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Scientific group leaders' authorship preferences: an empirical investigation

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Abstract Leaders are important for scientific groups. Authors of a research paper whose names are listed in the byline first, last, or as the corresponding author are often considered particularly important to that paper. The authorship preferences of scientific group leaders are examined for seven research fields and 11 geographic locations. There are some similarities and differences among research fields and geographic locations in listing group leaders. In the fields of "Mathematics" and "Physics, Particles & Fields", although the custom is for papers to list authors alphabetically, scientific group leaders from Egypt and Shanghai typically list their names first or last in the byline, the same as group leaders in other research fields. Opposite to the group leaders from other locations, leaders from Egypt often appear as the first authors. Scientific group leaders who are listed first in the byline typically also serve as the corresponding authors. For group leaders who are listed last in the byline, the proportion also serving as corresponding authors changes significantly. Accordingly, the proportion of papers in which group leaders are corresponding authors varies considerably among different research fields and geographic locations. The meaning of authorship for research group leaders is discussed in the end from the perspective of their roles in paper production.

Keywords Group leader · Corresponding author · Author position · Author contribution

Introduction

Papers increasingly have multiple co-authors and the proportion of single authored papers is decreasing (Shapiro et al. 1994; Drenth 1998; Cronin 2001; IWCSA Report 2012). This

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trend implies increasing collaborative research (Hara et al. 2003). Scientific collaboration usually occurs among independent individuals, individuals within a scientific group, or multiple scientific groups.

One consequence of scientific collaboration is co-authorship of papers. The roles played by different authors may, or may not, be equal in importance. Equally important contributors can be assigned equal credit by the indications, such as "equal first authors", "multiple corresponding authors" (Hu 2009). Alphabetical authorship listing is another method to equally allocate credit (Frandsen and Nicolaisen 2010). But not all the alphabetically ordered authorship papers mean that all authors contribute equally. Sometimes it is only a custom (Egghe et al. 2000). In non-alphabetical authorship papers, author listing order is naturally taken to imply relative individual contribution and thus byline position is important to the credit authors receive. Generally, the first and last byline positions, and corresponding authorship are used to indicate the most important or second most important authors (Tscharntke et al. 2007; Buehring et al. 2007; Wren et al. 2007; Hu et al. 2010; Mattsson et al. 2011).

A scientific group is usually directed by a leader who plays both academic and managerial roles (Etzioni 1961; Nagpaul and Gupta 1989). The academic status and experiences of group leaders are important for the development of their groups (Pelz and Andrews 1966; Hemlin and Gustafson 1996). Group leaders also provide group members with positions, research conditions, and so on (Martin and Skea 1992).

Few investigations have examined the relations among important authors, such as group leaders, corresponding author and first or last author. Mattsson et al. (2011) found that most corresponding authors in papers on the fields "Fundamental Biology" and "Medicine" from 18 European countries are also the first or last authors. Kosmulski (2012) showed that group leaders in research on the field "Physical Chemistry" from six cities prefer to be the first or last authors. This paper investigates the relations between the authorship of group leaders and the first, last and corresponding authors for seven research fields and 11 geographic locations. After reviewing the related literature, we detail the investigation method and results. Finally, after summarizing and discussing the study results, limitations of the study are given.

Literature about scientific group leaders and byline of papers

Scientific groups are research units that perform or participate in research and are organized by leaders. Group leaders are mostly senior scientists (Hemlin 2006) who are more prolific and frequently cited than the average (Pudovkin et al. 2010). Both the experience of group leaders in the research field of the group, and their academic seniority, are crucial for the group to thrive and accomplish creative results (Pelz and Andrews 1966; Hemlin and Gustafson 1996). Group leaders play academic and managerial roles that involve planning, as well as the organization, formalization, and social and normative integration of group members (Etzioni 1961; Nagpaul and Gupta 1989). Additionally, leaders help ensure that research is supported by essentials such as funds and equipment (Martin and Skea 1992). Effective research leaders motivate researchers, determine research objectives, and provide useful external information (Nagpaul and Gupta 1989). Leadership characteristics and organizational conditions are important for stimulating creativity and innovation in working groups (Amabile et al. 1996; Ford 1996; Mumford et al. 2002; Williams and Yang 1999; Woodman et al. 1993).

Research papers are a main result of the work of scientific groups just as they are for individual researchers. The authorship of papers denotes responsibility for their content (Biagioli 1998), and provides researchers with credit that can help them gain promotions, grants, academic position (Buehring et al. 2007; Tscharntke et al. 2007). Authorship thus has become a form of academic currency (Bennett and Taylor 2003; Cronin and Franks 2006; Dance 2012). Generally, all listed authors should have contributed to a paper, but in reality this is not always the case. Some papers list authors who expended no intellectual effort to produce the paper (Drenth 1998; Jones et al. 2005), such as through honorary, guest and gift-authorship arrangements (Yank and Rennie 1999; Dotson and Slaughter 2011; Vinther and Rosenberg 2012; Gasparyan et al. 2013). An opposite situation can also exist, where researchers who contributed substantially to the work do not appear in the author list. Such researchers are called ghost authors (Rennie et al. 1997; Dotson and Slaughter 2011; Vinther and Rosenberg 2012).

To limit irresponsible authorship listing, some general medical journals have asked authors to disclose their specific individual contributions (Bates et al. 2004). The International Committee of Medical Journal Editors requires authors meet the following definitions of authorship: (1) substantial contribution to the conception and design, or acquisition of data, or analysis and interpretation of data; (2) drafting the article or revising it critically for important intellectual content; and (3) final approval of the version to be published. However, Bates et al. (2004) found that after several years of contribution disclosure practices, a proportion of papers in three general medical journals continued to list honorary authors. In an environment where all researchers face pressure to publish, junior researchers may offer gift authorship to highly respected researchers to increase the credibility of their manuscripts (Bhopal et al. 1997), and gain gate pass to prestigious journals (Kosmulski 2012).

Authorship order is another research topic related to byline. Authors determine their authorship order according to the traditions of their countries and research fields. Traditional practices regarding author listing order include listing in declining significance of contribution, alphabetical order of name, or reverse seniority (Tscharntke et al. 2007). Alphabetically listed papers may have intentional or incidental alphabetical authorship (Waltman 2012). With intentionally alphabetized authorship there is no apparent hidden meaning to the order of authors. Waltman (2012) found that intentional use of alphabetical listing of authorship has decreased over time. In 2011 the percentage of papers with intentional alphabetical authorship in Web of Science database publications dropped to just 3.7 %.

Byline position is important to authors when papers use non-alphabetical authorship listing. Author listing order is naturally taken to imply relative individual contribution. Over and Smallman (1970) found that authors whose names fell late in the alphabet avoided *The Journal of Physiology* in the early 1960s when the journal insisted on alphabetical listing of authorship. Despite the contentious relationship between the byline position and contribution of an author, researchers frequently assume that the first author in a non-alphabetical authorship paper is primarily responsible for the work and has made the largest contribution (Riesenberg and Lundberg 1990; Shapiro et al. 1994; Yank and Rennie 1999; Bhandari et al. 2004; Beveridge and Morris 2007; Tscharntke et al. 2007).

The final position in the byline is also significant because it sometimes denotes senior author (Drenth 1998; Buehring et al. 2007). In an investigation of papers published in the *British Medical Journal*, Drenth (1998) explains this practice originated from senior researches appending their names to the bylines of papers written by junior authors. This reduced senior researchers' personal pressure to publish while retaining a positive position

for the junior authors. The last author position has gradually come to be reserved for senior members so as not to negatively affect junior members (Riesenberg and Lundberg 1990). An alternative explanation is senior members voluntarily take the final author position in a type of noblesse oblige. Zuckermann (1968) coined this term to describe the way Nobel laureates allow their co-workers to be listed as first authors even when they themselves may have contributed more to a work. Regardless of the specific origins of this byline preference of senior authors, the last spot in the byline has come to be widely considered to indicate the author that has made the second largest contribution (Shapiro et al. 1994; Bhandari et al. 2004). Because of the tradition of listing laboratory heads in the senior author position, last-author-based citation ranking and co-citation mapping reduce ambiguities regarding author name (Zhao and Strotmann 2011; Strotmann and Zhao 2012).

Corresponding author is another important term related to authorship. Initially, the corresponding author simply indicated the group member chosen to be responsible for all contact and correspondence with the journal (Mattsson et al. 2011). Gradually, however, the corresponding author came to denote a particularly important author who had been bestowed a token of leadership and responsibility (Wren et al. 2007). This is particularly prevalent in China, which ranks second globally for the number of scientific papers published (Hu et al. 2010). Consequently, some Chinese authors suggested that corresponding authors are of equal importance to the first one (Zhang 2009; Hu et al. 2010; Liu and Fang 2012). To indicate that several authors are equally important, some papers allow labeling to indicate equal first authorship or multiple corresponding authors (Hu 2009). The corresponding author can appear anywhere in the byline. Further evidence of the importance of the corresponding author is the fact that they most frequently appear first in the byline, followed by last (Mattsson et al. 2011).

Authors themselves generally decide the order in which their names will be listed. However, the various extant patterns for recognizing authorship can influence the perceptions of others. Author inflation, the trend towards increasing numbers of listed authors, which dilutes individual accountability and credit, makes it difficult for hiring, promotion and grant committees to accurately assess the research ability of individuals based solely on publication history and without explicit information on the contribution of each author (Shapiro et al. 1994; Bennett and Taylor 2003; Birnholtz 2006; Wren et al. 2007).

In the era of multi-authored papers, comprehensive investigation of byline systems and their usage can help readers correctly interpret author contributions. The phenomena of authorship of equal importance have been investigated by various researchers (Hu 2009; Akhabue and Lautenbach 2010; Tao et al. 2012; Wang et al. 2012). Mattsson et al. (2011) analyzed the byline position of corresponding authors. The influence of age and professional rank on author byline position has been examined (Drenth 1998; Gingras et al. 2008; Costas and Bordons 2011). To demonstrate the complexity of the byline, Kosmulski (2012) studied the byline position of group leaders in "Physical Chemistry". The first, last and corresponding author are often regarded as important authors in a research article. This paper investigates the occupation of important authorship by scientific group leaders in published articles.

Methodology

Each research group usually contains a single leader who directs the work of group members or sub-groups. Simultaneously, individual group members usually work under only one group leader. Therefore over an extended period, such as a decade, a group leader

typically publishes more papers than individual members of their research group (Kosmulski 2012). This phenomenon is supported by Pudovkin et al. (2010) and can identify group leaders in specific research fields and geographic locations (Kosmulski 2012).

We analyzed the authorship of group leaders in scientific publications in Thomson Reuters' ISI Web of Science database, dated to February 1, 2013. This study only considers the document types of article, letter, review and notes. The analysis considers publications in the following seven research fields of science and technology:

- Computer Science
- Environmental Sciences
- Mathematics
- Oncology
- Optics
- Physical Chemistry
- Physics, Particles & Fields

Group leaders were drawn from the following nine cities:

- Berlin
- London
- Melbourne
- Moscow
- New York
- Paris
- Shanghai
- Tokyo
- Toronto

and the following two countries

- Brazil
- Egypt

The countries Brazil and Egypt are included in the sample because individual cities in these countries have insufficient numbers of group leaders. Publications in the selected research fields from the above geographic locations during 2002–2011 were analyzed. Kosmulski (2012) believed the time window of 10 years was sufficient to distinguish group leaders in 2007 (the midpoint of the time window). We assume that group leaders should remain in leadership positions during the latter half of the study period, i.e. 2007–2011, provided they do not change location (Costas and Bordons 2011).

The database includes about 257,000 relevant publications. Authors were ranked within each geographical location based on the number of papers they published in each field with co-authors coming only from the corresponding country (for example, Germany for Berlin). To avoid confusing the analysis with papers that had multiple group leaders, papers with co-authors from different countries were excluded (Kosmulski 2012). The top 10 authors, in terms of number of published papers from each city or country, were assumed to be group leaders for the analysis of data from 2007 to 2011, provided that

(a) They published at least one multi-author paper in the selected field, with co-authors only from the corresponding country, in 2007–2011;
(b) They had no more than one paper in co-authorship with a more productive author from the same geographic location;

(c) During 2002–2011, the number of papers he/she has collaborated with any given author in the same geographic location does not reach 90 % or more of his/her total number of papers with co-authors only from the corresponding country.

Authors who did not meet the above criteria were excluded and replaced with the next (e.g., 11th, 12th) most-productive authors until a set of 10 leaders was derived. Criterion (b) is designed to exclude subgroup leaders who belong to a very efficient group and thus may be more productive than leaders of other groups. Moreover, there have been several cases in which partnership of two or three researchers have co-authored all or almost all of their papers from 2002 to 2011. Such arrangement makes it difficult to identify leaders based only on the byline. Criterion (c) is intended to exclude authors belonging to this group.

The ISI Web of Science database contains several research fields within Computer Science, namely *Compute Science Information Systems*, *Computer Science Hardware Architecture*, *Computer Science Interdisciplinary Applications*, *Computer Science Software Engineering*, *Computer Science Artificial Intelligence* and *Computer Science Theory Methods*. Research groups may distribute their papers among these fields rather than being focused on one. To identify the true group leaders, we thus combined all these fields into the single field "Computer Science".

Though Chinese and Japanese authors have many surnames, several common surnames account for the majority of the population of these two countries. It is common for two persons to have the same surname and first initial, or even the same full name. This means that papers from multiple scientists who have average productivity but happen to share a common name may outnumber those of prolific group leaders with more unusual names. To avoid the selection of false group leaders due to erroneously identifying the works of multiple authors as being from a single author based on their shared name, affiliation to academic institutions for all papers is manually compared to identify group leaders.

For many research fields, finding group leaders outside the top 10 leaders for a given geographic location is difficult. The analysis includes 11,645 papers from identified group leaders in the seven fields and from the 11 locations. To verify the reliability of this method for identifying group leaders, a set of 30 group leaders are randomly selected from those identified above, where the randomly selected set comprises leaders from London, Melbourne, New York, Shanghai, Tokyo, or Toronto who have an English or Chinese homepage. This test finds that the group leaders in the selected set are indeed group leaders according to their homepages. The reliability of the method thus is validated.

The corresponding author is labeled the reprint author in the address field of ISI. ISI provides the information of only one corresponding author for each paper. For papers where the group leader is not labeled as the corresponding author in ISI, we manually checked whether the group leader is one of the multiple corresponding authors (Hu 2009).

Results

Intentional alphabetical authorship listing in the papers of group leaders

For papers with intentional alphabetical authorship listing, author listing order contains no hidden meaning. Waltman (2012) developed an unbiased method to estimate the probability that a paper intentionally lists author names alphabetically (such papers are denoted

as intentionally alphabetical). For a set of N papers, the probability of a given paper being intentionally alphabetical is estimated as follows:

$$\hat{p}_a = \frac{1}{N}\sum_{i=1}^{N}\hat{p}_i = \frac{1}{N}\sum_{i=1}^{N}\frac{a_i - \frac{1}{n_i!}}{1 - \frac{1}{n_i!}} \quad (1)$$

where n_i is the number of authors of the i-th paper, and a_i indicates whether the i-th paper lists the author names alphabetically (whether intentionally or incidentally). For alphabetical authorship papers, $a_i = 1$, while for other papers $a_i = 0$. For each research field, the average probability of the papers of group leaders being intentionally alphabetical was estimated, as listed in Table 1.

Table 1 shows that the probability of the papers of group leaders being intentionally alphabetical is higher in the fields "Mathematics" and "Physics, Particles & Fields". Waltman (2012) demonstrated that intentional alphabetical authorship is common in these two fields. However, the frequency of papers of group leaders from Egypt and Shanghai in these two fields being intentionally alphabetical is very low. The estimated average probabilities of the papers of group leaders being intentionally alphabetical in the fields "Mathematics" and "Physics, Particles & Fields" are 0.684 and 0.672, respectively, if papers from Egypt and Shanghai are excluded.

Byline position of group leaders

As papers in the fields "Mathematics" and "Physics, Particles & Fields" often use alphabetical authorship, they are excluded from analysis of the byline preferences of group leaders that are based on geographical location, with the exception of Egypt and Shanghai. For convenience, papers in which the group leader is the first author are labeled as leader-first, and papers in which the group leader is the last author are labeled as leader-last. Table 2 lists the proportions of leader-first and leader-last papers, and the relative position of leaders in the byline. Suppose that in a set of N papers, N_{1st} and N_{last} are the numbers of leader-first and leader-last papers. The proportions of leader-first and leader-last papers are given by

$$r_{1st} = N_{1st}/N \quad (2)$$

$$r_{last} = N_{last}/N \quad (3)$$

Data in Table 2 show that more than half of all papers are either leader-first or leader-last. The leader-first and leader-last categories together comprise nearly 90 % of all papers for leaders from Egypt, and more than 75 % for those from Moscow. Group leaders from

Table 1 Estimated probability of intentionally alphabetical papers of the group leaders

Research field	$\hat{p}_a$
Computer Science	0.079
Environmental Sciences	0.010
Mathematics	0.478
Oncology	0.005
Optics	0.039
Physical Chemistry	0.008
Physics, Particles & Fields	0.559

Egypt prefer to be listed as first authors (nearly 70 %). Leader-first papers comprise less than 10 % of the total in locations other than Egypt and Moscow. The proportion of leader-last papers exceeds 60 % for group leaders from Moscow, Shanghai and Toronto. The lowest proportion of leader-last comes from Paris, where it is slightly below 50 %. Additionally, the group leaders are listed on the middle positions in more than 40 % of papers from New York and Paris.

The number of authors per paper varies. Normalized Rank of Author (NRA) reflects relative position in the author list (Kosmulski 2012). The NRA for the j-th author in a paper with n authors is as follows

$$\mathrm{NRA}(j,n) = 1 - 2(j-1)/(n-1) \tag{4}$$

NRA ranges from 1 for the first author to -1 for the last author irrespective of n. The average NRA is expected to equal zero in a series of randomly ranked authorships. Positive average NRA indicates that the author(s) prefer to appear in the upper part of the byline, and negative average NRA indicates a preference for the lower part. Accordingly, with r_{1st} and r_{last}, the absolute average NRA of the group leaders from each location in Table 2 exceeds or approaches 0.5 when papers in the fields "Mathematics" and "Physics, Particles & Fields" are excluded (for Egypt and Shanghai, these two fields are counted). Average NRA is only positive for the leaders from Egypt. The highest absolute average NRA is from Tokyo.

Table 3 lists byline position of group leaders by research field. Papers from Egypt are excluded because these group leaders displayed opposite authorship tendencies to those from other locations. The group leaders involved in research on the field "Physical Chemistry" have the highest percentage (near 70 %) of leader-last papers and the lowest percentage of leader-first papers. Thus on average their position in the byline is nearer the bottom end than for group leaders in other research fields. The field "Oncology" has the lowest proportion (less than 50 %) of leader-last papers. Meanwhile, the fields "Computer Science" and "Environmental Sciences" have the highest proportions of leader-first papers (more than 10 %).

Table 2 The proportions of leader-first and leader-last papers, and the relative position of leaders in the byline according to geographic location

Geographic location	r_{1st}	r_{last}	Average NRA
Berlin	0.069	0.585	–0.642
Brazil	0.077	0.566	–0.572
Egypt	0.683	0.198	0.499
London	0.081	0.521	–0.498
Melbourne	0.080	0.552	–0.506
Moscow	0.138	0.619	–0.471
New York	0.084	0.507	–0.526
Paris	0.072	0.487	–0.517
Shanghai	0.041	0.616	–0.607
Tokyo	0.051	0.595	–0.649
Toronto	0.065	0.609	–0.572

For Egypt and Shanghai, papers in all the seven fields are all taken into consideration. For other cities and country, papers on the fields "Mathematics" and "Physics, Particles & Fields" are excluded

Preference of group leaders to be listed as corresponding authors

Leader-corresponding refers to papers for which the group leader is the corresponding author. The proportion of leader-corresponding papers indicates the preferences of group leaders regarding being corresponding authors, and is calculated as follows:

$$r_{ca} = N_{ca}/N \tag{5}$$

where, N_{ca} is the number of leader-corresponding papers in a set of N papers.

Table 4 lists the proportion of leader-corresponding papers in each research field. The proportion of leader-corresponding papers divides the research fields into two discipline groups. The first discipline group (labeled MLC for more leader-corresponding papers) contains the fields "Environmental Sciences", "Mathematics" and "Physical Chemistry", which have higher percentages (exceeding 45 %) of leader-corresponding papers. The second discipline group (labeled LLC for less leader-corresponding papers) contains the fields "Computer Science", "Oncology", "Optics" and "Physics, Particles & Fields". The proportion of leader-corresponding papers is lowest for the field "Optics", at slightly above 15 %.

Table 5 lists the proportions of leader-corresponding papers for group leaders from each location. As fewer corresponding authors of papers in the LLC discipline group are group leaders, the proportion of leader-corresponding papers for group leaders from each location in the MLC is also listed (as r'_{ca}) in Table 5. The ratio of r'_{ca} to r_{ca} shows that whether group leaders from Brazil are corresponding authors is insensitive to the discipline group (MLC or LLC). Discipline group most strongly influences the corresponding authorship preferences of group leaders from Tokyo. The promotion of r'_{ca} from r_{ca} of Melbourne and New York is also high. In all the seven research fields, leaders from Egypt are most likely to be the corresponding authors (more than 50 %). In MLC, Toronto is where the group leaders most strongly prefer to be the corresponding authors (near 70 %). Group leaders from Moscow and Berlin have the weakest preference for being corresponding authors in MLC (about 36 %).

Relationship between byline position preferences and corresponding authorship preferences of group leaders

To analyze the relationships between the byline position preference and corresponding authorship preference of group leaders, the proportion of leader-first to leader-corresponding papers is introduced, as follows:

$$r_{1st\_ca} = N_{ca,1st}/N_{ca} \tag{6}$$

Similarly, the proportion of leader-last papers to leader-corresponding papers is:

Table 3 The proportions of leader-first and leader-last papers, and the relative position of leaders in the byline according to research field

For each research field authors from Egypt are excluded

Research field	r_{1st}	r_{last}	Average NRA
Computer Science	0.116	0.593	–0.498
Environmental Sciences	0.104	0.501	–0.415
Oncology	0.068	0.434	–0.505
Optics	0.048	0.660	–0.654
Physical Chemistry	0.039	0.680	–0.703

Table 4 The proportion of leader-corresponding papers on each research field

Research field	r_{ca}
Computer Science	0.222
Environmental Sciences	0.451
Mathematics	0.505
Oncology	0.276
Optics	0.159
Physical Chemistry	0.538
Physics, Particles & Fields	0.303

Table 5 The proportion of leader-corresponding papers for group leaders from each location

Geographic location	r_{ca}	r'_{ca}	r'_{ca}/r_{ca}
Berlin	0.237	0.360	1.52
Brazil	0.372	0.370	0.995
Egypt	0.590	0.640	1.08
London	0.349	0.528	1.51
Melbourne	0.362	0.643	1.77
Moscow	0.321	0.357	1.11
New York	0.346	0.596	1.72
Paris	0.286	0.410	1.38
Shanghai	0.421	0.572	1.35
Tokyo	0.246	0.466	1.89
Toronto	0.487	0.683	1.40

r'_{ca} is the proportion of the leader-corresponding papers in MLC for the group leaders from each location

$$r_{last\_ca} = N_{ca,last}/N_{ca} \quad (7)$$

where $N_{ca,1st}$ is the number of papers where the group leaders are both the corresponding and first authors (termed leader-corresponding-first papers), $N_{ca,last}$ is the number of papers where the group leaders are both the corresponding and last authors (termed leader-corresponding-last papers). Similarly, the proportion of leader-corresponding papers relative to leader-first papers is:

$$r_{ca\_1st} = N_{ca,1st}/N_{1st} \quad (8)$$

and that of leader-corresponding papers relative to leader-last papers is:

$$r_{ca\_last} = N_{ca,last}/N_{last} \quad (9)$$

In the fields "Computer Science", "Mathematics", "Oncology", "Optics", "Physical Chemistry" and "Physics, Particles & Fields", more than 80 % of the leader-corresponding papers are also leader-first papers or leader-last papers, as listed in Table 6. In the field "Environmental Sciences", nearly 30 % of leader-corresponding papers are papers with the group leaders listed in the middle of the byline.

Table 6 also shows that most leader-first papers list the group leaders as the corresponding authors. The percentage of leader-last papers with group leaders listed as corresponding authors varies considerably among research fields. In the fields "Computer Science", "Optics" and "Physics, Particles & Fields", the group leaders are the corresponding authors in only around 15 % or less of the leader-last papers. This proportion is

relatively high in the fields "Environmental Sciences", "Oncology" and "Physical Chemistry". The field "Physical Chemistry" has the highest r_{ca_last}, at more than 60 %. Despite r_{ca_1st} being much higher than r_{ca_last}, leader-last papers comprise most of the leader-corresponding papers in the fields "Oncology", "Optics" and "Physical Chemistry". This phenomenon occurs because these fields have far fewer leader-first papers than leader-last papers. The numbers of leader-first and leader-last papers differ less in the fields "Mathematics" and "Physics, Particles & Fields" than in other fields because many papers are intentionally alphabetical in the fields "Mathematics" and "Physics, Particles & Fields". Together with the much higher r_{ca_1st} than r_{ca_last}, leader-corresponding papers in these two fields are more likely to be leader-first papers.

As shown in Table 2, leader-first papers are more common than leader-last papers in Egypt, opposite to the trend elsewhere. After excluding papers from Egypt in each field, the proportion of group leaders that are the first authors in leader-corresponding papers (r'_{1st_ca} in Table 6) drops except for the field "Physics, Particles & Fields". There is a clear increase in r_{ca_1st} when papers from Egypt are excluded (denoted as r'_{ca_1st} in Table 6) in the fields "Computer Science", "Mathematics" and "Optics".

Similarly, in most leader-corresponding papers the group leaders from each location are listed first or last in the byline, as shown in Table 7. Most group leaders from each location are the corresponding authors in their leader-first papers. Shanghai has the highest percentage of group leaders being listed in middle positions in the bylines of their leader-corresponding papers (more than 25 %). Although the percentage of leader-corresponding papers to leader-first papers of Egypt is the lowest in Table 7, leader-first papers account for near 90 % of leader-corresponding papers from Egypt because of their high percentage of leader-first papers. Moscow is another location where leader-corresponding-first papers exceed leader-corresponding-last papers. The percentage of group leaders from Toronto that are corresponding authors in leader-last papers is near 60 %, which is much higher than for other locations.

Table 6 Relationship between byline position preferences and corresponding authorship preferences of group leaders according to research field

Research field	Computer Science	Environmental Sciences	Mathematics	Oncology	Optics	Physical Chemistry	Physics, Particles & Fields
r_{1st_ca}	0.469	0.248	0.598	0.241	0.350	0.112	0.821
r_{last_ca}	0.397	0.459	0.335	0.696	0.536	0.748	0.106
$r_{1st\_ca} + r_{last\_ca}$	0.866	0.707	0.933	0.937	0.886	0.850	0.927
r'_{1st_ca}	0.462	0.222	0.570	0.225	0.300	0.066	0.822
r'_{last_ca}	0.410	0.478	0.360	0.713	0.576	0.788	0.100
$r'_{1st\_ca} + r'_{last\_ca}$	0.872	0.700	0.930	0.938	0.876	0.854	0.922
r_{ca_1st}	0.814	0.944	0.843	0.901	0.843	0.886	0.955
r_{ca_last}	0.152	0.421	0.331	0.446	0.131	0.611	0.080
r'_{ca_1st}	0.867	0.942	0.888	0.897	0.934	0.896	0.952
r'_{ca_last}	0.151	0.420	0.335	0.446	0.132	0.616	0.072

For each research field, r'_{1st_ca}, r'_{last_ca}, r'_{ca_1st} and r'_{ca_last} are r_{1st_ca}, r_{last_ca}, r_{ca_1st} and r_{ca_last} when papers from Egypt are excluded respectively

Figure 1 shows the approximately linear relationship between r_{ca} and r_{ca_last}. The exceptions are leaders from Egypt and Moscow, who have higher r_{1st}, and lower r_{last} and r_{ca_last}.

The impact of number of authors on the byline preference of group leaders

Next we tested whether the number of authors (*an*) in a publication impacted the authorship preference of the group leader. Figure 2 displays r_{1st}, r_{last} and r_{ca} versus *an*. The *an* of the points listed in Fig. 2 must meet the requirement that the number of papers with *an* authors in the corresponding field exceeds 20. For example, the papers of the leaders in the field "Mathematics" are concentrated on those with two, three, and four authors. The proportion of leader-first papers decreases with the number of authors. The proportion of leader-last papers and leader-corresponding papers slowly decreases when *an* exceeds four, except for r_{ca} in the field "Physics, Particles & Fields", r_{last} and r_{ca} in the field "Physical Chemistry". r_{last} and r_{ca} in the field "Physical Chemistry" finally go up.

Summary and discussions

We investigated the similarities and differences among research fields and geographic locations in listing group leaders as the first, last and corresponding authors. Our research results show that:

(1) Most leader-corresponding papers are also leader-first or leader-last papers, and most leader-first papers are also leader-corresponding papers.
(2) In the fields of"Mathematics" and "Physics, Particles & Fields", researcher groups from Egypt and Shanghai do not follow the widespread custom of listing author names alphabetically.
(3) Unlike group leaders elsewhere, those from Egypt often list their name first in the byline.

Table 7 Relationship between byline position preferences and corresponding authorship preferences of group leaders according to geographic location

Geographic location	r_{1st_ca}	r_{last_ca}	$r_{1st\_ca} + r_{last\_ca}$	r_{ca_1st}	r_{ca_last}
Berlin	0.341	0.571	0.915	0.937	0.232
Brazil	0.342	0.554	0.896	0.879	0.389
Egypt	0.873	0.074	0.947	0.755	0.221
London	0.280	0.589	0.869	0.882	0.392
Melbourne	0.205	0.701	0.906	0.812	0.446
Moscow	0.791	0.149	0.940	0.919	0.095
New York	0.371	0.577	0.948	0.968	0.398
Paris	0.385	0.498	0.883	0.897	0.305
Shanghai	0.085	0.655	0.740	0.883	0.448
Tokyo	0.338	0.608	0.946	0.926	0.260
Toronto	0.159	0.739	0.898	0.918	0.592

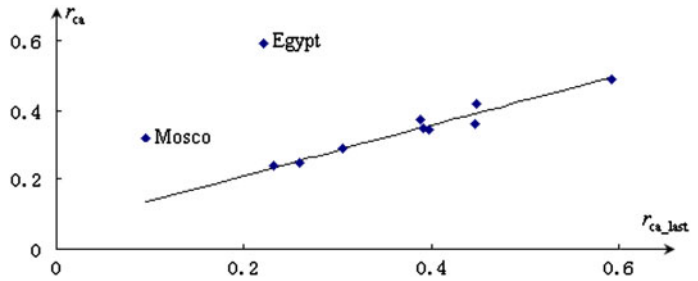

Fig. 1 The relationship between r_{ca} and r_{ca_last} of group leaders from different geographic locations

(4) Group leaders in the field "Optics" are corresponding authors of less than one-fifth of their papers, while those in the fields "Mathematics" and "Physical Chemistry" are corresponding authors of more than half of their papers.
(5) In Berlin, London, Melbourne, New York and Tokyo, obvious differences in the proportion of leader-corresponding papers exist between the discipline groups MLC ("Environmental Sciences", "Mathematics" and "Physical Chemistry") and LLC (the other four fields).
(6) In the field "Physics, Particles & Fields", most leader-corresponding papers are leader-first papers. In the fields "Oncology" and "Physical Chemistry" most leader-corresponding papers are leader-last papers.
(7) Group leaders from Egypt and Moscow are the first authors in most of their leader-corresponding papers, while group leaders from Melbourne and Toronto are the last authors in most of their leader-corresponding papers.

The results of this study provide evidence of relationships between important contributors and the corresponding, first or last authors (Wren et al. 2007; Mattsson et al. 2011). In the absence of further information being provided people may apply their personal experience to judge the importance and status of an author from the authorship information. However, this method is unreliable. In appraising the importance of the authors of a paper in a research field or from a geographic location other than his/her own, one should be cognizant of the differences in byline customs among different research fields or geographic locations. Moreover, an appreciable number of last authors are not senior authors (Tscharntke et al. 2007), and in fact may have contributed only negligibly to the research (Bhandari et al. 2004; Buehring et al. 2007). Besides the potential for confusion regarding the importance of the authors, listing important contributors towards the end of the byline may cause them to become invisible in citation—for example, certain referencing styles limit authors cited to a certain number (Buehring et al. 2007).

One proposed solution to the ambiguities that surround the presentation of authorship in the new environment of author inflation is to require that the byline list authors in order of the relative importance of their contributions (Rennie et al. 1997; Savitz 1999). The Optical Society (OSA) has suggested that authors list their names in this way (http://opticsinfobase.org/submit/review/PubBrochEnglish-April-2012.pdf).

In China, the corresponding author is thought to be of equal importance to the first author, and the last position of the byline has no special meaning to hiring, promotion and grant committees. Leading research institutes in China now only consider papers from candidates listed as the first author or corresponding author. However, the proportion of group leaders from Shanghai being the first or corresponding authors is not high, at less

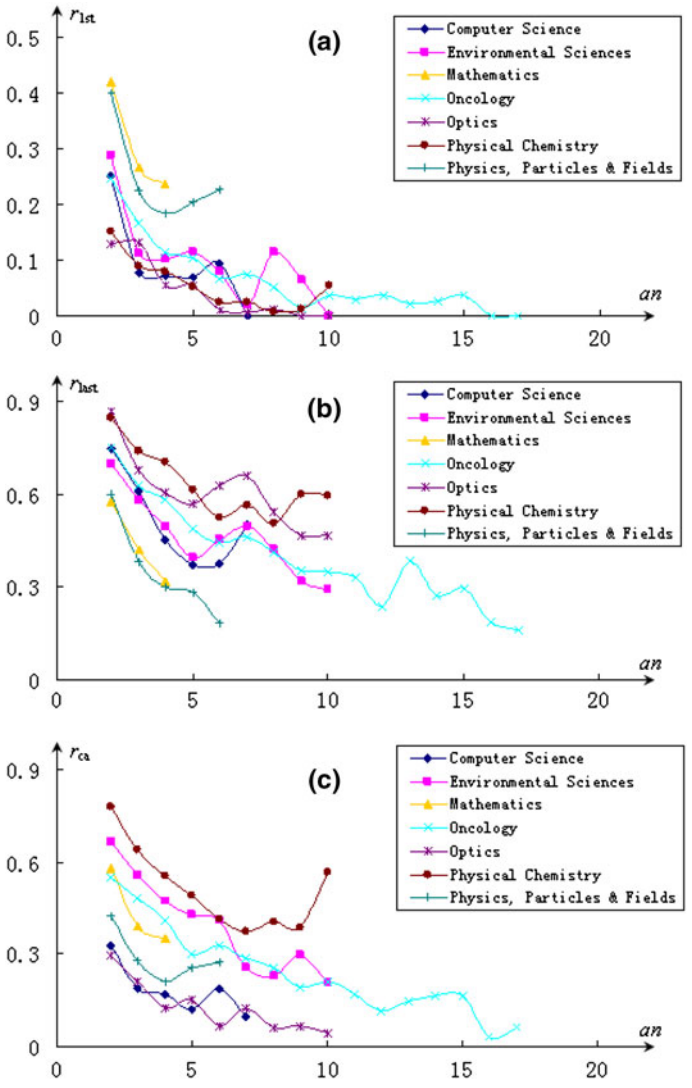

Fig. 2 Distribution of papers by number of authors and byline preference of group leader. **a** r_{1st} versus *an*, **b** r_{last} versus *an*, **c** r_{ca} versus *an*

than 50 %. This phenomenon may occur for the following two reasons. First, the benefits of being labeled as important authors are lower for group leaders than for other group members. Group leaders are likely to have stable positions and academic status, as well as strong academic reputations that let them easily obtain research funds. This frees group leaders to encourage the recognition of their younger colleagues in a form of noblesse oblige (Rennie et al. 1997; Buehring et al. 2007; Kosmulski 2012).

Second, separate perceptions of importance exist for a scientific research group and a scientific paper. The leader of a research group performs both academic and management roles. Managerial roles, such as planning, organizing, and the provision of funds and

instruments, indirectly contribute to specific papers and thus are disputed items of authorship (Laurance 2006). On the other hand, the efficiency with which the group leader performs their managerial role can impact the productivity, creativity and influence of a scientific team (Nagpaul and Gupta 1989; Hemlin 2006). Thus, the group's productivity and influence can indicate the managerial ability of its leader. The management achievements of a group leader are thus also part of their academic contribution. In this sense, merely being listed in the byline of papers by his/her group, regardless of the listing position, is enough to reflect a leader's achievements in scientific management. And listing the leader in the byline helps the group to win funding in the future. On the other hand, in cases where the group leader makes a substantial contribution to the academic content of a paper, he/she will be labeled as an important author of the paper itself, such as the corresponding author.

Limitations of the study

Our findings should be generalized with caution. Because of the tedious manual work required to select group leaders from homonymous researchers and subgroup leaders, and checking corresponding authorship of many papers, our work has focused only on the papers in seven research fields from 11 geographic locations within a 10-year time window. The results are therefore not transferable to other cities or countries, research fields and periods. Further extensive investigations are required to obtain more detailed distributions for the authorship preferences of group leaders and other researchers.

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