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Genre analysis: Structural and linguistic evolution of the English-medium medical research article (1985–2004)☆

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Abstract

This paper reports a corpus-based genre analysis of the structural and linguistic evolution of medical research articles (RAs) written in English. Towards that end, we analyzed the frequency of occurrence of the 11 moves identified by Nwogu (1997), of the three most frequently used verb tenses (simple past, simple present and present perfect) and of the first person pronouns in 25 RAs published between 1985 and 1989 (Corpus A), on the one hand, and 25 RAs published between 2000 and 2004 (Corpus B), on the other. The results obtained were compared by means of Chi-square test or Mann–Whitney *U* test with those reported in previous research. Our findings indicated that Moves 1 and 6 changed from "optional" to "obligatory" (c.f. Nwogu, 1997) whereas Move 9 switched from "obligatory" to "optional". Move 8 remained an "optional" move, though significant difference was found in its frequency of occurrence between the two corpora ($p = 0.015$). Regarding verb tenses, we found that the frequency of the simple past significantly increased in Move 3 ($p = 0.001$) as well as that of the simple present in Move 10 ($p = 0.004$). The frequency of the present perfect significantly decreased in both Move 3 ($p = 0.001$) and Move 10 ($p = 0.001$). Regarding the first person pronoun, we found significant inter-corpus differences in the total number of the plural form of the first person pronoun and its related cases ($p = 0.001$) and in their frequency of occurrence in the Methods, Results, and Discussion sections (respectively, $p = 0.001$). These findings are discussed in light of the evolution of medical science and attitude changes of medical RA writers.

1. Introduction

Language always changes in response to social, economic and political development and these changes are related to the context in which discourse is produced, the actors involved and the function served by the text (Salager-Meyer, 1999). Bazerman's (1988) studies have indicated that as sciences have continued to evolve, so too have the language and rhetorical means by which they are primarily communicated. The evolution of the information structure of a society thus is reflected in the generic structure of the texts produced by that society at a given point in time (Halliday, 1978; Valle, 1991).

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Table 1
Moves and their discourse functions in medical RAs identified by Nwogu (1997).

Move	Discourse function
1. Presenting background information	Introduction section
2. Reviewing related research	
3. Presenting new research	
4. Describing data collection procedure	Methods section
5. Describing experimental procedure	
6. Describing data-analysis procedure	
7. Indicating consistent observations	Results section
8. Indicating non-consistent observations	
9. Highlighting overall research outcome	Discussion section
10. Explaining specific research outcomes	
11. Stating research conclusions	

The concept of genre, as defined by Swales (1990), indicates that the textural patterns are subject to change and evolution. Research articles (RAs) constitute the most important channel for the presentation of new knowledge in today's scientific arena (Hyland, 2000; Salager-Meyer, 2001; Swales, 1990). According to Ard (1983), this "prestigious genre", as Swales (2004, p. 217) calls it, originated from letters between scientists for information exchange, the first RA appearing with the birth of the first English-medium scientific journal: *The Philosophical Transactions of the Royal Society* of London in 1665.

Being a specific genre, the RA has its conventional structure. In ESP genre analysis of RAs, some researchers have concentrated on its structure (Brett, 1994; Holmes, 1997; Lim, 2006; Nwogu, 1997; Ozturk, 2007; Piqué, 2006; Posteguillo, 1999; Samraj, 2002; Swales, 1990; Williams, 1999; Yang & Allison, 2003, 2004), while others have focused more on some of its particular linguistic features, such as hedging (Crompton, 1997; Huangfu, 2005; Hyland, 1994, 1996, 1998; Salager-Meyer, 1994), modality (Huangfu, 2005; Salager-Meyer, 1992), voice (Matsuda, 2001; Matsuda & Tardy, 2007), verb tense (Liang, 2005; Malcolm, 1987; Salager-Meyer, 1992; Thompson & Ye, 1991) and first person pronoun (Hyland, 2001; Kuo, 1999; Liang, 2005; Salager-Meyer, 2001; Thetela, 1997).

In his study of the structure of medical RAs, Nwogu (1997) employed Swales' (1990) CARS model and examined the whole body of 15 medical RAs from five authoritative medical journals. He developed a schema of 11 moves (Table 1), eight of which (Moves 2, 3, 4, 5, 7, 9, 10 and 11) he described as "normally required" (also known as "obligatory") and three of which (Moves 1, 6 and 8) as "optional". The "obligatory" moves constitute the limits of a genre and give a pattern of communication its identity, without which a genre would lose its integrity, while the "optional" moves are available choices authors or speakers may choose to use. Each move embodies "constituent elements" or "sub-moves" (also known as steps) and is characterized by some distinct linguistic features.

As English is predominantly a tense language (Norman, 1988), many researchers (Heslot, 1982; Liang, 2005; Malcolm, 1987; Salager-Meyer, 1992; Zhang, 2004) have employed the ESP genre analysis or functional grammar approach in their studies on the use of tenses at move- or section-level, or in complete English medical RAs[1]. On the basis of her findings of the tense distribution in a corpus of RAs in the field of plant pathology, Heslot (1982) reported that the most frequently used verb tenses in RAs were the simple past tense, the simple present tense and the present perfect tense. In her study on English-medium medical RA abstracts, Salager-Meyer (1992) later reported a close relationship between the rhetorical function of each move and the choice of verb tenses.

Studies have also been conducted on the use of personal pronouns in written texts. Some researchers have dealt with this question from the point of politeness. Brown and Levinson (1987), for example, argued that the use of "we" including both speaker and hearer was identified with positive politeness. Along the same lines, relating the choice of personal pronouns to the intended creation of distance between the speaker and the receiver of the message, Kamio (2001) highlighted the gradation of closeness from "we" (highest closeness)

[1] By complete RAs, it is meant the body of the text, i.e. the plain text only, without abstracts, citations, figures, reference lists etc.

through "you" to "they". He considered that "they" was "psychologically very distant" both from the speaker's and the hearer's territory. Hyland (2001) attributed the use of self-mention by research article authors to their intention to be closely associated with their work or to mediate in the relationship between their arguments and their discourse communities. Kuo (1999) conducted an empirical study on the use of personal pronouns in 36 scientific journal articles from three journals in three scientific fields (computer science, electronic engineering, and physics) and found that the first person plural pronouns were used far more frequently than other types of personal pronouns.

If "the genres are living and the RA is continually evolving" as suggested by Swales (1990, p. 110), medical genres will also undergo some changes dictated by the outer and wider contexts surrounding the discipline. Although several researchers have reported structural and/or linguistic changes in certain sections of medical RAs (Atkinson, 1992; Ayers, 2008; Huangfu, 2005; Liang, 2005), no report, to our knowledge, has specially dealt with the structural or linguistic changes in complete medical RAs. The present study was thus designed to determine what are the structural and linguistic changes English-medium medical RAs in their entirety have undergone over time.

2. Methodology

2.1. Corpus compilation

2.1.1. Journal selection

On the basis of the three criteria set by Nwogu (1997) – representativity, reputation and accessibility – the five English medical journals included in Nwogu's (1997) study were used as the source journals for the present study. The five English medical journals were: *The New England Journal of Medicine* (J1), *The British Medical Journal* (J2), *The Journal of Clinical Investigation* (J3), *The Lancet* (J4) and *The Journal of the American Medical Association* (J5).

In terms of representativity and reputation, the five journals selected were all leading journals in the medical discipline, indexed in the SCI with an average impact factor (IF) above 20, according to the Journal Citation Reports (2004). The RAs published in these journals were fairly representative of the genre in content and style, i.e. in Bazerman's words, the texts were "situationally effective" (1994, p. 23) and the results of "expert performance" (p. 131). In terms of accessibility, these five journals were all accessible in either the Fourth Military Medical University Library or the Medical Library of the People's Liberation Army (PLA). If not, they could be retrieved online.

2.1.2. Selection criteria for the RAs

The inclusion criteria for the RAs to be selected were:

a. The selected RAs were all experimental research articles drawn from under the categories of "articles", "research articles", "original articles", "original contributions" or "papers" in the selected source journals.
b. The selected RAs all followed the IMRD framework, a widely accepted conventional structure of experimental RAs referring respectively to the four sections of Introduction, Methods, Results, and Discussion.
c. The selected RAs were written by native English speakers. Native speaker authors were distinguished from non-native speaker authors using Wood's (2001) "strict" criterion (not his less stringent "broad" criterion): first authors must have names "native to the country concerned" and also be affiliated with an institution in countries where English is spoken as the first language.
d. The selected RAs were complete RAs (as defined in Footnote 1), with a length ranging from 2500 to 4000 words.

2.1.3. Compilation of the two corpora

On the basis of the criteria specified above, we conducted a two-round random stratified sampling for choosing the medical RAs to be analyzed. In the first round, 250 criteria-meeting RAs published in the two

5-year periods (1985–1989; 2000–2004) were selected from the five journals, with five RAs each year/per journal. In the second round, one RA was randomly selected from the five RAs each year/per journal obtained in the first round. In total, 25 RAs published from the period of 1985–1989 compiled Corpus A and 25 RAs published from the period of 2000–2004 compiled Corpus B. The RAs chosen in Corpus A and Corpus B made up 68,516 and 78,570 running words, respectively.

2.2. Data collection and analysis

2.2.1. Analyzing the structure of RAs in the two corpora

After establishing the corpora, we proceeded to identify the moves in each RA in accordance with the five-step procedure suggested by Nwogu (1997). Following Swales' (1990) analytical framework of move analysis, we identified the textual boundaries between moves in each section by their content and linguistic criteria.

The frequencies of individual moves in each RA of the two corpora were recorded to determine whether a particular move occurred frequently enough to be considered "obligatory". In this regard, a cut-off frequency of 50% was established as a potential measure of move stability, as suggested by Nwogu (1997). Specifically, a move must occur in 50% of the RAs under study in each corpus before it was labeled an "obligatory" move. If the frequency of a move fell below 50%, it was considered "optional". Chi-square test or Mann–Whitney *U* test was employed to compare the move frequencies and recorded data in the two corpora. Alpha value was set at 0.05.

To minimize the risk of arbitrariness and to demarcate the boundary of units at a sufficiently high level of agreement, we invited a second rater to code a subset of 30 RAs from our corpora, 15 RAs from each corpus. The second rater was an MA graduate student whose research also dealt with genre analysis of medical RAs and she was thus quite familiar with the move identification system. After the coding of each RA was completed, both the second rater and the researcher went through the text for coding disagreements, if any. Differences in coding led to discussion, negotiation and clarification of the criteria used for coding assignments. Tests for intra-rater agreement were conducted by re-coding 20 randomly selected RAs from each corpus six months after the initial coding. The reliability index for both inter-rater and intra-rater agreement was over 90%.

2.2.2. Analyzing the linguistic features of the selected RAs in the two corpora

We conducted the verb tense analyses by manually recording and counting the frequency of occurrence of the verb tenses in each move of the 50 medical RAs under study. Modals were excluded, for modals belonged to the hedge category, according to Salager-Meyer (1992). The total occurrences of the three most frequently used tenses (viz. the simple past tense, the simple present tense and the present perfect tense) as reported by Heslot (1982) were recorded in each move of the RAs in the two corpora. The data recorded were normalized following Biber, Conrad and Reppen's (1998) methods to normalize frequency counts [(Raw frequency count/number of words in the text) $\times$ 1000 = normalized frequency count]. Chi-Square test with SPSS 13.0 software was applied to compare the normalized data. For the inter-corpus comparison of the overall frequency of occurrence of the three most frequently used verb tenses, Alpha value was set at 0.05. For the inter-corpus multi-comparison of the individual frequency of occurrence of each of the three most frequently used verb tenses, Alpha value was set at 0.0125.

We conducted the first person pronouns analyses by manually recording and counting the frequency of occurrence of the first person pronouns in each section of the 50 RAs following Kuo's (1999) method of quantitative frequency analysis. As the length of the RAs in Corpus A and Corpus B varied, we normalized the frequency of occurrence using Biber, Conrad and Reppen's formula as described above. Chi-Square test with SPSS 13.0 software was applied to compare the data recorded in each corpus. Alpha value was set at 0.05.

3. Results and discussion

3.1. Structural analysis of RAs in the two corpora

As Table 2 shows, no statistically significant differences were found in the frequency of occurrence of Moves 2, 3, 4, 5, 7, 10 and 11, when comparing our results from Corpus A and Corpus B with those obtained by

Nwogu (1997). According to our cut-off of a 50% occurrence rate, these seven moves can thus be defined as "obligatory". However, though no significant differences in the frequency of occurrence were found in Moves 1, 6, 8 and 9 between our results in Corpus A and Nwogu's findings, Chi-square test showed statistically significant differences between the frequency of occurrence of Move 1 (Corpus A 44% vs. Corpus B 96%; $\chi^2 = 16.095$, $p = 0.001$), Move 6 (Corpus A 40% vs. Corpus B 96%; $\chi^2 = 18.015$, $p = 0.001$), Move 8 (Corpus A 48% vs. Corpus B 16%; $\chi^2 = 5.882$, $p = 0.015$) and Move 9 (Corpus A 92% vs. Corpus B 44%; $\chi^2 = 13.235$, $p = 0.001$) recorded in Corpus A and that observed in Corpus B.

3.1.1. Move 1: Presenting background information

In our study, Move 1 was found to be present in 11 of the 25 RAs in Corpus A versus 24 of the 25 in Corpus B. The frequency of occurrence of this move in Corpus A (44%) is similar to that reported by Nwogu (46.7%) in 1997, while the data recorded in Corpus B (96%) corroborate the results reported by Liang (2005). In her study of the introduction section of medical RAs published in 2003–2004, she reported that Move 1 was present in 95% of the English RAs written by native English speaking writers and 100% of the English RAs written by Chinese medical writers.

Move 1 has obviously changed from an "optional" move in the 1985–1989 period to an "obligatory" move in the 2000–2004 period ($p = 0.001$). Move 1, as suggested by Nwogu (1997), provides background information explaining the topic of discourse either by presenting knowledge regarded as having been true for a long period of time or by highlighting the main research problems, or both. The change of this move from "optional" to "obligatory" clearly shows that today's medical writers tend to provide more background information so as to present a clearer picture of the topic of discourse for the editors as well as the readers. The "obligatory" use of this move has rhetorical usefulness in that it enhances the researchers' credibility by indicating that the reported research is based on a thorough knowledge of the subject under study, making their RAs more convincing and persuasive in the first place.

3.1.2. Move 6: Describing data-analysis procedure

The frequency of occurrence of Move 6 found in Corpus A (10/25, 40%) shows that it was an "optional" move in the 1985–1989 period while its significantly higher frequency of occurrence found in Corpus B (24/25, 96%) clearly indicates that Move 6 has changed to an "obligatory" move in the 2000–2004 period ($p = 0.001$). Another significant change concerning the use of Move 6 is the space devoted to the move. We found that the space devoted to Move 6 in Corpus A was usually small with only a few sentences, while a much larger space with longer sentences was assigned to this move in Corpus B. In Corpus A, the median of the word number in Move 6 was zero and the interquartile range was 26.5, with a mean and standard deviation of (21.8 ± 46.62). In Corpus B, the median of the word number in this move was 222 and the interquartile range was 132, with a

Table 2
Frequencies of occurrence of moves and percentages of their use in the medical RAs in the two corpora.

Moves	Nwogu's results $N = 15$ F (P%)	Corpus A $N = 25$ F (P%)	Corpus B $N = 25$ F (P%)
1. Presenting background information	7 (46.7)	11 (44)	24 (96)*
2. Reviewing related research	15 (100)	23 (92)	25 (100)
3. Presenting new research	15 (100)	25 (100)	25 (100)
4. Describing data collection procedure	15 (100)	25 (100)	25 (100)
5. Describing experimental procedure	15 (100)	25 (100)	25 (100)
6. Describing data-analysis procedure	9 (60)	10 (40)	24 (96)*
7. Indicating consistent observations	15 (100)	25 (100)	25 (100)
8. Indicating non-consistent observations	6 (40)	12 (48)	4 (16)*
9. Highlighting overall research outcome	15 (100)	23 (92)	11 (44)*
10. Explaining specific research outcomes	15 (100)	25 (100)	25 (100)
11. Stating research conclusions	14 (93.3)	23 (92)	25 (100)

Note: F: frequency *P*: percentage.
* $p < 0.05$ vs. Corpus A and Nwogu's results.

mean and standard deviation of (228.2 ± 167.8). Mann–Whitney *U* test showed a statistically significant difference in the length of this move between the two corpora ($p = 0.001$).

This change clearly evinces the fact that present-day medical RA writers are more aware of the importance of describing data-analysis procedures in reporting their research. This change is in line with Bazerman's (1988) statement that appropriateness of a research design can be indicated by referring to names of approaches and techniques to attract the interest of professional readers and to suggest that the methods employed are appropriate for the research design or are widely accepted. Moreover, the change to a more elaborate presentation of the data-analysis procedures may serve to strengthen the dependability (e.g. consistent, faithful, stable, unbiased.), accuracy (e.g. clearer, precise) and aptness (e.g., well-suited, appropriate, suited) of the findings to be reported subsequently in the Results section, to stifle potential criticisms, to avoid expected challenges to their research designs and to ward off possible doubts about both the results and their related interpretations. A more detailed description of the data-analysis procedures may also allow the readers to duplicate the experiment if such were desired to confirm, or refute the findings reported.

Another possible explanation for the much greater length of today's Move 6 can also be related to the growing complexity of the methods and statistics used in biomedical research (Lassen, 2006). Indeed, the newly developed and established analysis tools and procedures easily accessed in the medical field provide more source materials for the data-analysis procedures, and the justification for an explicit and validated procedure motivates and provides a foundation for making Move 6 an obligatory move of in-depth description of data-analysis procedures.

3.1.3. Move 8: Indicating non-consistent observations

Move 8 was found "optional" in RAs in both Corpus A (12/25, 48%) and Corpus B (4/25, 16%), but the difference in the frequency of occurrence between the two corpora was significant ($p = 0.015$). The occurrence of Move 8 in Corpus B was significantly lower than that in Corpus A. The four examples recorded in Corpus B are listed below:

1. Analyses of other hormone dependent cancers such as uterine or ovarian cancer did not reveal a significant inverse association, but statistical power was limited (data not shown).
2. We observed no interactions between Lp(a) lipoprotein and other particles.
3. There were no significant differences in kidney AT_{1A} receptor or liver antiotensinogen mRNA levels between any of the study group.
4. There was no significant difference between primary PTCA and streptokinase therapy for total stroke ($p = 0.078$) and haemorrhagic stroke ($p = 1.0$; Table 3).

As is well-known, Move 8 usually presents non-consistent or negative results which do not conform to the expected outcomes. Concerning this move, the results (12/25, 48%) recorded in Corpus A are more consistent with Nwogu's results (6/15, 40%). Nwogu defined Move 8 as a highly "flexible" move and he ascribed the low-level occurrence of this move to the fact that research articles did not always reflect all results in the research, but only those which the researchers considered important and necessary for their purposes (Knorr-Cetina, 1981). However, the perceptibly lower frequency of this move in Corpus B strongly suggests that present-day medical RA writers tend to avoid using Move 8. One reason for this avoidance may be the common belief that a paper with negative results is more difficult to get accepted for publication. Some medical RA writers tend to believe that reporting only positive consistent results may help to have their papers accepted.

3.1.4. Move 9: Highlighting overall research outcome

Move 9 was found in 23 of the 25 RAs in Corpus A, but only in 11 out of the 25 RAs in Corpus B ($p = 0.001$). The lower frequency of occurrence in Corpus B indicates that Move 9 has changed from an "obligatory" move to an "optional" one.

Our findings concerning Move 9 in Corpus A (23/25, 92%) corroborate those reported by Nwogu (15/15, 100%), and our results from Corpus B (11/25, 44%) are more consistent with Huangfu's (2005) comparative study of medical RAs published in 2003–2004. Huangfu reported that Move 9 was the move of the lowest frequency of occurrence in the two corpora she studied, with only two out of the 20 medical RAs written by

native English speaking authors and none in the 50 medical RAs written by Chinese authors. The lower occurrence of Move 9 observed in Corpus B clearly shows that some present-day medical RA writers have omitted Move 9.

Move 9 (*highlighting overall research outcome*), as defined by Nwogu (1997), represents the first segment of information in the Discussion section and often corresponds with the information in the first paragraph of the Discussion section. The main function of Move 9, a short move usually with one complex sentence presenting the overall research result, is to confirm or refute the attainment of the main research objective. Piqué and Andreu-Besó (2000) studied 10 health science RAs published in 1980s and 1990s and as regarding Move 9, they found some difference between their observations and Nwogu's findings. They reported that Move 9 was only present in some of the RAs in their study and they ascribed the discrepancy to a more restrictive interpretation of the move label. Moreover, the lower frequency of occurrence of Move 9 in Corpus B may be explained by the fact that present-day medical RA writers tend to adopt a more direct approach to presenting their research results. Instead of highlighting overall research outcome, they prefer to begin their discussion by directly explaining specific outcomes. The infrequent or rare use of Move 9 may also indicate that more present-day medical writers may prefer to use induction rather than deduction to develop their discussion. By applying the inductive method, writers may first state the specific findings and then derive some principles from these particular findings (inducing the overall outcome), thus unfolding their discussion in a way they might think more logical and convincing.

3.2. Linguistic features analysis

3.2.1. Verb tense

A total of seven verb tenses were found used in our selected RAs in the two corpora and their occurrence frequencies and distributions are presented in Table 3. Of the seven verb tenses, the simple past tense was the most frequently used verb tense in both Corpus A (65.72%) and Corpus B (66.12%), followed by the simple present tense (Corpus A, 24.79%; Corpus B 25.71%) and the present perfect tense (Corpus A, 7.37%; Corpus B, 5.46%). Our findings of the three most frequently used verb tenses in medical RAs are in agreement with Heslot's (1982) in her corpus of RAs in plant pathology.

Despite the non-significant inter-corpus difference in the cumulative percentages of the three most frequently used verb tenses (Corpus A, 97.88% vs. Corpus B, 97.29%, $\chi^2 = 0.025$, $p = 0.857$), Chi-square test showed inter-corpus statistical difference in the overall frequency of occurrence of the three verb tenses in Move 3 ($\chi^2 = 31.47$, $p = 0.001$), Move 7 ($\chi^2 = 6.28$, $p = 0.042$) and Move 10 ($\chi^2 = 13.92$, $p = 0.001$). The results of our analyses of the individual frequency of occurrence of the three verb tenses in the 11 moves in both Corpus A and Corpus B are listed in Table 4.

In Move 3, a sharp increase in the use of the simple past tense (Corpus A 37.11% vs. Corpus B 75.58%; $\chi^2 = 27.276$, $p = 0.001$) and a significant drop in the use of the present perfect tense (Corpus A 26.81% vs. Corpus B 3.49%; $\chi^2 = 18.582$, $p = 0.001$) were observed in Corpus B compared with those in Corpus A. The relatively high frequency of occurrence of the present perfect tense (26.81%) in Move 3 of Corpus A further

Table 3
Frequencies of occurrence and distributions of tenses in the medical RAs in the two corpora.

Tenses	Corpus A		Corpus B	
	F	*P* (%)	*F*	*P* (%)
The simple past	1649	65.72	1854	66.12
The simple present	622	24.79	721	25.71
The present perfect	185	7.37	153	5.46
The past perfect	24	0.96	35	1.25
The simple future	16	0.64	30	1.07
The past progressive	8	0.32	4	0.14
The present progressive	5	0.20	7	0.25
Total	2509	100	2804	100

Note: F: frequency *P*: percentage.

Table 4
Normalized individual frequency of occurrence of the three most frequently used verb tenses in each move of the medical RAs in the two corpora.

Moves	Corpus A						Corpus B					
	Past		Present		Pr. Pf		Past		Present		Pr. Pf	
	F	%	*F*	%	*F*	%	*F*	%	*F*	%	*F*	%
Move 1	42	22.83	108	58.69	34	18.48	32	18.60	108	62.80	32	18.60
Move 2	48	31.17	61	39.61	45	29.22	36	25.53	67	47.52	38	26.95
Move 3	36	37.11	35	36.08	26	26.81	65	75.58[a]	18	20.93	3	3.49[b]
Move 4	328	88.65	29	7.84	13	3.51	298	86.88	36	10.50	9	2.62
Move 5	629	91.55	48	6.99	10	1.46	575	92.59	42	6.76	4	0.65
Move 6	152	92.68	12	7.32	0	0	218	96.46	8	3.54	0	0
Move 7	733	83.11	140	15.87	9	1.02	729	86.27	102	12.07	14	1.66
Move 8	53	98.15	1	1.85	0	0	9	100	0	0	0	0
Move 9	9	21.95	28	68.29	4	9.76	6	30.00	11	55.00	3	15.00
Move 10	374	42.60	377	42.94	127	14.46	391	40.77	476	49.64[c]	92	9.59[d]
Move 11	3	4.11	69	94.52	1	1.37	1	1.92	50	96.16	1	1.92
Total	2407	67.16	908	25.33	269	7.51	2360	67.94	918	26.42	196	5.64

Note. Normalized numbers of the three most frequently used verb tenses in each move of the two corpora per 100,000 words in Corpus A (1985–1989) and Corpus B (2000–2004). Present: simple present tense; Past: simple past tense; Pr. Pf: present perfect tense; and *F*: frequency.
[a,b,c,d] In Corpus B $P < 0.05$ vs. respectively Past; Pr. Pf; Present; Pr. Pf in Corpus A.

substantiates Nwogu's (1997) findings from his study of RAs published in the 1985–1987 period, in which the present perfect tense was found to be one of the distinct linguistic characteristics of Move 3. But the predominantly high frequency of occurrence of the past tense (75.58%) in Move 3 of Corpus B resonates with Liang's (2005) study of the medical RAs published in 2003–2004 period. Liang reported that the most frequently used tense in Move 3 was the simple past tense (68.79% in the English medical RAs written by Chinese medical writers and 73.86% in the English medical RAs written by native English speaking medical writers). In Move 7, though no significant inter-corpus difference was found in the individual frequency of occurrence of the three verb tenses, the respective frequency of occurrence of the three verb tenses has slightly changed. Compared respectively with the corresponding frequency of occurrence of the three verb tenses in Corpus A, the frequency of occurrence of the simple present tense in Corpus B decreased by 3.80%, while the frequency of occurrence of the simple past tense and the present perfect tense in Corpus B increased respectively by 3.16% and 0.64%. In Move 10, the simple present tense significantly increased in Corpus B (Corpus A 42.94% vs. Corpus B 49.64%; $\chi^2 = 8.264$, $p = 0.004$) while the present perfect tense significantly decreased (Corpus A 14.46% vs. Corpus B 9.59%; $\chi^2 = 10.359$, $p = 0.001$) compared with those in Corpus A.

Salager-Meyer (1992) has stated that there is a close relationship between the rhetorical function of each move and the use of verb tenses in medical abstracts and we share her view and presume that the changes of the frequency of occurrence of the three most frequently used verb tenses in these moves may be related to the basic functions of each tense and the attitude changes of medical RA writers.

Scientific English has certain conventions or rules that are supposed to be adhered to. The simple past tense is used to refer to specific events, actions or processes occurring during an experimental study (Malcolm, 1987) or to report the authors' own research actions and findings (Burrough-Boenisch, 2003). Move 3, consisting of the Step of reference to research purpose and/or the Step of reference to main research procedure, was defined by Nwogu (1997) as presenting new research. Our findings from Corpus B that more present-day medical RA writers prefer to use the past tense rather than the present tense or the present perfect tense in presenting new research could be attributed to (a) a rigid adherence to the verb tense convention that research purpose should be described in the past tense in scientific English writing (Weissberg & Buker, 1990) or (b) a rhetorical or strategic choice rather than an obligatory constraint. It could be speculated that present-day medical writers know that the present tense provides a greater immediacy and certainty to science and the present perfect tense signals generality to science, but using these tenses would be at the expense of "humbleness". Science is a collection of hypotheses and it is not a field of certainty. The

higher frequency of the past tense in presenting new research may mirror the attitude changes of some medical RA writers.

The simple present tense, with its main function of enhancing and emphasizing the generality of specific findings or reference to established knowledge as unarguable by the scientific community (Salager-Meyer, 1992), matches well with the rhetorical function of Move 10 of interpreting specific research outcomes. The significantly increased use of the simple present in Move 10 in Corpus B may indicate that present-day medical RA writers are more aware of the importance of enhancing and emphasizing the generality of their findings in reporting and interpreting their own results. Their choice of using the simple present tense may send the signal to the readers as well as editors that their results have a broad applicability, thus making their results and discussions more convincing.

The attitude changes of some medical RA writers are also reflected in the significantly decreased use of the present perfect tense in both Move 3 and Move 10. Rather than using the present perfect tense to emphasize the relevance of their own study and to enhance its generality (Heslot, 1985; Lackstrom, 1978; Vazquez, 1987) in Move 3, present-day medical writers, in signaling the distinction of their research, would rather choose the simple past tense to occupy the niche. In Move 10, the significantly decreased present perfect tense may indicate that instead of using the present perfect tense to report past literature, emphasizing a certain degree of disagreement with previous research findings (Salager-Meyer, 1992), more present-day medical writers are now favoring simple present tense in discussing their results. They are using the present tense in discussion to quote established knowledge (Day, 1995) and to signal the universal (that a statement is irrefutable) (Burrough-Boenisch, 2003).

3.2.2. First person pronouns

No singular first person pronouns were found in the RAs in our corpora, which is consistent with Kuo's (1999) report that the first person singular pronoun "I" and its other cases did not occur in his corpus of scientific research articles.

Table 5 shows that a total of 252 plural forms of the first person pronoun and its related cases were found in Corpus A, with an average of 3.68 words per 1000 words, and 482 were found in Corpus B, with an average of 6.13 words per 1000 words. The total number of occurrences of the plural first person pronoun and its related cases in Corpus B was significantly higher than that in Corpus A ($\chi^2 = 0.259$, $p = 0.001$). Except for the Introduction section, inter-corpus statistical differences of the frequency of occurrence were found in all the other three sections – Methods, Results, and Discussion ($\chi^2 = 60.446$, $p = 0.001$; $\chi^2 = 11.525$, $p = 0.001$; $\chi^2 = 35.282$, $p = 0.001$). The highest frequency in both corpora was in the Discussion section.

The high frequency of occurrence of the plural form of the first person pronoun in both Corpus A and Corpus B is a predictable result of the continuous increase reported by many researchers in the number of coauthored papers in many scientific disciplines (Cronin, 2005; Cronin, Shaw, & La Barre, 2003, 2004; Wagner & Leyesdorff, 2005). Weeks, Wallace, and Surott-Kimberly (2004) carried out an examination of changes in authorship patterns in a number of prestigious US medical journals. They reported that from the year 1980 to 2000, the number of authors per article in the medical journals in their study increased dramatically over time and that manuscripts published by single authors all but vanished. In addition to the increased

Table 5
Frequencies of occurrence of plural first person pronouns in each section of the medical RAs in the two corpora.

Sections	Corpus A				Corpus B			
	We	Us	Our	Total[1]	We	Us	Our	Total[2]
Introduction	35	1	1	37	33	0	6	39
Methods	38	0	3	41	119	0	22	141*
Results	35	0	2	37	53	1	7	61*
Discussion	88	1	48	137	118	4	119	241*
Total	196	2	54	252	323	5	154	482*
‰	2.86	0.03	0.79	3.68	4.11	0.06	1.96	6.13*

Note: ‰: the average number of plural first person pronouns per 1000 words in Corpus A (1985–1989) and Corpus B (2000–2004).
* $p < 0.05$ vs. Total[1].

number of co-authored papers, one possible explanation for the significantly higher frequency of plural first person pronouns in Corpus B may be that present-day contributors are using the active voice more and the passive voice less in writing their academic papers. Indeed, some academic writing manuals now explicitly advise their contributors to use the active voice whenever possible in place of the passive voice (Day, 1998; Goodman & Edwards, 1997; O'Connor, 1991). The syntactic requirement of the agent performing the action in the active voice should have pointedly increased the frequency of occurrence of the plural first person pronoun "we" (a good example is the Method section). Moreover, the discourse function of personal pronoun in scientific RAs may also contribute to this significantly higher frequency of occurrence of plural first person pronouns in present-day medical RAs. Among other things, the use of the plural first person pronoun may increase the sense of reliability of the RAs because more than one person, as indicated by the plural form first person pronoun "we", have endorsed the accuracy, quality and meaning of the results (Beaver, 2001; Thagard, 1997). Kuo (1999) also reported that the plural form of the first person pronouns may perform a wide variety of discourse functions linked with different semantic references in journal articles. The plural form of the first person pronoun can be used to refer not only to writers and their communicative roles, but also to both writers and readers and the discipline as a whole. The higher occurrence of plural first person pronouns in medical RAs in Corpus B may suggest that present-day medical RA writers, in reporting their research, tend to emphasize their role in the research or to highlight their unique contribution. The significantly higher frequency of occurrences of the plural form of the first person pronoun in medical RAs in Corpus B may also be a sign of present-day medical RA writers' awareness of mediation in the relationship between their arguments and their discourse communities. The use of plural first person pronouns may help shorten the distance between researchers and readers and stress solidarity with readers.

4. Conclusion

Our research results show that genre has an evolutionary nature and medical RAs have undergone some significant structural and linguistic changes over the past two decades. Indeed, Berkenkotter and Huckin (1995) suggest that genre knowledge refers to the repertoires of "situationally appropriate responses to recurrent situations" (p. ix). Genres are capable of modification over time in response to socio-cognitive needs of the users and genres will change with the modification of the discourse community and its members' perceptions of the world. The status change from "obligatory" to "optional" or vice versa in some moves as against the status defined by Nwogu (1997) and the change of the frequency of occurrence of some verb tenses and personal pronouns have presented some tangible evidence for this genre evolution. Technological advancements in the field of medical science, coupled with the attitude changes of the discourse community (medical RA writers in our case), appear to have contributed to the evolution of medical RAs.

The findings of this study may help medical RA writers better understand the changes or development of medical RAs, both structurally and linguistically. Awareness of present-day set patterns of "obligatory" or "optional" moves and linguistic features in medical RAs may help medical writers to produce English-medium medical RAs more likely to be accepted by international English medical journals. We hope that this study may contribute to our understanding of genre conventions in academic teaching and writing, especially in English for medical purposes teaching and writing.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.esp.2008.12.004.

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