure 6.
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12 13 14 Co-Author Location

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16 Co-author relations within an author's higher education institution provided a starting point
17 for the majority of authors (mean 72%; range 33%-100%); but decreased over time (Year 12 -
18 mean 34%; range 28%-43%); see Figure 7.
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23 Levels of collaborations within the higher education sector remain higher (Year 1 - 53%-
24 100%), at 12 years into a publication career the majority of author collaborations measured
25 between 61% and 66%; see Figure 8. Q2_h28_M is anomalous with 94% of their co-author
26 collaborations occurring within the higher education sector.
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32 33 Country

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35 For most authors initial co-authors relationships are built within their host country (83%-
36 100%); see Table 4. After 12 years, authors with higher h -indexes have smaller numbers of
37 host country co-authors and, inversely, larger numbers of international collaborators:
38 Q1_h42_M had 46% host country co-authors and 54% of international co-authors compared
39 with Q4_h10_F who had 86% host country co-authors and 14% international co-authors.
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46 In this sample, Q2_h28_M and Q3_h12_F relocated to another country during their
47 *professional academic writing* career after three and six years respectively. After 12 years
48 publishing, Q3_h12_F's collaborations occurred in 61% of their host and previous host
49 country compared with 56% in host country alone; Q2_h28_M's collaborations in their host
50 and previous host country accounted for in 77% of co-author collaborations compared with
51 64% in host country alone; see Table 5.
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57 58 Gender

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3 The male authors in this analysis began publishing earlier than the females, in 2003 compared
4 with 2006 and 2007, publishing either exclusively or with 50% of male colleagues. In
5 comparison, female authors began their publishing career co-authoring up to 100% of their
6 papers with other females; see Table 6. To account for changes in gender related policies over
7 time, data were analysed by year of publication rather than number of years into a writing
8 career; see Table 7. In these data there is remains a strong correlation of female authors
9 publishing with other female authors (mean 66%; range 61%-69%), male authors
10 demonstrating a more even split (mean 49%; range 46%-55%).
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17 Author Position

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19 Except for Q4_h10_F, authors began their career as first authors. As time progressed there
20 was an even split between first and final author position; see Table 8.
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25 **Discussion**

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27 Representing an important marker of professional and institutional achievement, writing for
28 publication is a core element in the contemporary university setting. This study examined the
29 personal-network characteristics of the *professional academic writing* portfolios of four elite
30 academics publishing in the area of *General Nursing*. The study identifies trends to inform the
31 organisational strategic investment required in the support provided to those wishing to write
32 for publication as part of their academic life. Central in the *General Nursing* portfolios
33 analysed was the development of co-author networks, with a noticeably shift in the number
34 of co-authors around four years, and again at seven years, from first co-authored publication.
35 Preferential attachment theory states that when seeking a collaborator to join one's network,
36 in this instance a co-author, a determining factor is to connect with someone who has already
37 established a positive reputation and, by association, is highly connected with access to the
38 resources (Wagner and Leydesdorff, 2005). Such successes have been shown to perpetuate
39 success with authors who have published before being more likely to publish again, and
40 papers which attract citations are more likely to be cited again (de Solla Price, 1976).
41 Preferential attachment has been linked with international co-author collaborations, noting
42 that highly connected individuals increase their number of collaborations faster than their
43 less connected colleagues (Wagner and Leydesdorff, 2005). In seeking to build collaborative
44 networks, Wagner and Leydesdorff (2005) note that junior researchers may not be able to
45 leverage the advantage of preferential attachment, sometimes referred to as cumulative
46 advantage, because they have not yet established themselves as potentially attractive co-
47 workers. The concept of preferential attachment is consistent with the marked increase in
48 the number of co-author collaborations noted at four and seven years from first co-authored
49 publication as junior researchers begin to establish their reputations as professional academic
50 authors. To support employees in achieving elevated status, some organisations have
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3 proposed a range of measures to facilitate the building of networks and research
4 collaborations including time for continuing professional development activities, sabbatical
5 and visiting fellowships (Leydesdorff et al., 2013, Farajollahi et al., 2013).
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10 Within the portfolios analysed a diversity of research areas are evident, in addition to the
11 inclusion criterion of *General Nursing*. In a study of academic collaborations within and across
12 disciplines it was noted that research tends to be organised around epistemological rather
13 than ontological dimensions, that is, methods of investigation rather than topics of research
14 (Bellotti et al., 2016). Notwithstanding, disciplinary areas are known to experience large
15 variations in citation patterns (Aksnes et al., 2019). Ontologically, authors in the first two
16 quartiles both published more frequently in the field of *Medicine* compared to *General*
17 *Nursing* which may account for the difference in the quantity of citations received and
18 subsequent elevated *h*-index. Adopting an epistemological approach to collaboration, shared
19 methods of investigation may account for the range of disciplines, including medicine, social
20 sciences and psychology, rather than the topic of research (Bellotti et al., 2016); see Table 3.
21 Further analysis of the trends of methods, funding and topics under investigation within
22 portfolios is proposed.
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30 A marked change in the geographic location of co-authors within this analysis is evident
31 between six- to nine- years into their publication portfolios (see Table 4). When accounting
32 for the relocation of authors (see Table 5) a noticeable decrease in the dominance of co-
33 authors based in an author's host or previous country remains evident as the percentage of
34 international co-authors increases. The consistent and growing proportion of internationally
35 co-authored papers (Leydesdorff et al., 2013) may, in part, be accounted for by technological
36 advances that have mitigated the need for researchers to work in close geographical
37 proximity (Hoekman et al., 2010). Initiatives by national governments (Kwon et al., 2011) and
38 programmes such as the European Framework (European Commission, 2020), purposefully
39 established to stimulate international research collaboration (Adams and Gurney, 2016) may
40 also be a factor. Elsewhere, evaluation frameworks such as the Research Excellence
41 Framework in the United Kingdom (Research Excellence Framework, 2020a) and the
42 Excellence in Research for Australia (Australian Research Council, 2015) continue to influence
43 what, how and for whom academics write (Murray and Thow, 2014). Previously dominated
44 by research-intensive western Europe and the USA, an analysis of a sub-set of Science
45 Citation-Index Expanded (SCI-E) journals, identified that all nations are now collaborating in
46 co-authored papers across geographical boundaries (Leydesdorff et al., 2013). For some
47 established economies the total research output since the mid-1980's has more than doubled
48 (Adams and Gurney, 2016). However, while domestic research output levels have not
49 increased (United Kingdom – 47,5000 papers per year), international collaborations have
50 increased more than ten-fold (Adams and Gurney, 2016). The true import of these
51 explanatory frameworks on writing behaviour are worthy of additional examination.
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5 Male authors were disproportionately represented in all the portfolios analysed: 31%-53% of
6 co-authors in the portfolios analysed were male; see Table 6. Women typically co-authored
7 with other women 20% more than men with women; male co-author relationships presenting
8 closer to a 50-50 split. Male authors wrote with female co-authors a maximum of 58% of the
9 time; range 43%-53%. A recent ranking of the world's top 100 universities (Times Higher
10 Education, 2020) included analysis of organisational commitments to gender equality,
11 including the recruitment and promotion of women, as informed by the United Nation
12 Sustainable Development Goals (United Nations, 2020b). Sustainable Development Goal 5
13 calls for the adoption of sound policies to empower all women and girls at all levels (United
14 Nations, 2020a). Within this context gender differences evident in the portfolios is of
15 particular significance given the latest available data indicating that nursing is a highly
16 gendered profession with a consistent 89% to 11% female-to-male ratio of nurses on the
17 Nursing and Midwifery Council register since 2013 (Nursing and Midwifery Council, 2014,
18 Nursing and Midwifery Council, 2015, Nursing and Midwifery Council, 2016, Nursing and
19 Midwifery Council, 2017, Nursing and Midwifery Council, 2018, Nursing and Midwifery
20 Council, 2019). Academic nursing departments also have a high female-to-male staff ratio of
21 75% female to 25% male (Higher Education Statistics Agency, 2019). These findings firmly
22 indicate gender inequality beneficial to male authors in the *General Nursing* portfolios
23 analysed.
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33 Clear longitudinal trends are apparent across this study of portfolios containing *General*
34 *Nursing* outputs, with most authors beginning their co-authored *professional academic*
35 *writing* career as first authors; see Table 8. The technical definition of authorship
36 encompasses not only the person who undertakes the writing of a manuscript, but also those
37 who have made a substantial contribution to a study, whether in formulating the problem,
38 structuring the design, conducting statistical analysis, or interpreting the results (American
39 Psychological Association, 2019). Authorship conventions differ among disciplines and can
40 prove challenging to negotiate when writing as part of a multidisciplinary team (National
41 Academy of Sciences et al., 2009). Nonetheless, the convention of placing the principle
42 investigator last in an author list has become an accepted standard across most research
43 areas, signalling intellectual input or supervision of the work reported rather than actively
44 conducting the research or writing the manuscript (American Psychological Association,
45 2019). In nursing the first author has typically contributed the most to the development of a
46 manuscript with the assignment of subsequent authors reflecting their relative contribution
47 (Oermann and Hays, 2016), as is apparent at the start of co-author relationships represented
48 in this analysis. However, in contrast with the anticipated shift towards final author placement
49 of the female authors, male authors continued to be named as first author more than a
50 decade after first publication. Whether first author male authors attributions persist because
51 they maintain a higher level of project involvement or, contrary to guidance (American
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3 Psychological Association, 2019), have been assigned the position of first author due to
4 relative status is unclear.
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9 Although some academic staff appear to spontaneously succeed in *professional academic*
10 *writing* the assumption that all writers have similar capacity to flourish is too simplistic
11 (Hyland, 2016). The findings of this study highlight consistent trends in the publication
12 portfolios of elite academics publishing in *General Nursing*, particularly the significance of
13 expansive professional networks in producing sustained *professional academic writing*
14 outputs. To enable all academic staff to thrive in achieving their personal and organisational
15 publishing goals, the implementation of institution-wide strategies facilitating continuing
16 professional development are recommended. These development activities should focus on
17 fostering opportunities to build the interdisciplinary professional networks necessary to make
18 academics wishing to publish in the area of *General Nursing* attractive as collaborators and
19 co-authors.
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27 While university Vice Chancellors act as Chief Executives responsible for authorising strategic
28 decisions within their institution their decisions are informed by the work of executive
29 committees. Also known as strategic management teams, executive committees are in charge
30 of devising policies in key areas of university business including developing strategic and
31 operational plans with associated budget allocations. Based on this research, it is
32 recommended that higher education institution executive committees build medium-term
33 investment into their strategic and operational plans for time, resources and facilitation of
34 academic staff development in relation to writing for publication. Acknowledging the role of
35 the university library in assisting academics with their publishing endeavours (Akers, 2019),
36 targeted investment in library services to support *professional academic writing* should be
37 represented as part of these organisational plans. Within the context of gender differences
38 evident in *General Nursing* portfolios, it is recommended that strategic and operational plans
39 particularly focus on the continuing professional development of female academics. In
40 focusing on gender equality (Times Higher Education, 2020, United Nations, 2020a), the
41 female academics who comprise the majority of the nursing practice and academic
42 communities will experience parity of opportunity in achieving this key marker of
43 achievement used by university in promotion, tenure and academic review, *professional*
44 *academic writing*.
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55 **Limitations**

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57 Like bibliometric and social network analysis studies before, this study has relied upon
58 quantification of network characteristics without the opportunity to explore qualitatively the
59 meanings of those characteristics. The *h*-index is used by SCOPUS to compile a list of the Top
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3 100 authors in a specialism and provided a useful starting point to purposively select
4 publication portfolios for analysis in this study. However, it is reasonable to conclude that all
5 the authors of these portfolios should be considered elite authors given the latest available
6 World Health Organisation statistics that there are 20.7 million nurses and midwives in the
7 world (World Health Organisation, 2016); a premise borne out by Hirsch (2005), creator of
8 the *h*-index, estimation that after 20 years a "successful scientist" would have an *h*-index of
9 20, an "outstanding scientist" an *h*-index of 40, and a "truly unique" individual an *h*-index of
10 60. the portfolios within the analysis were consistent with this definition, *h*-indexes ranging
11 from 10 to 42, even accounting for the variation of *h*-indexes between fields (Hirsch, 2005).
12 The analysis presented illustrates the *professional academic writing* networks of an elite
13 cohort of academic writers publishing in *General Nursing* and may therefore differ from the
14 portfolios of other disciplines.
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22 While whole-network designed social network analysis which assume that the full data set is
23 available (Borgatti et al., 2018b), or studies which combine whole-networks with the
24 quantitative analysis of written documents (Waltman and Noyons, 2018) that is bibliometric
25 or citation analysis (Yu-Wei, 2011, Mangas-Vega et al., 2016, Lining et al., 2019, Ardanuy et
26 al., 2009), this study has focused on personal-networks of a select group of elite authors.
27 While other techniques can provide statistical generalisations of an area, the case studies
28 presented have enabled analytic generalisations to be made (Yin, 2018). The findings within
29 this study demonstrate correlations between co-author network size, employing
30 organisation, geographic location and gender, though further investigation is required to
31 determine the cause of these relationships.
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38 **Conclusion**

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40 This research presents insight into consistent publication trends across gender, sector and
41 geographic location in the portfolios of academics publishing in the area of *General Nursing*.
42 University executive committees can use the trends evident in these descriptive data to
43 support the development of, and investment in, institutional-wide strategic and operational
44 plans to support academics writing for publication; these plans should include targeted
45 investment in academic staff time and resources to foster interdisciplinary connections,
46 nationally and internationally, through continuing professional development activities.
47 Strategic investment in staff development over a medium- to long- term may be required
48 before the impact of that investment becomes apparent.
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57 Further research is underway to develop insight into the qualitative experiences of how staff
58 negotiate the *professional academic writing* landscape, from developing research skills,
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3 building support structures and interdisciplinary networks, securing adequate resources, and
4 negotiating the publishing process.
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9 **Practical Implications**

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11 The development of extended co-author networks, locally, internationally, and across the
12 higher education sector, enable authors to attain the marker of achievement required by
13 universities and government funding bodies, namely sustained output of *professional*
14 *academic writing* for publication. Identified trends support strategic investment in academic
15 time and resources to build professional networks across disciplines. Medium- to long- term
16 investment may be required before the impact of that investment becomes apparent.
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24 Using social network analysis techniques to interrogate personal-networks, this information
25 science based doctoral research demonstrates that by aligning to the needs of our
26 stakeholders, as advocated by our professional associations (Chartered Institute of Library
27 and Information Professionals, 2019, Medical Library Association, 2020), we can generate
28 evidence to help inform strategic investment in staff time and resources.
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Table 1: Research Excellence Framework – Panel A

Panel A of the Research Excellence Framework includes the following disciplines:

Agriculture; Allied Health Professions; Biological Sciences; Clinical Medicine; Dentistry; Food; Health Services; Neuroscience; Nursing; Pharmacy; Primary Care; Psychiatry; Psychology; Public Health; and Veterinary Sciences.

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Table 2: Author Profiles of Selected *General Nursing* Portfolios

Q1_h42_M: Professor at a higher education institution in Western Europe. He has a background in health sciences and has studied to PhD level. He has received international awards recognising the quality of his research, was a founding member of an international research network, and holds advisory positions with national and international organisations and journals.

Q2_h28_M: Professor and Associate Dean (Research) at a higher education institution in North America. He is a Registered Nurse and has studied to PhD level. Having worked as a Post-Doctoral Researcher, he relocated from the United Kingdom to an Associate Professor position in North America. He has received international awards recognising the quality of his research, held leading roles on international nursing organisations, and holds an editorial position with an international ISI listed journal.

Q3_h12_F: Associate Professor at a higher education institution in South East Asia. She has a background in clinical medicine. Her Masters' in Nursing and PhD-level studies were completed in Europe before returning to South East Asia to take up her position as Associate Professor.

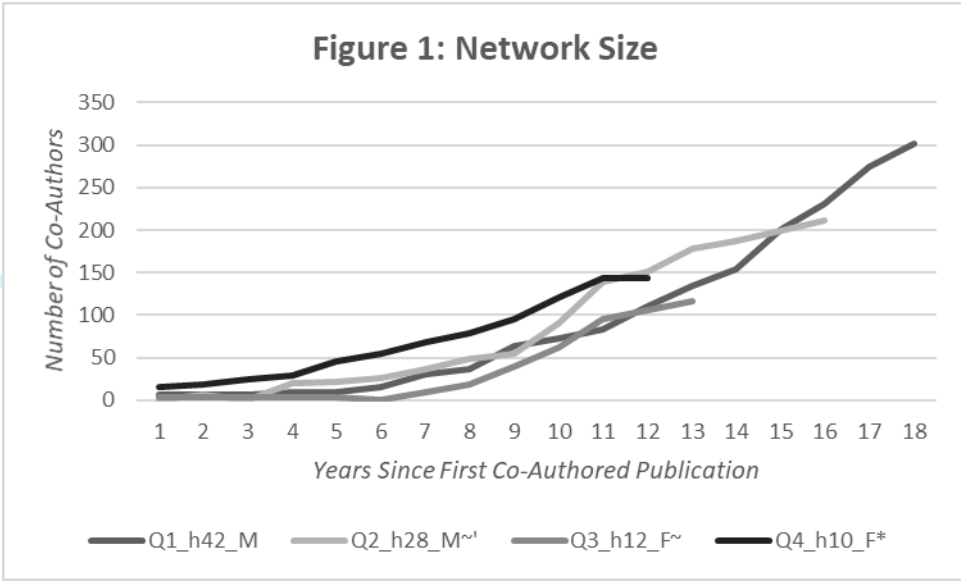
Q4_h10_F: Professor at a higher education institution in Southern Europe. She is a Registered Nurse, held leading roles in European regulatory bodies, was a founding member of national research network, and is a leading member of her national nursing association.

Note: Authors are defined by Quartile_h-Index_Gender e.g. Quartile1_h-index=42_Male reads Q1_h42_M

Table 3: Subject Composition of Publication Portfolios

	Biochemistry, Genetics and Molecular Biology	General Nursing	Medicine	Psychology	Social Sciences	Others
Q1_h42_M	7%	18%	63%	3%	3%	6% <i>Including agricultural and biological sciences</i>
Q2_h28_M	-	32%	46%	2%	14%	6% <i>Including health professions, & arts and humanities</i>
Q3_h12_F	-	67%	33%	-	-	-
Q4_h10_F	-	57%	29%	-	7%	7% <i>Including mathematics</i>

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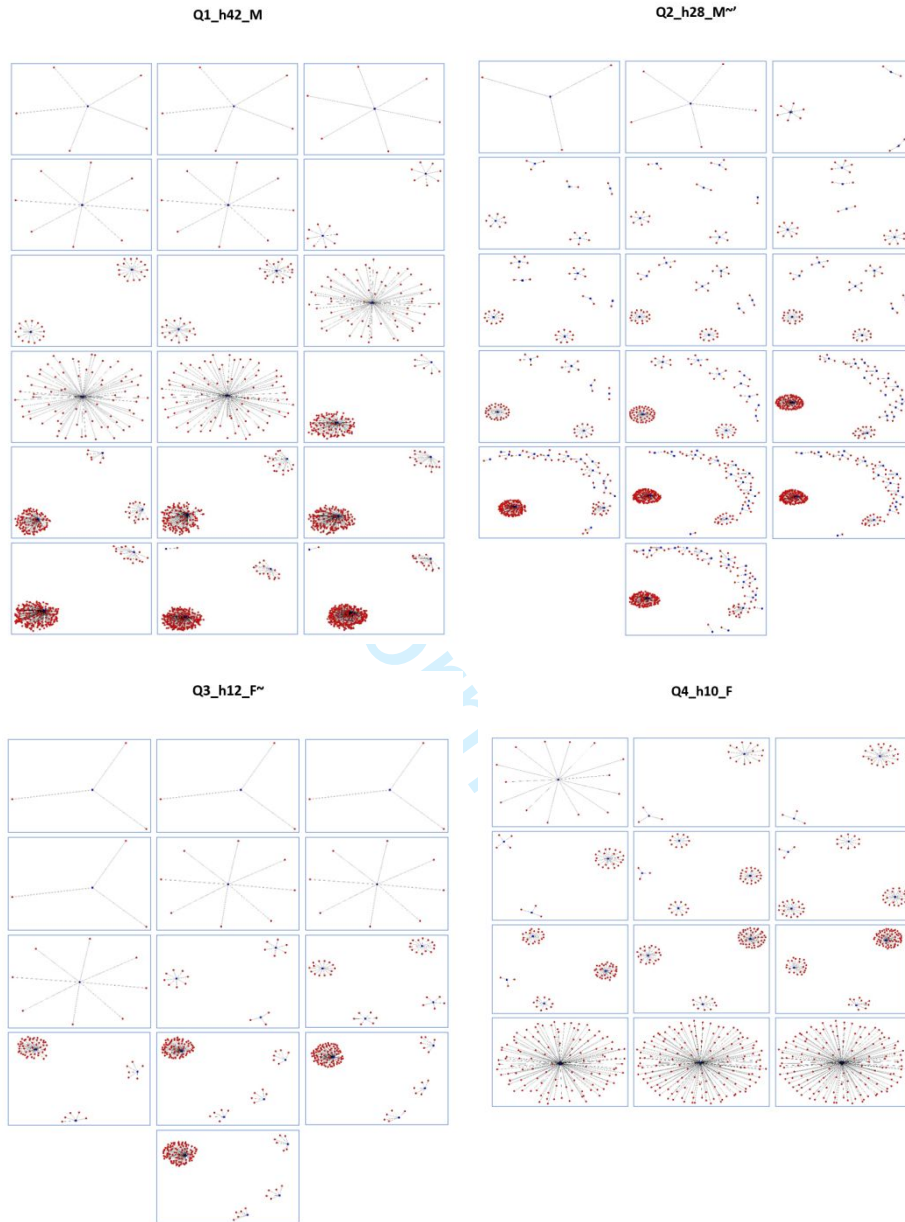
~ Moved countries: Q2_h28_M in Year 3 & Q3_h12_F in Year 6

' Published single authored papers in the preceding four years

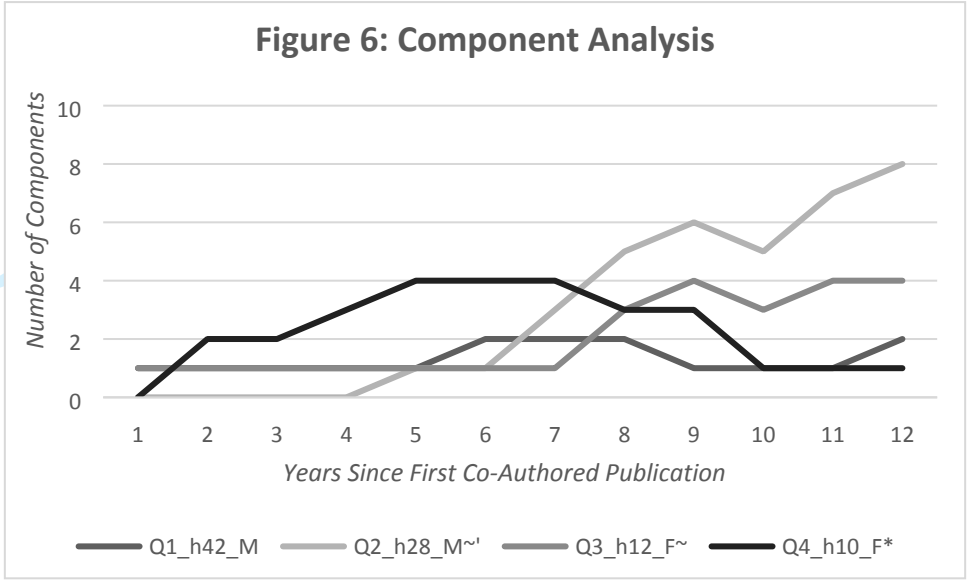
* Partial data for final year

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Figures 2-5: Co-Author Collaborations of up to 18 Years
From First Co-Authored Publication



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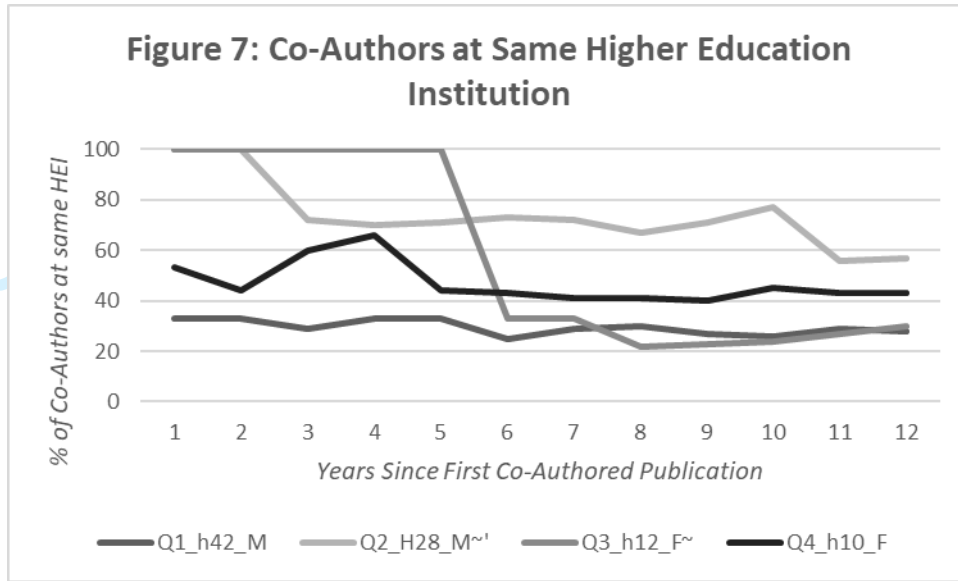


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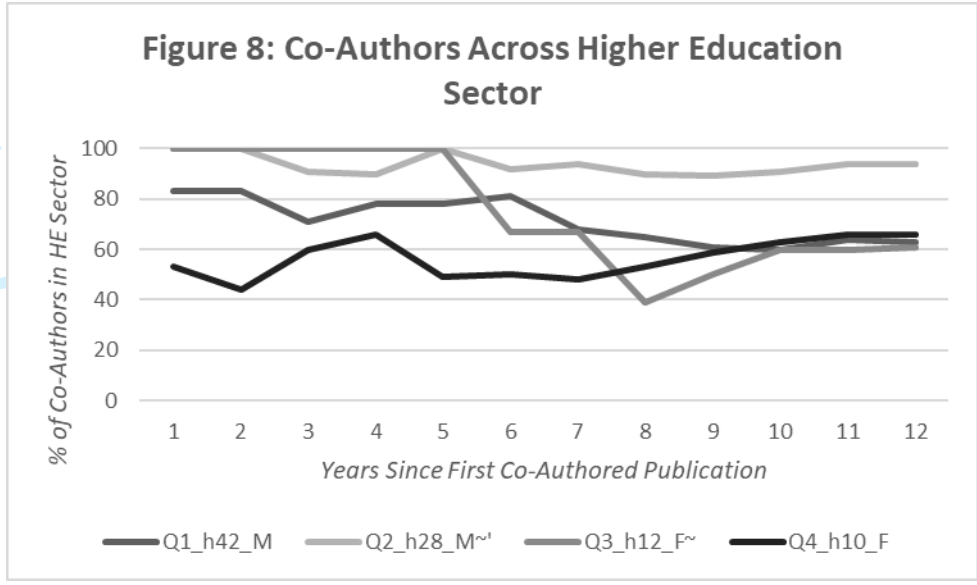


~ Moved countries: Q2_h28_M in Year 3 & Q3_h12_F in Year 6

¹ Published single authored papers in the preceding four years

* Partial data for final year

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~ Moved countries: Q2_h28_M in Year 3 & Q3_h12_F in Year 6

' Published single authored papers in the preceding four years

* Partial data for final year

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Table 4: Percentage of Co-Author Collaborations in Host Country

	Years of Publishing											
	1	2	3	4	5	6	7	8	9	10	11	12
Q1_h42_M	83%	83%	86%	89%	89%	56%	45%	49%	44%	44%	44%	46%
Q2_h38_M'	100%	100%	27%~	35%	48%	46%	50%	60%	64%	53%	63%	64%
Q3_h12_F	100%	100%	100%	100%	100%	67%~	67%	50%	45%	45%	52%	56%
Q4_h10_F	100%	94%	96%	97%	98%	97%	97%	96%	90%	90%	86%	86%*

' Published single authored papers in the preceding four years

~ Moved countries

* Partial data

Table 5: Percentage of Collaborations in Host Country or Previous Host Country

	Years of Publishing											
	1	2	3	4	5	6	7	8	9	10	11	12
Q1_h42_M	83%	83%	86%	89%	89%	56%	45%	49%	44%	44%	44%	46%
Q2_h28_M'	100%	100%	100%~	95%	95%	92%	92%	90%	91%	71%	77%	76%
Q3_h12_F	100%	100%	100%	100%	100%	100%~	100%	67%	48%	50%	42%	61%
Q4_h10_F	100%	94%	96%	97%	98%	97%	97%	96%	90%	90%	86%	86%*

' Published single authored papers in the preceding four years

~ Moved countries

* Partial data

Table 6: Percentage of Collaborations with Female Authors by Year of Publication

Gender	Years of Publishing															
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Q1_h42_M	0%	0%	0%	19%	29%	38%	40%	42%	43%	47%	55%	52%	50%	50%	48%	47%
Q2_h38_M'	50%'	50%	54%~	50%	52%	46%	58%	53%	56%	50%	55%	56%	47%	47%	46%	46%
Q3_h12_F	-	-	-	100%	100%	100%	100%	100%	78%~	78%	61%	63%	68%	62%	64%	68%
Q4_h10_F	-	-	-	-	27%^	20%^	18%^	36%^	57%^	64%^	64%^	62%^	66%^	68%^	69%^	69%*^

' Published single authored papers in the preceding four years

~ Moved countries

^ Contained instances where co-author gender was not possible to determine; these data were excluded from the analysis

* Partial data

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Table 7: Aggregated Percentage of Collaboration with Female Authors

	2004-2008	2009-2013	2014-2018
Q1_h42_M	17%	45%	49%
Q2_h38_M'	50%~	54%	48%
Q3_h12_F	100%	83%~	65%
Q4_h10_F	24%^	48%^	67%^

' Published single authored papers in the preceding four years

~ Moved countries

^Contained instances where co-author gender was not possible to determine; these data were excluded from the analysis

** Partial data*

Table 8: Position in List of Authors

	Start of Writing Career			Twelve Years into Writing Career			Eighteen Years into Writing Career		
Q1_h42_M	First	Middle	Final	First	Middle	Final	Final	Middle	First
Q2_h28_M	First	Middle	Final	First	Final	Middle	First	Final	Middle
Q3_h12_F	First	Final	Middle	Final	Middle	First	-	-	-
Q4_h10_F	Middle	First	Final	Final	First	Middle	-	-	-

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TRACKED CHANGES

Aslib Journal of Information Management

Abstract

Purpose: To ~~identify publication trends by successful academic authors to construct an understanding of professional academic writing network structures to~~ inform organisational strategic ~~development~~investment in academic staff development.

Design: Longitudinal social network analysis is used to examine the personal-networks evident in the publication portfolios of a purposive sample of four international academics within-across each quartile of the SCOPUS defined area of *General Nursing's* Top 100 authors.

Findings: ~~Unique insight is presented of trends~~Trends in the publication portfolios of elite academics across gender, sector and geographic location are presented. In the first years of successful writing for publication authors collaborate within a single highly connected co-author network. This network will typically expand to include new co-authors, before additional separate co-author collaborations emerge (three- to four- years). Authors experience steady growth in co-author numbers four- to seven- years from first co-authored publication. After a period of rapid expansion, these collaborations coalesce into a smaller number of highly connected groups (eight- to ten- years). Most collaborations occur within the higher education sector and across multiple disciplines including medicine, social sciences and psychology. Male co-authors are disproportionately represented in what is a predominantly female profession.

Practical implications: The development of extended co-author networks, locally, internationally, and across the higher education sector, enable authors to attain the marker of achievement required by universities and government funding bodies, namely sustained output of high-quality academic publications. Identified trends support the inclusion of strategic~~investment in academic time and resources~~ in higher education institutions' strategic and operational plans to enable academic staff to develop interdisciplinary build professional networks-across-disciplines. In focusing this investment on gender equality, female academics will experience parity of opportunity in achieving their organisational and personal goals relating to professional academic writing. Medium term investment may be required before the impact of that investment becomes apparent.

Originality/value: This is the first example of social network analysis used to determine characteristics of *professional academic writing* portfolios over time. Findings inform the type and range of investment required to facilitate academic staff writing activities, specifically those publishing in the area of General Nursing.

Background

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3 Writing for publication is core to academic life and is used as a marker of achievement, with
4 by universities (University of Manchester, 2019) and government funding bodies to inform
5 the selective allocation of research funding (Australian Research Council, 2015, Research
6 Excellence Framework, 2020a), requiring sustained outputs of high-quality publications.
7 These high-quality publications were recently defined by 40% of 129 research intensive higher
8 education institutions with reference to a journal's impact factor (McKiernan et al., 2019).
9 Reservations about the use of journal impact factors as a mark of quality for research
10 publications are well rehearsed, from unaccounted differences between disciplines and
11 insufficient citation windows, through to the skewing of underlying citation distributions
12 (Larivière and Sugimoto, 2019). Although professional associations promoting excellence in
13 higher education have called for the processes, policies and practice of achievement markers
14 to be refined (Advance HE, 2017), high-quality publications continue to be used to inform
15 university criteria for academic staff review (McKiernan et al., 2019), promotion (University
16 of Manchester, 2019) or tenure (McKiernan et al., 2019).

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19 While much has been written about supporting academic writing in students (Adler-Kassner
20 and Wardle, 2015), there is an assumption that because staff can support students writing for
21 assessment they are naturally equipped to write for publication (Grant et al., 2010).

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35 This assumption runs counter to findings that one-quarter of academic staff do not publish over
36 a five year period (Harris, 1990), despite 97% of newly qualified staff signalled an intention to
37 write for journals, newsletters and peer-review publications (Bradley, 2008). This supports
38 earlier studies that report that as few as 1% of writing projects are ever translated into published
39 articles (Hicks, 1993, Hicks, 1995). In the absence of contemporary studies exploring why
40 nursing research is not published (Flanagan et al., 2016), (Clark and Thompson, 2015) it is
41 unknown to what extent a lack of writing skills development contributes to these figures, nor
42 the form that writing skills training should take (Stylianou et al., 2017). For the inexperienced
43 academic writer it can be difficult to know how to start writing (Grant et al., 2010) with many
44 seeking to acquire writing skills through a time-consuming process of trial and error (Galipeau
45 et al., 2015). Expectation of competence and a lack of a support system to encourage, develop,
46 and support writers (McGrail et al., 2006) can result in the process of learning to write for
47 publication being a demanding and stressful experience (Smith and Deane, 2014) For the
48 inexperienced academic writer it can be difficult to know how to start writing (Grant et al.,
49 2010) with many seeking to acquire writing skills through a time-consuming process of trial
50 and error (Galipeau et al., 2015), resulting in some academics believing they are not
51 sufficiently capable (Swart et al., 2015).

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4 Libraries have long supported writing within higher education, with initiatives ranging from
5 writing centres located in library services in the early noughties (Rader, 2001) to
6 contemporary narratives of libraries assisting staff in identifying journals that authors may
7 wish to publish in, editing manuscripts and creating bibliographies (Akers, 2019). At this
8 juncture it is important to distinguish between *academic writing* and *professional academic*
9 *writing*. Writing centres have typically focused on *academic writing*, defined as writing by
10 students in academic settings relating to assignments and theses for assessment. Broader
11 library services having focused on supporting the *professional academic writing* of higher
12 education staff for publication.

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18 Responding to the findings of their systematic review exploring the “publish or perish” culture
19 of universities and research institutes, Guraya et al (2016) suggest that universities have an
20 obligation to train staff in sound scientific writing. The most effective forms of writing skills
21 training in particular contexts remains unknown (Stylianou et al., 2017), though a lack of
22 confidence in their writing ability can preclude an academic’s decision to attend a writing
23 interventions (Noone and Young, 2019). Sword (2017) found that only 15% of academic staff
24 in their mixed methods study acquired *professional academic writing* skills through accredited
25 writing courses or institutional sponsored mentoring programmes; for the majority of
26 academics, skills development was achieved through reading books or attending occasional
27 academic development workshops (38%), or ad hoc, opportunistic, and noninstitutionalised
28 processes (47%). Multiple writing interventions exist to support academic staff on their
29 journey to published author including writing groups (Grant et al., 2010), promoting
30 motivation (Smith and Deane, 2014) through peer-formativity interviews (Murray and Thow,
31 2014), the use of specific software packages to provide an underlying structure for a piece of
32 academic writing (Smith and Deane, 2014), writing retreats (Dwyer et al., 2015), how-to-
33 guides (Belcher, 2019), and publisher provided author resources (Elsevier, 2020c, Taylor &
34 Francis, 2020, Wiley, 2020a) and webinars (Wiley, 2020b). Multiple writing interventions have
35 been identified as supporting academic staff on their journey to published author including
36 how-to-guides (Belcher, 2019), writing groups (Grant et al., 2010), writing retreats (Dwyer et
37 al., 2015), promoting motivation (Smith and Deane, 2014) through peer-formativity
38 interviews (Murray and Thow, 2014), and use of specific software packages to provide an
39 underlying structure for a piece of academic writing (Smith and Deane, 2014). Evaluation of
40 these techniques are typically drawn on anecdotal accounts or based on single case studies;
41 it being noted that
42 although programmes of this type can facilitate research outputs, their
43 impact and sustainability are generally limited (Kempenaar and Murray, 2018) suggesting
44 that an alternative approach to supporting the *professional academic writing* of university
45 staff may be required.

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59 Recent estimates for the 2021 Research Excellence Framework suggest there will be a 43.8%
60 increase in the number of full-time equivalent staff included in Panel A: Medicine, Health and

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3 Life Sciences, from 13,611 full-time equivalent members of staff in 2014 to 19,573 full-time
4 equivalent members of staff (Research Excellence Framework, 2020c). The projected increase
5 partly reflects a move from a selective staff inclusion in 2014 (Stern, 2016) to submitting all
6 staff with 20% or more of their role being assigned to research in the 2021 census. These full-
7 time equivalents are projected to be 73 per cent of the total eligible population of 26,812
8 estimated by the Higher Education Statistics Agency (Higher Education Statistics Agency,
9 2019). It is unclear what proportion of 11,095 full-time equivalent nursing and allied
10 professionals academics' employed in the United Kingdom higher education sector in
11 2018/2019 (Higher Education Statistics Agency, 2019) will contribute to Panel A assessment
12 (see Table 1), though given the research intensity of disciplines such as medicine and
13 neuroscience also represented (Research Excellence Framework, 2020b) it seems unlikely
14 that publications from all full-time equivalent nursing academics will be assessed. Although
15 professional associations promoting excellence in higher education have called for the
16 processes, policies and practice of achievement markers to be refined (Advance HE, 2017),
17 publishing research papers remains a key marker of academic success. The question of what
18 facilitated professional academic writing is a complex one worthy of exploration.

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27 ~~This study moves beyond anecdotal accounts of one-to-one library support for professional~~
28 ~~academic writing to examine the characteristics of the professional academic writing~~
29 ~~portfolios of academics. It seeks to determine whether there are identifiable trends in~~
30 ~~publication profiles that can be used to inform the support provided to future academic staff~~
31 ~~seeking to write for publication. Analysis is made of co-authors relationships, co-author~~
32 ~~employer, country of co-author collaboration and gender.~~

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37 Originating in sociology, social network analysis facilitates the mapping of relationships and
38 information flows between people and information/knowledge entities (Borgatti et al.,
39 2018a). For example, Leonard and Bob are friends and they both work in the intensive care
40 unitsmusic industry. Social network analysis enables researchers to integrate quantitative
41 data with qualitative and graphical data to construct a rich analysis of phenomena (Scott,
42 2017). Social network analysis uncovers trends of interaction and determines the conditions
43 under which those trends arose (Quatman and Chelladurai, 2008).

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48 In the absence of an accepted framework of how academics acquire writing skills (Murray and
49 Thow, 2014), this study responds to the call for time series analysis to develop longitudinal
50 perspectives of academic community research outputs (Kumar, 2015). A network can be
51 understood as a web of relationships such as, in this instance, co-author relationships.
52 Personal-networks, commonly referred to as ego-nets, are constructed from a purposely
53 selected group of elite authors with the intention of exploring social structures between co-
54 authors, facilitating representations of relationships between co-authors. Designed with the
55 aim of understanding the social environment of individuals (Borgatti et al., 2018b), by
56 constructing and reflecting upon several personal-network cases it is possible to identify
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3 general types of network structure including similarities and differences across individual
4 cases, to produce general theories (Crossley et al., 2015), achieving what Borgatti et al.
5 (2018b) propose is richer, more detailed data.
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9 In the absence of contemporary studies exploring why nursing research is not published
10 (Flanagan et al., 2016), it has been suggested that academic's writing activity is often informed
11 by a desire to enable positive change in care provision through publication in practice-based
12 journals (Clark and Thompson, 2015). A focus on publishing in practice-based journals is in
13 tension with organisational expectations to publish in high impact journals, achieve high
14 citation rates and achieve a high *h*-index (Clark and Thompson, 2018). Disparity in writing
15 aspirations coupled with expectations of competence and a lack of a support system to
16 encourage, develop, and support writers (McGrail et al., 2006) can result in the process of
17 learning to write for publication being a demanding and stressful experience (Smith and
18 Deane, 2014). It can be difficult for inexperienced academic writers to know how to start
19 writing (Grant et al., 2010), their inexperience being a named barrier to writing for publication
20 (Dhakal and Tornwal, 2020); as a consequence, many seek to acquire writing skills through a
21 time consuming process of trial and error (Galipeau et al., 2015).
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32 to the call for time series analysis to develop longitudinal perspectives of academic
33 community research outputs (Kumar, 2015). This study moves beyond anecdotal accounts of
34 one-to-one library initiatives to support for professional academic writing to examine the
35 characteristics of the professional academic writing portfolios of academics publishing in the
36 area of General Nursing. It seeks to determine whether there are identifiable trends in
37 publication profiles that can be used to inform organisational strategic investment in the
38 support provided to future academic staff seeking to write for publication in General Nursing.
39 Analysis is made of co-authors relationships, co-author employer, country of co-author
40 collaboration and gender.
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49 **Design**

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51 Social network analysis was used to identify and consider the significance of trends of co-
52 author collaboration on writing productivity and impact. ~~Using the abstract and citation~~
53 ~~database Scopus as its data source (Elsevier, 2020c),~~ Data were acquired from SciVal. SciVal
54 ~~is~~ ~~is~~ an online bibliometric resource containing data on the research performances of
55 worldwide research institutions, disciplines and individuals, ~~using the abstract and citation~~
56 ~~database Scopus as its data source~~ (Elsevier, 2020b). Authors were purposively sampled
57 (Williamson, 2017), one from each quartile of SciVal's Top 100 authors of the Scopus defined
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3 area of *General Nursing* (Elsevier, 2020a). A full record of each author's publication history,
4 herein defined as a portfolio, provided an information-rich case for in-depth study.
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10 Inclusion criterion were that each author's ~~recent~~ employment included a minimum 50% in a
11 higher education institution within the last five years. Portfolios were purposively selected to
12 cover both qualitative and quantitative research projects. This .—Acknowledging
13 acknowledged the inherent differences in writing styles of narrative based qualitative studies
14 (American Psychological Association, 2020a) compared with the more routine and minimally
15 burdensome reporting of quantitative studies (American Psychological Association, 2020b);
16 ~~portfolios were purposively selected to cover both writing styles.~~ Longitudinal comparisons
17 were made of changes in author collaboration trends from first publication to latest available
18 data to identify trends of central importance in the development of a *professional academic*
19 *writing* portfolio.
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26 Social network visualisations were ~~used-generated~~ to forefront network characteristics and
27 trends of interactions of potential significance (Quatman and Chelladurai, 2008).
28 Acknowledging the challenges inherent in drawing conclusions from large network
29 visualisations, quantification of network properties (Quatman and Chelladurai, 2008),
30 including network size and composition, was used to facilitate more precise interpretation
31 and greater conceptual understanding of network trends ~~(Quatman and Chelladurai, 2008).~~
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37 Name ambiguity is a key consideration in the compilation of networks (Kumar, 2015),
38 ~~particular-particularly~~ in analyses of publication portfolios where authors may have used
39 multiple versions of their name over the course of their writing career. To ensure the network
40 analysis in this study created a true representation of co-author relations, instances of co-
41 author name ambiguity *e.g. Grant, Maria J., Grant, MJ, Grant, M.J., Grant, Maria.*, were cross-
42 checked in terms of an author's previous, current and latter organisational affiliations, contact
43 details and recurring co-author collaboration. Disambiguated co-author details were merged
44 to create a single entity for an author prior to the inclusion of each publication in the network
45 analysis.
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52 Network compositions were analysed using categorical data for number of co-authors, co-
53 author employer, country of co-author collaboration and gender.
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This study received ethical approval from the Liverpool John Moores University Nursing and Allied Health Research Ethics Committee on 12th June 2017: 17/NAH/018.

Findings

~~The-There were two male and two female authors entered in this analysis. Authors were drawn from across the globe including Europe, North America and South East Asia and- had h -indexes ranging from 10 to 42; see Table 12. Portfolios included publications which contained a combination of qualitative and quantitative publication. Portfolios ranged in size from 57 to 360 outputs published over periods between 12 and 18 years. There were two male and two female authors. Authors were drawn from across the globe including Europe, North America and South East Asia.~~

A breakdown of additional areas in which outputs were published included medicine; social sciences; biochemistry, genetics and molecular biology; and psychology (see Table 23). Network size and gender differences were analysed for the full data set. For other analyses the first 12 years from first co-authored paper were assessed for equivalence based on the publication period of the least published author.

Network Size

~~In the first years of successful writing for publication authors publish within a single highly connected co-author network. This network will typically expand to include new co-authors, before additional separate co-author collaborations emerge after three- to four- years.~~ Authors experience a steady growth in co-author numbers between four- to seven- years from first co-authored publication. A rapid expansion in ~~co-author collaborations network size~~ occurs ~~in eight- to twelve- years from first co-authored publication~~ ~~the subsequent three- to four- years~~, increasing from between nine and 45 co-authored publications in Year Seven of a portfolio to between 40 and 96 co-authored publications in Year Nine; see Figure 1. Twelve years into their publication portfolios, the maximum number of years for the least published author, the size of collaborative writing networks had increased to between 106 and 151 co-authors.

Component Analysis

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3 In social network analysis, components are maximally connected portions of a network
4 disconnected from others (Borgatti et al., 2018a, Tsvetovat and Kouznetsov, 2011). Within
5 the present study, components represent groups of co-authors connected only by the author
6 of the portfolio under analysis. Figures 2-5 present the growth of co-author networks with
7 each box representing a year of publication. Viewed from left to right, top to bottom, each
8 author begins their co-author *professional academic writing* in a single group of co-authors.
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14 Taking Q1_h42_M as an example, Year 1 of their publication record sees six co-authors in a
15 single highly connected component. Year 4 sees new co-authors joining the writing group and
16 increasing the component size. Year 6 sees the formation of a new co-author collaboration,
17 with both components increasing in size over the next two years. In Year 9, the two writing
18 collaborations join into a single entity and continue to expand in the next two years. From
19 Year 12 of Q1_h42_M's writing career, smaller but highly connected writing groups also
20 establish and grow.
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27 After a period of steady growth in their co-author networks, the portfolios in this analysis
28 experience a period in which the number of writing groups collaborations coalesce into a
29 smaller number of larger entities; see Figures 2-5. In three quarters of portfolios the
30 consolidation is followed by development of new components. Twelve years into their
31 publication portfolios those authors with the highest and lowest *h*-index worked with fewest
32 components; see Figure 6.
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38 Co-Author Location

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40 Co-author relations within an author's higher education institution provided a starting point
41 for the majority of authors (mean 72%; range 33%-100%); but decreased over time (Year 12 -
42 mean 34%; range 28%-43%); see Figure 7.
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47 Levels of collaborations within the higher education sector remain higher (Year 1 - 4453%-
48 100%), at 12 years into a publication career the majority of author collaborations measured
49 between 61% and 66%; see Figure 8. Q2_h28_M is anomalous with 94% of their co-author
50 collaborations occurring within the higher education sector.
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56 Country

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58 For most authors initial co-authors relationships are built within their host country (83%-
59 100%); see Table 34. After 12 years, authors with higher *h*-indexes have smaller numbers of
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3 host country co-authors and, inversely, larger numbers of international collaborators:
4 Q1_h42_M had 46% host country co-authors and 54% of international co-authors compared
5 with Q4_h10_F who had 86% host country co-authors and 14% international co-authors.
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11 In this sample, Q2_h28_M and Q3_h12_F relocated to another country during their
12 *professional academic writing* career after three and six years respectively. After 12 years
13 publishing, Q3_h12_F's collaborations occurred in 61% of their host and previous host
14 country compared with 56% in host country alone; Q2_h28_M's collaborations in their host
15 and previous host country accounted for in 77% of co-author collaborations compared with
16 64% in host country alone; see Table 45.
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26 The male authors in this analysis began publishing earlier than the females, in 2003 compared
27 with 2006 and 2007, publishing either exclusively or with 50% of male colleagues. In
28 comparison, female authors began their publishing career co-authoring up to 100% of their
29 papers with other females; see Table 6. Acknowledging the predominance of females working
30 in nursing practice (89% female / 11% male) (Nursing and Midwifery Council, 2019) and
31 nursing higher education (75% female / 25% male) (Higher Education Statistics Agency, 2019)
32 data were collected on the gender of co-authors to determine whether gender differences
33 existed in co-author networks. To account for possible changes in gender related policies
34 workforce composition over time, data were analysed by year of publication rather than
35 number of years into a writing career; see Table 5 and Table 67.
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41 In these data there is remains a strong correlation of female authors publishing with other
42 female authors (mean 66%; range 61%-69%), male authors demonstrating a more even split
43 (mean 49%; range 46%-55%).
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50 51 Author Position

52 Except for Q4_h10_F, authors began their career as first authors. As time progressed there
53 was an even split between first and final author position; see Table 78.
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57 58 **Discussion**

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Representing an important marker of professional and institutional achievement, writing for publication is a core element in the contemporary university setting. This study examined the personal-network characteristics of the *professional academic writing* portfolios of four elite academics publishing in the area of General Nursing. The study and identifies trends which canto inform the organisational strategic investment required in the support provided to those wishing to write for publication as part of their academic life. Central in the *General Nursing* portfolios analysed was the development of co-author networks, with a noticeably shift in the number of co-authors around four years, and again at seven years, from first co-authored publication. Preferential attachment theory states that when seeking a collaborator to join one's network, in this instance a co-author, a determining factor is to connect with someone who has already established a positive reputation and, by association, is highly connected with access to the resources (Wagner and Leydesdorff, 2005). Such successes have been shown to perpetuate success with authors who have published before being more likely to publish again, and papers which attract citations are more likely to be cited again (de Solla Price, 1976). Preferential attachment has been linked with international co-author collaborations, noting that highly connected individuals increase their number of collaborations faster than their less connected colleagues (Wagner and Leydesdorff, 2005). In seeking to build collaborative networks, Wagner and Leydesdorff (2005) note that junior researchers may not be able to leverage the advantage of preferential attachment, sometimes referred to as cumulative advantage, because they have not yet established themselves as potentially attractive co-workers. The concept of preferential attachment is consistent and with the marked increase in the number of co-author collaborations noted at four and seven years from first co-authored publication as junior researchers begin to establish their reputations as professional academic authors. To support employees in achieving elevated status, some organisations have proposed a range of measures to facilitate the building of networks and research collaborations including time for continuing professional development activities, sabbatical and visiting fellowships (Leydesdorff et al., 2013, Farajollahi et al., 2013).

Within the portfolios analysed a diversity of research areas are evident, in addition to the inclusion criterion of *General Nursing*. In a study of academic collaborations within and across disciplines it was noted that research tends to be organised around epistemological rather than ontological dimensions, that is, methods of investigation rather than topics of research (Bellotti et al., 2016). Notwithstanding, disciplinary areas are known to experience large variations in citation patterns (Aksnes et al., 2019). Ontologically, authors in the first two quartiles both published more frequently in the field of *Medicine* compared to *General Nursing* which may account for the difference in the quantity of citations received and subsequent elevated *h*-index. Adopting an epistemological approach to collaboration, shared methods of investigation may account for the range of disciplines, including medicine, social sciences and psychology, rather than the topic of research (Bellotti et al., 2016); see Table 23.

Further analysis of the trends of methods, funding and topics under investigation within portfolios is ~~recommended~~proposed.

~~The portfolios within this analysis demonstrate a~~ A marked change in the geographic location of co-authors ~~within this analysis is evident at~~ between six- to nine- years into their ~~co-author~~ publication portfolios (see Table 4). ~~;~~even~~When~~ accounting for the relocation of authors (see Table 54) a noticeable decrease in the dominance of co-authors based in an author's host or previous country ~~is~~remains evident as the ~~number~~percentage of international co-authors increases. The consistent and growing proportion of internationally co-authored papers (Leydesdorff et al., 2013) may, in part, be accounted for by technological advances that have mitigated the need for researchers to work in close geographical proximity (Hoekman et al., 2010). Initiatives by national governments (~~Leydesdorff et al., 2013 citing Kwon et al 2012~~)(Kwon et al., 2011) and programmes such as the European Framework (European Commission, 2020), purposefully established to stimulate international research collaboration (Adams and Gurney, 2016) may also be a factor. Elsewhere, evaluation frameworks such as the Research Excellence Framework in the United Kingdom (Research Excellence Framework, 2020a) and the Excellence in Research for Australia (Australian Research Council, 2015) continue to influence what, how and for whom academics write (Murray and Thow, 2014). Previously dominated by research-intensive western Europe and the USA, an analysis of a sub-set of Science Citation-Index Expanded (SCI-E) journals, identified that all nations are now collaborating in co-authored papers across geographical boundaries (Leydesdorff et al., 2013). For some established economies the total research output since the mid-1980's has more than doubled (Adams and Gurney, 2016). However, while domestic research output levels have not increased (~~UK-United Kingdom~~ – 47,5000 papers per year), international collaborations have increased more than ten-fold (Adams and Gurney, 2016). The true import of these explanatory frameworks on writing behaviour are worthy of additional examination.

Male authors were disproportionately represented in all the portfolios analysed: 31%-53% of co-authors in the portfolios analysed were male; see Table 56. Women typically co-authored with other women 20% more than men with women; male co-author relationships presenting closer to a 50-50 split. Male authors wrote with female co-authors a maximum of 58% of the time; range 43%-53%. A recent ranking of the world's top 100 universities (Times Higher Education, 2020) included analysis of organisational commitments to gender equality, including the recruitment and promotion of women, as informed by the United Nation Sustainable Development Goals (United Nations, 2020b)(United Nations, 2020b). Sustainable Development Goal 5 calls for the adoption of sound policies to empower all women and girls at all levels (United Nations, 2020a). Within this context gender Gender-differences evident in the portfolios is ~~are~~ of particular significance given the latest available data indicating that nursing is a highly gendered profession with a consistent 89% to 11% female-to-male ratio of nurses on the Nursing and Midwifery Council register since 2013 (Nursing and Midwifery

Council, 2014, Nursing and Midwifery Council, 2015, Nursing and Midwifery Council, 2016, Nursing and Midwifery Council, 2017, Nursing and Midwifery Council, 2018, Nursing and Midwifery Council, 2019). Academic nursing departments also have a high female-to-male staff ratio of 75% female to 25% male (Higher Education Statistics Agency, 2019). These findings firmly indicate gender inequality beneficial to male authors in the *General Nursing* portfolios analysed. The source of these gender differences, what influences co-author selection, and the practices which result in the corresponding higher representation of men within the portfolios analysed merits closer inquiry.

Clear longitudinal trends are apparent across this study of portfolios containing *General Nursing* outputs, with most authors beginning their co-authored *professional academic writing* career as first authors; see Table 78. The technical definition of authorship encompasses not only the person who undertakes the writing of a manuscript, but also those who have made a substantial contribution to a study, whether in formulating the problem, structuring the design, conducting statistical analysis, or interpreting the results (American Psychological Association, 2019). Authorship conventions differ among disciplines and can prove challenging to negotiate when writing as part of a multidisciplinary team (National Academy of Sciences et al., 2009). Nonetheless, the convention of placing the principle investigator last in an author list has become an accepted standard across most research areas, signalling intellectual input or supervision of the work reported rather than actively conducting the research or writing the manuscript (American Psychological Association, 2019). In nursing the first author has typically contributed the most to the development of a manuscript with the assignment of subsequent authors reflecting their relative contribution (Oermann and Hays, 2016), as is apparent at the start of co-author relationships represented in this analysis. However, in contrast with the anticipated shift towards final author placement of the female authors, male authors continued to be named as first author more than a decade after first publication. Whether first author male authors attributions persist because they maintain a higher level of project involvement or, contrary to guidance (American Psychological Association, 2019), have been assigned the position of first author due to relative status is a subject of supplementary inquiry unclear.

Although some academic staff appear to spontaneously succeed in *professional academic writing* the assumption that all writers have similar capacity to flourish is too simplistic (Hyland, 2016). The findings of this study highlight consistent trends in the publication portfolios of elite academics publishing in *General Nursing*, particularly the significance of expansive professional networks in producing sustained *professional academic writing* outputs. To enable all academic staff to thrive in achieving their personal and organisational publishing goals, the implementation of institution-wide strategies facilitating continuing professional development are recommended. These development activities should focus on fostering opportunities to build the interdisciplinary professional networks necessary to make

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3 academics wishing to publish in the area of *General Nursing* attractive as collaborators and
4 co-authors.
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9 While university Vice Chancellors act as Chief Executives responsible for authorising strategic
10 decisions within their institution their decisions are informed by the work of executive
11 committees. Also known as strategic management teams, executive committees are in charge
12 of devising policies in key areas of university business including developing strategic and
13 operational plans with associated budget allocations. Based on this research, it is
14 recommended that higher education institution executive committees build medium-term
15 investment into their strategic and operational plans for time, resources and facilitation of
16 academic staff development in relation to writing for publication. Acknowledging the role of
17 the university library in assisting academics with their publishing endeavours (Akers, 2019),
18 targeted investment in library services to support *professional academic writing* should be
19 represented as part of these organisational plans. Within the context of gender differences
20 evident in *General Nursing* portfolios, it is recommended that strategic and operational plans
21 particularly focus on the continuing professional development of female academics. In
22 focusing on gender equality (Times Higher Education, 2020, United Nations, 2020a), the
23 female academics who comprise the majority of the nursing practice and academic
24 communities will experience parity of opportunity in achieving this key marker of
25 achievement used by university in promotion, tenure and academic review, *professional*
26 *academic writing*.
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37 **Limitations**

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39 Like bibliometric and social network analysis studies before, this study has relied upon
40 quantification of network characteristics without the opportunity to explore qualitatively
41 explore the meanings of those characteristics. The *h*-index is used by SCOPUS to compile a list
42 of the Top 100 authors in a specialism and provided a useful starting point to purposively
43 select publication portfolios for analysis in this study. However, it is reasonable to conclude
44 that all the authors of these portfolios should be considered elite authors given the latest
45 available World Health Organisation statistics that there are 20.7 million nurses and midwives
46 in the world (World Health Organisation, 2016); a premise borne out by Hirsch (2005), creator
47 of the *h*-index, estimation that after 20 years a "successful scientist" would have an *h*-index
48 of 20, an "outstanding scientist" an *h*-index of 40, and a "truly unique" individual an *h*-index
49 of 60. the portfolios within the analysis were consistent with this definition, *h*-indexes ranging
50 from 10 to 42, even accounting for the variation of *h*-indexes between fields (Hirsch, 2005).
51 The analysis presented illustrates the *professional academic writing* networks of an elite
52 cohort of academic writers publishing in *General Nursing* and may therefore differ from the
53 portfolios of other disciplines ~~this end presents an aspirational template for others to~~
54 emulate.
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6 While whole-network designed social network analysis which assume that the full data set is
7 available (Borgatti et al., 2018b), or studies which combine whole-networks with the
8 quantitative analysis of written documents (Waltman and Noyons, 2018) that is bibliometric
9 or citation analysis (Yu-Wei, 2011, Mangas-Vega et al., 2016, Lining et al., 2019, Ardanuy et
10 al., 2009), this study has focused on personal-networks of a select group of elite authors.
11 While other techniques can provide statistical generalisations of an area, the case studies
12 presented have enabled analytic generalisations to be made (Yin, 2018). The findings within
13 this study demonstrate correlations between co-author network size, employing
14 organisation, geographic location and gender, though further investigation is required to
15 determine the cause of these relationships.
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21 **Conclusion**

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24 ~~Although some academic staff appear to spontaneously succeed in *professional academic*~~
25 ~~*writing* the assumption that all writers have similar capacity to succeed and merely require~~
26 ~~right conditions to flourish has been proposed as too simplistic (Hyland, 2016). However, in~~
27 ~~the absence of an accepted framework of how academics acquire writing skills (Murray and~~
28 ~~Thow, 2014), this~~ This research presents study provides a preliminary insight into the
29 consistent publication trends consistently present across gender, sector and geographic
30 location in the early publication portfolios of academics publishing in the area of *General*
31 *Nursing*. University executive committees can use the across gender, sector and geographic
32 location. This study is a response to the call for time series analysis to develop longitudinal
33 perspectives of academic community research outputs (Kumar, 2015). The trends evident in
34 these descriptive data to support the development of, and investment in, institutional-wide
35 strategic and operational plans to support academics writing for publication; these plans
36 should include targeted support an investment in academic staff time and resources to foster
37 build professional interdisciplinary connections across disciplines, nationally and
38 internationally, through continuing professional development activities. Strategic investment
39 in staff development over a medium- to long- term may be required before the impact of that
40 investment becomes apparent.
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52 Further research is underway to develop insight into the qualitative experiences of how staff
53 negotiate the *professional academic writing* landscape, from developing research skills,
54 building support structures and interdisciplinary networks, securing adequate resources, and
55 negotiating the publishing processthe processes of successfully writing and becoming
56 published.
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Practical Implications

The development of extended co-author networks, locally, internationally, and across the higher education sector, enable authors to attain the marker of achievement required by universities and government funding bodies, namely sustained output of *professional academic writing for publication* high-quality publications. Identified trends support strategic investment in academic time and resources to build professional networks across disciplines. Medium- to long- term investment may be required before the impact of that investment becomes apparent.

Using social network analysis techniques *to interrogate personal-networks*, this information science based doctoral research demonstrates that by aligning to the needs of our stakeholders, as advocated by our professional associations (Chartered Institute of Library and Information Professionals, 2019, Medical Library Association, 2020), we can generate evidence to help inform strategic investment in staff time and resources.

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Table 2: Author Profiles of Selected *General Nursing* Portfolios

Q1_h42_M: Professor at a higher education institution in Western Europe. He has a background in health sciences and has studied to PhD level. He has received international awards recognising the quality of his research, was a founding member of an international research network, and holds advisory positions with national and international organisations and journals.

Q2_h28_M: Professor and Associate Dean (Research) at a higher education institution in North America. He is a Registered Nurse and has studied to PhD level. Having worked as a Post-Doctoral Researcher, he relocated from the United Kingdom to an Associate Professor position in North America. He has received international awards recognising the quality of his research, held leading roles on international nursing organisations, and holds an editorial position with an international ISI listed journal.

Q3_h12_F: Associate Professor at a higher education institution in South East Asia. She has a background in clinical medicine. Her Masters' in Nursing and PhD-level studies were completed in Europe, an MSc in Nursing and has studied to PhD level. before returning to South East Asia to take up her position as Associate Professor.

Q4_h10_F: Professor at a higher education institution in Southern Europe. She is a Registered Nurse, held leading roles in European regulatory bodies, was a founding member of national research network, and is a leading member of her national nursing association.

Note: Authors are defined by Quartile_h-Index_Gender e.g. Quartile1_h-index=42_Male reads Q1_h42_M