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The Medical Research Paper: Structure and Functions

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Abstract—Studies into the organization of information in the medical research paper have tended to present accounts of the structure of information in sections in isolation. The structure of information in all sections of the medical research paper was investigated using Swales' (1981, 1990) genre-analysis model. An eleven-move schema was identified, out of which nine were found to be "normally required" and two "optional". Each schema was found to embody "constituent elements" and to be characterized by distinct linguistic features. The study provides insights into the nature of discourse organization in this genre of written discourse. © 1997 The American University. Published by Elsevier Science Ltd

Introduction

As with most experimental research reports, the medical research paper is a highly technical form with a standard format for the presentation of information. This format is the division of the paper into "Introduction, Methods, Results and Discussion" — the traditional IMRD sections of the research paper.

Most research article writers are familiar with the IMRD format, but not all are conscious of the fact that there exists an internal ordering of the information presented in the various sections of the research article. This lack of awareness may account partly for the difficulty which most writers, especially new entrants into the academic discourse community face with producing clear, coherent and logically organized research reports.

A number of studies have shown that medical professionals have difficulties with writing experimental research reports. Citing McPhill (1911), Adams-Smith (1983) argues that the phenomenon of bad writing amongst medical practitioners is a long-standing one. She observed instances of bad writing among medical professionals involving the excessive use of jargon, careless phrasing, poor flow of ideas, verbose and even pompous writing style. Hemminki (1982) found that most clinical trial reports by medical

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professionals are either uncontrolled or poorly controlled. That is, that they tend to be poorly organized or structured. Hibberd and Meadows (1980) also observed that the information contained in major medical journals is generally not well reported in the article summary, including dosage and duration of therapy.

Studies into features of written medical discourse have tended to focus almost exclusively on the syntactic features of text (see Pettinari 1982; Dubois 1981; Malcolm 1987; Salager 1986; Adams-Smith 1983). Only a few studies (e.g. Bruce 1983; Adams-Smith 1984, 1987; Gosden 1992, 1993; Skelton, 1994) have attempted any form of detailed investigation into the organization of information into medical research reports.

This study is an attempt to account for the schematic structure of information in the medical research paper using Swales' (1981, 1990) genre-analysis model. Although based on Swales' model, this study represents an application of the model beyond Swales' article introduction to the whole body of the research article. Except perhaps for Skelton (1994) who examined the structure of original research papers and Gosden (1992, 1993) who examined the discourse functions of theme in the scientific research article, most genre-based investigations into the research article have focused on isolated sections (e.g. Swales 1981; Cooper 1985; Hopkins 1985; Crookes 1986 for the article introduction; Belanger 1982; Peng 1987; Hopkins & Dudley-Evans 1988 for the discussion section).

Similarities exist between this study and that reported by Skelton (1994). For instance, both studies characterize the structure of information in medical research papers and both adopt a genre-analysis approach to their descriptions. However, despite these similarities, both studies differ fundamentally in focus and consequently in aspects of methodology. Skelton's study is intended for a non-specialist audience — general medical practitioners. This in itself limits the extent of the linguistic analysis that is provided to support observations and claims made in the paper. This paper, on the other hand, is written for specialists in the field of linguistics. Therefore, it describes moves with greater linguistic depth and rigour than Skelton's. In addition, Skelton in his account does not characterize the sub-moves which constitute a move as has been done in this study.

Therefore, while a few studies have attempted a description of the structure of the research article, none has attempted detailed linguistic description of that structure as reported in this paper.

The Methodological Framework

The Analytical Model

The theoretical framework for the study is Swales' (1981, 1990) genre-analysis model which draws insights from schema-theory models such as those developed by Rumelhart (1975, 1980), Rumelhart and Ortony (1977) and Rumelhart and Norman (1987). Schema theory concepts have been

found to be most useful for accounting for the structure of technical texts (Huckin & Olsen 1984). In a revised version of his 1981 seminal work on genre-analysis, Swales (1990: 141) posits a three-move schema for article introductions, as shown below:

MOVE 1:	ESTABLISHING A TERRITORY
Step 1	Claiming Centrality and/or
Step 2	Making topic generalization and/or
Step 3	Reviewing items of previous research
MOVE 2:	ESTABLISHING A NICHE
Step 1A	Counter-claiming or
Step 1B	Indicating a gap or
Step 1C	Question-Raising or
MOVE 3:	OCCUPYING THE NICHE
Step 1A	Outlining purposes or
Step 1B	Announcing present research
Step 2	Announcing principal findings
Step 3	Indicating RA structure.

Swales' (1981, 1990) model has been validated and extensively applied to different texts by among others Crookes (1986), Dudley-Evans (1986), Hopkins (1985), Nwogu (1991) and Pindi (1988).

The Corpus

A preliminary analysis was carried out on an initial corpus of thirty texts selected from five refereed medical journals — The Lancet, the British Medical Journal (BMJ), The New England Journal of Medicine (NEJM), The Journal of Clinical Investigation (JcL Inv) and The Journal of the American Medical Association (JAMA) — to determine the extent of discourse patterning in them. The major issues which guided the identification of sources from which texts in the corpus are based are representativity, reputation and accessibility. In other words, the sources and texts were systematically chosen to ensure a representative sample of the language of members of the medical profession. To this end, a conscious effort was made to ensure that the texts were written by members of the medical profession, most of whom are native speakers of English. Reputation refers to the esteem which members of an assumed readership hold for a particular publication or group of publications. Although no attempt was made to measure this variable, the journals from which texts in the corpus were selected are no doubt some of the most reputable in the field of medicine as they were recommended by medical practitioners at the University of Birmingham Medical School. Accessibility here refers to the ease with which texts which constitute the corpus can be obtained. It does not refer to the extent of knowledge which one has about the content of discourse in the texts analysed. The latter form of accessibility, which has been the subject of much controversy in ESP-related research, led Selinker (1979), Huckin and Olsen (1984), Bley-

Vromen and Selinker (1984) to propose the idea of the use of a subject specialist informant in ESP-related analysis of discourse. But, as Swales (1987: 125) points out, the use of a specialist informant on a formal scale could be time-consuming and could create uncertainties and difficulties in comparing texts from different genres. Therefore, in place of a subject specialist informant, informal discussions were held with medical practitioners at the Birmingham University Medical School on the fundamental principles underlying some of the medical topics contained in the texts.

After the preliminary analysis carried out on the thirty initial texts, fifteen were randomly selected for detailed analysis. They were constituted as follows: The Lancet (7), The BMJ (1), The NEJM (5), JAMA (1), JcL Inv (1). To qualify for selection, all papers had to have the traditional IMRD (Introduction, Methods, Results, Discussion) sections of the research article.

The Identification of Schematic Units or Moves

Texts in the corpus were analysed into hierarchical schematic structures or Moves. The term Move means a text segment made up of a bundle of linguistic features (lexical meaning, propositional meanings, illocutionary forces, etc.) which give the segment a uniform orientation and signal the content of discourse in it. Each Move is taken to embody a number of constituent elements or slots which combine in identifiable ways to constitute information in the Move. Moves and their constituent elements were determined partly by inferencing from context, but also by reference to linguistic clues in the discourse, such as:

(a) Explicit prefacing or preparatory expression or statements which signal information from content occurring later in the text;

> e.g. The major aim of this trial — to show whether injection of paternal cells produced as a result significantly better than the control placebo effect over the known placebo effect in this condition — has been achieved. (The Lancet, April 17, 1985)

In the text above, the expression, "the major aim of this trial" is acting as a prefacing or preparatory statement which indicates the direction of discourse in that segment of text.

(b) Explicit lexical items which signal explicitly the information contained in each move;

> e.g. The methods used to collect data on patients with cervical and prostate cancer were identical with those reported in our retrospective study of colonic and rectal tumours. (British Medical Journal, 30 August, 1986)

This is the first sentence in the "Patients and Methods" section of the research article cited above. The lexical items "methods", "collect" and

"data" provide clues which suggest that the segment of text is presenting information on methods of data collection.

(c) Discourse conjuncts are cohesive devices which function or relate linguistic items which occur in succession but are not related by other structural means to each other in discourse. They are signals of discourse relations in text;

> e.g. Several features of the outbreak are of importance. First, there is no evidence after $4\frac{1}{2}$ years that the outbreak is waning. In Norway, over an 11 year period from 1974 to 1984, the average annual ...
> Secondly, the age distribution of cases is unusual by comparison with recent national data (figure 2). Meningococcal disease usually affects children under the age of 5 years, a reflection of the low antibody levels in this age group.
> Thirdly, throat-swabbing revealed a very low carriage rate of B.15R meningococci in symptomless contacts ...
> (The Lancet, 6 September, 1986)

This is from the Discussion section of the research article in the Lancet cited above. The discourse conjuncts, "first", "secondly", "thirdly" signal that a uniformity of orientation exists between the various paragraphs in the text. They also indicate a sequence in the relationship existing between all three paragraphs.

(d) Summary statements are statements or expressions which signal the end of a Move or the beginning of a concluding Move usually by the paraphrasing of information already presented in an existing Move or by means of an explicit concluding phrase;

> e.g. In summary, this study provides the first demonstration of kininogenase activity and elevated amounts of kinin in BAL fluid asthmatic subjects. The predominant kininogenase possessed the structural, functional, and antigenic characteristics of a tissue Killikrein.
> (Journal of Clinical Investigation, January 1987)

The text above is the last paragraph in the article from which it is extracted. The phrase "In summary" signals that the function of the segment is to present the research conclusion.

The process of identification of schematic structures involved the following procedures:

1. Focusing on the propositions in the texts and identifying important information.
2. Searching for linguistic clues such as function words, explicit lexemes and expressions, verb forms, discourse conjuncts and markers, structural headings and subheadings, summary statements, etc.
3. Classifying and paraphrasing the context of discourse based on the linguistic clues.

4. Assigning discourse functions to the overall information in segments of text as well as constituent elements of information in the segments.
5. Establishing whether or not the function identified is a general one by reference to other texts in the corpus.

A text segment is therefore considered a move if there is an association between a function and the linguistic clues by which it is realized. In addition, the function must have occurred with about 50% regularity in the corpus to be considered a stable move.

Results and Discussion

The Ordering of Moves and Their Constituent Elements

The analysis of texts in the corpus reveals that in a typical medical research paper, the author(s) is likely to:

1. Begin by providing some background details about the subject matter of the research investigation.
2. Conduct a brief review of previous studies.
3. Introduce the new research and state research objectives.
4. Identify the source of data and the method adopted in collecting them.
5. Discuss the methods adopted in the analysis of data.
6. Discuss the statistical procedures adopted in the analysis of data, if any.
7. Discuss results which are consistent with the objectives of the study.
8. Discuss results which deviate from expected outcomes.
9. Discuss the main results and their significance.
10. Explain and justify results and approaches adopted in achieving them.
11. Provide a conclusion and indicate implications of the research.

Each of these statements represents an identifiable segment of information which is capable of being transformed into a schematic Unit or Move and assigned a functional label as shown in Table 1, below:

These eleven moves were found to occur with varying degrees of regularity in the texts examined (see Table 2).

As can be seen in Table 2, seven of the moves (2, 3, 4, 5, 7, 9, 10) were found to occur in all the fifteen texts in the corpus. Move 11 occurred in all but one text. These moves were accordingly classified as "normally required moves". On the other hand, Moves 1, 6 and 8 which were found to occur less frequently in texts in the corpus werè classified as "optional moves".

Each of the eleven moves identified in the corpus was found to contain a number of "constituent elements" or sub-moves.

The Description of Moves and Their Constituent Elements

Move 1, Presenting Background Information, is an initiation move. It provides background information which explains the topic of discourse,

TABLE 1
Moves and Their Discourse Functions

Move	Discourse function	
1:	Presenting Background Information ⎫	
2:	Reviewing Related Research ⎬	The Introduction Section
3:	Presenting New Research ⎭	
4:	Describing Data Collection Procedure ⎫	
5:	Describing Experimental Procedure ⎬	The Methods Section
6:	Describing Data-Analysis Procedure ⎭	
7:	Indicating Consistent Observations ⎫	The Results Section
8:	Indicating Non-Consistent Observations ⎭	
9:	Highlighting Overall Research Outcome ⎫	
10:	Explaining Specific Research Outcomes ⎬	The Discussion Section
11:	Stating Research Conclusions ⎭	

TABLE 2
The Distribution of Moves Per Text

Text	Move 1	Move 2	Move 3	Move 4	Move 5	Move 6	Move 7	Move 8	Move 9	Move 10	Move 11	Total
1	−	+	+	+	+	+	+	−	+	+	+	9
2	−	+	+	+	+	+	+	−	+	+	−	8
3	+	+	+	+	+	+	+	+	+	+	+	11
4	+	+	+	+	+	−	+	−	+	+	+	9
5	+	+	+	+	+	+	+	−	+	+	+	10
6	−	+	+	+	+	+	+	−	+	+	+	9
7	+	+	+	+	+	−	+	+	+	+	+	10
8	+	+	+	+	+	+	+	−	+	+	+	10
9	+	+	+	+	+	−	+	+	+	+	+	10
10	−	+	+	+	+	−	+	−	+	+	+	8
11	−	+	+	+	+	−	+	−	+	+	+	8
12	−	+	+	+	+	+	+	+	+	+	+	10
13	−	+	+	+	+	+	+	−	+	+	+	9
14	−	+	+	+	+	−	+	+	+	+	+	9
15	+	+	+	+	+	+	+	+	+	+	+	11
Total	7	15	15	15	15	9	15	6	15	15	14	

either by presenting knowledge which is regarded as having been true for a long period of time or by highlighting the main research problem or both. The information contained in Move 1 can be persuasive (Swales 1981). It could also be anecdotal and didactic, presenting sequential account of events. An example of a typical Move 1 sentence which makes reference to established knowledge is:

> Pregnancy-Induced hypertension (PIH) and pre-eclamsia appear to be associated with increased production of Thromboxans A2-(TXA2), a potent vasoconstrictor and simulator of platelet aggregation, by the placenta and by platelets. (The Lancet, 4 January 1986)

An example of a Move 1 text which is anecdotal is:

> Since 1940 when there were over 12,000 notifications in England and Wales, Meningococcal disease has been much less common. Following the last peak in 1974 (1296 notifications), the annual number of notifications declined steadily until 1984, when 401 cases were notified. In 1985, 549 cases were notified and the rise has continued into the first quarter of 1986. (The Lancet, 6 September 1986)

An example of a Move 1 text which can be said to be performing a didactic function is:

> Recurrent spontaneous abortion has been treated by means of immunization with paternal cells and cells from multiple unrelated donors. Organ allograft rejection is diminished by previous immunization with blood transfusion and
> ...

Thus, a characteristic feature of Move 1 is the predominant use of present tense verb forms, as in the text above. Move 1 is also characterized by the use of locative and temporal adverbials as sentence elements in preparatory expressions and statements. Gosden (1992, 1993) recognizes this as a distinctive feature of research articles and contends that they play a pivotal role in the organization and dynamic development of discourse in RAS. Similarly Brandt (1986: 98) comments that such linguistic features provide the reader with an interpretative framework for the rest of the sentence;

> e.g. (i) <u>In England and Wales</u>, death rates during the past hundred years have been consistently higher in the North and West of the Country than in the South-East.
> (ii) <u>Since 1940</u>, when there were over 12,000 notifications in England and Wales, meningococcal disease has been much less common.

The temporal and locative adverbials are scene-setting linguistic features functioning to signal the commencement of information acting as background to the discourse in the rest of the sentence.

Move 2, Reviewing Related Research, contributes to the development of discourse in the experimental research paper by providing information against which the research being reported can be evaluated. It does this by placing the new research within the context of on-going research in the field. The aim is to indicate that the research derives from a lively tradition of established works in the field, some of which have left gaps in understanding.

Therefore, Move 2 contains two units of information, thus:

1. Reference to previous research
2. Reference to limitations of previous research.

The first unit of information — reference to previous research — is realized in one or more of the following ways:

(a) Identification of author(s), by placing author's name in subject position;

e.g. Thus, <u>Pike *et al.* reported</u> that women who used OCS with high pro-
gestagen "potency" for more than 4 years before age 25 were over four times
more likely to have breast cancer before age 37 than women who did not use
these contraceptives before age 25.

(b) Identification of researchers; by the use of common nouns;

e.g. <u>These investigators</u> demonstrated that nasal installation of allergen to
atopic individuals elevated the concentration of kinins in lavage fluid, cor-
relating with symptoms, P-tosyl-l-arginine methyl ester (TAME) estrae
activity, and histamine release.

(c) Generalized reference to previous research;   .

e.g. <u>A growing body of data</u> shows that blood transfusions have immunological
effects on patients and experimental animals beyond those of allo-
immunisation to blood cell antigens.

(d) Reference to the outcomes of research investigations:

e.g. <u>The findings</u> supporting this conclusion come from more than two score
prospective epidemiologic studies in many countries throughout the world
. . .

The second unit of information — reference to limitation of previous
research — is realized in either of the following ways:

(a) By negative evaluation of previous research;

e.g. Some studies <u>have failed to find</u> such associations or <u>have found small
differences</u> that are not significant.

(b) By indicating a gap in previous research;

e.g. However, <u>the possible prevention of PIH and pre-eclamsia</u> in pri-
migravidae by suppression of platelet TXA2 production with low dose aspirin
<u>has not been investigated</u>.

From the illustrations above, it can be seen that Move 2 is characterized by
five main linguistic features which signal the information contained in it.

1. The use of simple past test verb forms to refer to a single research
    event; e.g. Thus, Pike *et al.* reported that ...
2. Use of present perfect tense form to refer to more than one research
    event.
3. Use of present tense forms to refer to more than one previous research
    event whose results have implications for the new research.
4. Use of adversative adverbial conjuncts; e.g. <u>However</u>, the possible
    prevention of ...

5. Use of negative forms; e.g. However, the possible prevention of ... <u>have not been</u> investigated.

Move 3, Presenting New Research, functions primarily to introduce the new research, mainly by stating research purpose. In addition to stating research purpose, the move may also present information which indicates the primary methods of investigation adopted in the study. In some cases, reference may also be made to the sample data on which the study is based. However, the dominant "constituent element" in Move 3 is "reference to research purpose". This dominant element is characterized by the following linguistic features:

(a) By the use of present simple tense forms;

> e.g. (i) <u>The present report describes</u> the extension of those studies to phar-
>   yngeal epithelia which may be directly exposed to ...
> (ii) <u>In this study we describe</u> a degeneration of rational ganglion cells and
>   of optic nerves ...

(b) By means of present perfect tense form;

> e.g. <u>We have now investigated</u> the relation between OC use and risk of breast
> cancer in women under 45 by analysing data from ...

(c) By the use of explicit lexemes;

> e.g. (i) The <u>objective</u> of the current investigation was to determine in a popu-
>   lation-based study ...
> (ii) We <u>wanted to find out</u> whether the success was truly immunological
>   or a placebo effect ...

Move 4, Describing Data-Collection Procedure, represents the first move in the "Methods" section of the research paper. As its functional label clearly suggests, Move 4 is concerned with a discussion of all aspects of the process of data identification, selection and delimitation. Therefore, information in Move 4 is typically expressed via one or more of the following "constituent elements".

(a) Indicating source of data;

> e.g. HB.5 (1g G2a) and anti-B2 (1gM) are mouse MALs against the C3d/EBV
> receptor on human cells and <u>were kindly provided in ascitic fluid form by Dr.
> T. Tedder.</u>

(b) Indicating sample size;

> e.g. <u>The final sample sizes</u> for analyses involving a paternal or maternal
> myocardial infarction were 2416 and 2604 respectively.

(c) Indicating criteria for data selection;

e.g. Criteria for inclusion in the trial were as follows:
 (i) No detectable antibody against paternal lymphocytes.
 (ii) No cause found for the abortion, etc.

The information in Move 4 tends to be realized by the following linguistic forms:

(a) The use of the passive to indicate source of data;

> e.g. Samples of fossa of Rosenmuller, soft palate, oropharynx, cheek, tongue, nasal cavity, and trachea <u>were obtained</u> post mortem.

(b) By means of present or past tense forms to indicate sample size;

> e.g. (i) The study population <u>includes</u> all children and young adults (up to age 26) in Bogulasa ...
> (ii) The study group <u>consisted</u> of 30 patients in district hospitals in Western Scotland.

(c) By means of explicit lexemes:

> e.g. (i) <u>The study population</u> includes all children ...
> (ii) <u>Criteria</u> for inclusion in the trial were ...

Move 5, Describing Experimental Procedures, occurs in those texts in which laboratory tests have been carried out, or studies based on experimental work. It may also occur, albeit sparingly, in texts which are non-experimental, but are concerned with the analysis and description of already generated data especially where some procedural or methodological processes are considered crucial to the overall observations made during the process or analysis. Therefore, Move 5 presents in a logical and sequential manner the steps and procedures adopted during experimentation. It also indicates the types of apparatus used in the research. In line with the above, Move 5 contains the following "constituent elements":

(a) Identification of Main Research Apparatus, by:

 (i) Use of explicit lexemes (apparatus as grammatical subject in a passive construction) where the apparatus is subject of the clause;

> e.g. <u>A computer-generated list of pseudo-random number</u> was used to allot the patient to receive either her own or her husband's lymphocytes.

(ii) Use of explicit lexemes (apparatus as adjunct in a passive construction);

> e.g. Blood pressure was measured in the left upper arm <u>with a standard sphygmomanometer</u> (lower end of the mercury column at the level of the heart).

(b) Recounting experimental process, by:

(i) The use of passive verb form;

> e.g. Blood pressure <u>was measured</u> every 5 minutes until a stable diastolic pressure had been recorded for 15 mins.

(ii) The use of temporal adverbials;

> e.g. <u>After 1 hour incubation at 37°C</u>, the slides were washed in PBS and incubated with 1.75 dilution of ...

(c) Indicating criteria for success, by:

(i) The use of explicit lexemes;

> e.g. <u>A failure</u> of treatment was an abortion before 28 weeks and <u>a success was scored</u> when the pregnancy had continued beyond 28 weeks.

Move 6, Describing Data-Analysis Procedures, occurs in those research reports involving statistical or quantitative approaches to the analysis of data. Therefore, Move 6 proceeds by identifying the statistical tools used in the study and accounting for their application to a body of data. The Move also presents information on modifications made to statistical tools used in the study as well as defining measuring instruments as they relate to the study situation. Thus Move 6 is made up of the "constituent elements", defining terminologies, indicating process of data classification and identifying analytical instrument/procedure. Information in the Move is signalled by the following linguistic devices:

(a) By means of explicit lexemes;

> e.g. (i) Definitions of pregnancy outcome were decided before the start of the trial. PIH <u>was defined</u> as the presence of ...
> (ii) Birth weights <u>were classified</u> according to the centiles of distribution of normal weight.

(b) By means of passive verb forms;

> e.g. Logistic repression <u>was used</u> to predict the probability of myocardial infarction in the parents on the basis of serum levels of the variables in their offspring.

Move 7, Indicating Consistent Observation, is the initial Move in the "Results" section of an experimental research report. It contains information concerned with stating the overall observation made in the study. It also reports on all other significant observations which impinge on the objectives of the research, and presents information on visuals such as tables, graphs and pictorials. Move 7 also attempts to give an account of necessary procedural adjustments made before consistency was achieved in the observations recorded. Thus Move 7 highlights overall observations, indicates

specific observations and accounts for such observations. The realization of these constituent elements is signalled by:

(a) The use of preparatory expressions;

> e.g. At the beginning of the study the two groups were comparable with respect to age, body weight, diastolic blood pressure and effective pressure (Table 1).

(b) The use of the passive and present tense forms to refer to visuals;

> e.g. (i) The characteristics of cases and controls are shown in Table 1.
>   (ii) Table 3 shows our findings on the issue raised by Pile *et al.*; the estimates of relative risk, by their approach and by the method of this study, show no significant ...

(c) The use of existential constructions;

> e.g. There are no differences in success rate between the 9 pregnancies in this study and those in women without a previous successful pregnancy (Table 2).

(d) The use of the past tense to report results;

> e.g. Of the 106 evaluable patients treated with LAK cells plus interleukin-2, 8 had total repression ... 15 had more than ...

(e) The use of hedging devices to account for observations made;

> e.g. The impression appears to be misleading, however, because of certain differences between ...

Move 8, Indicating Non-Consistent Observations, presents negative results. That is, those results which do not conform with expected outcomes in the study. The frequency of occurrence of this move in the data used in this study is low (see Table 2 above), thus suggesting that it would be an optional move in the research article. Its low level of occurrence lends credence to the fact that research articles do not always reflect all that goes on in the research laboratory, but only those facts which the researcher considers important for his/her purpose (Knorr-Cetina 1981). Move 8 was found to be a highly flexible move in terms of its position of occurrence in text. Information in Move 8 is signalled by means of the following linguistic features.

(a) The use of negative verb phrases and negative qualifiers;

> e.g. (i) Thioflavine S staining (which is specific for amyloid) on sections of retina and topic nerve did not reveal neuritic plagues, neurofibrillary tangles or amyloid angiopathy.

    (ii) <u>I genetically abnormal</u> abortion was found, a trisomy 15 in a woman
        immunised with her husband's cells.

Move 9, Highlighting Overall Research Outcome, represents the first
segment of information in the Discussion section. It often corresponds with
information in the first paragraph of the Discussion section. The main
function of Move 9 is to confirm or refute the attainment of the main research
objective. Therefore, it is a short Move, consisting in most cases of one
complex sentence containing the main research result. The Move is sig-
nalled by:

(a) Explicit preparatory statements;

    e.g. (i) <u>The result of this study suggests that</u> OC use has no significant effect
        on the risk of breast cancer in women under 45 years of age.
      (ii) <u>Our results offer clear evidence of</u> a distinctive histopathologic
        process in the retinas and optic nerves of patients with Alzheimers
        disease ...

(b) The use of explicit lexemes;

    e.g. <u>The major aim of this trial</u> — to show whether injection of paternal cells
    produced a result ... <u>has been attained</u>.

Move 10, Explaining Specific Research Outcome, is the most elaborate
Move in the Discussion section. It restates the main observations made
in the study, indicates their significance, interprets and justifies them by
reference to procedures adopted in the study. The observations may also be
contrasted with similar ones made in related studies. Thus Move 10 contains
information which (a) states a specific outcome, (b) interprets the outcome,
(c) indicates the significance of the outcome, (d) contrasts present and
previous outcomes, (e) indicates limitations of the outcomes.
    These "constituent elements" are signalled by:

(a) Past tense verb forms to state a specific outcome;

    e.g. The current study which was free of all temporal uncertainty and selection
    biases <u>indicated</u> that adverse levels of apoliproteins are evident long before
    clinical symptoms begin.

Other linguistic signals which are used to state specific observations are
existential constructions, adverbial discourse conjuncts as preview of pre-
paratory expressions, and comparatives.

(b) The use of explicit lexical items (present tense+that participle) to signal
    the interpretation of research outcome;

    e.g. This finding <u>implies that</u> certain HSV DNA sequences may have a function
    in the initiation of cellular events that are important for the transformed state.

(c) The use of explicit lexical items to indicate the significance of the outcome;

> e.g. These results are <u>particularly important</u> because they come in the wake of several observations suggesting EBV infection of epithelia may be central to the events of primary injection and ...

(d) The use of explicit preparatory expressions/lexical items to signal a contrast between present and previous outcomes;

> e.g. (i) <u>Studies cited by Ferenzey *et al.* and our results</u> indicate the importance of close and frequent follow-up of patients from whom malignant genital tissue has been excised.
>
> (ii) <u>Ferenzey *et al.* have discussed</u> the difficulty of treating vulvar disease with its extensive lesions and frequency of recurrence. <u>Our study</u> included 11 vulvar carcinomas, 9 of which (82 percent) contained HPV-16 genomes.

(e) The use of explicit preparatory expressions to indicate limitation of outcomes;

> e.g. (i) <u>The major sources of error in studies of this type</u> are bias and selection of cases compared with controls ...
>
> (ii) <u>We do not know</u> the effect of immunization on women with detectable anti-paternal antibody <u>because these were excluded from the trial</u>.
>
> (iii) Our data was <u>clearly unable to define</u> conclusively the role of HPV-16 in genital neoplastic disease.

(f) The use of negative verb forms to indicate limitations of previous studies;

> e.g. (i) However, McCance *et al.* <u>did not mention</u> the status of HPV-16 genomes in paired, matched internal control tissue.
>
> (ii) Though some studies have reported a significant association between parental smoking and increased incidence of hospitalization of children for respiratory disease, <u>they do not distinguish</u> between the effect of passive exposure to cigarette smoke after birth and the effect of ...

Move 11, stating Research Conclusions, is the last Move in the experimental medical research report. It represents an attempt to sum up the writer's views on the contributions which the study has made to the field. Therefore, it contains information on the implications of the study. It may also indicate a need for further research. Thus, Move 11 is made up of two "constituent elements" which are signalled by the following linguistic devices.

(a) Indicating research implications, by: use of explicit lexemes;

> e.g. (i) The <u>practical implications</u> of our data are that transfusions to patients

> with cancer should be performed only when clinically essential and
> that ...
> (ii) The results of the current study <u>support the concept</u> that ...

(b) Prompting further research, by: use of explicit lexemes;

> e.g. (i) The nature of such an effect <u>deserve further study</u>. It may be that ...
> (ii) <u>Further studies are required</u> to support or refute this hypothesis.

In general terms, Move 11 is signalled by words such as <u>conclusion</u>, <u>summary</u>, e.g.:

> <u>In summary</u>, this study has shown that analapril to patients with severe
> congestive heart failure is associated with ...

The moves and their constituents are summarized in Table 3.

Discussion

The results obtained in this study show that a typical medical research paper may be made up of eleven schematic units or "Moves", consisting of three each from the Introduction and Methods sections, two from the Results section and four from the Discussion section.

This result compares favourably with those obtained in studies of isolated sections of the experimental research paper. For instance, Swales (1981) identified four Moves in Article Introductions. Following observations on the difficulty of demarcating Moves 1 and 2 in Swales' Model (see Bley-Vroman and Selinker 1984; Crookes, 1986), Swales (1990) conflated the two Moves into one, thus bringing the number of Moves in the Introduction section down to three. However, unlike Swales (1990), this study adopts very clear and unambiguous functional labels to characterize Moves and their constituent elements, and a more precise framework for the demarcation of Moves. Similarly, the four-move structure identified in the Discussion section corresponds fairly closely with the five-move structure posited by Mckinlay (1983). However, Mckinlay's moves are highly generalized with no indications of the sub-categories which make up each of them. Thus, it is difficult to determine whether Moves 2, 3 and 4 in Mckinlay's characterization are really separate Moves or subcategories of a single Move. Finally, as pointed out elsewhere in this paper, no studies have been reported on the structure of the Methods and Results sections of the research paper. This notwithstanding, the correlation between results obtained in this study and those of related studies, the rigorous framework upon which Moves were demarcated are enough reasons to state that the Moves identified here for the Methods and Results sections are reliable and consistent.

This study has shown that experimental research papers in medical journals can be analysed in terms of a conventional schema, consisting of

TABLE 3
Outline of Moves and their Constituent Elements

Introduction
Move 1:   Presenting Background Information:
   by   (1) Reference to established knowledge in the field.
             (2) Reference to main research problems.
Move 2:   Reviewing Related Research:
   by   (1) Reference to previous research.
             (2) Reference to limitations of previous research.
Move 3:   Presenting New Research:
   by   (1) Reference to research purpose.
             (2) Reference to main research procedure.

Methods
Move 4:   Describing Data-Collection Procedure:
   by   (1) Indicating source of data.
             (2) Indicating data size.
             (3) Indicating criteria for data collection.
Move 5:   Describing Experimental Procedures:
   by   (1) Identification of main research apparatus.
             (2) Recounting experimental process.
             (3) Indicating criteria for success.
Move 6:   Describing Data-Analysis Procedures:
   by   (1) Defining terminologies.
             (2) Indicating process of data classification.
             (3) Identifying analytical instrument/procedure.
             (4) Indicating modification to instrument/procedure.

Results
Move 7:   Indicating Consistent Observation:
   by   (1) Highlighting overall observation.
             (2) Indicating specific observations.
             (3) Accounting for observations made.
Move 8:   Indicating Non-Consistent Observations:

Discussion
Move 9:   Highlighting Overall Research Outcome:
Move 10:   Explaining Specific Research Outcomes:
   by   (1) Stating a specific outcome.
             (2) Interpreting the outcome.
             (3) Indicating significance of the outcome.
             (4) Contrasting present and previous outcomes.
             (5) Indicating limitations of outcomes.
Move 11:   Stating Research Conclusions:
   by   (1) Indicating research implications.
             (2) Promoting further research.

hierarchically ordered knowledge structures referred to as Moves and their constituent elements or Sub-Moves. The moves and their constituent elements assign functions to segments of information which together in the research paper constitute the overall semantic macrostructure of such texts. Medical professionals and other members of the discourse community may have implicit knowledge of the categories of Moves and Sub-Moves identified in this study, but linguistic evidence for such knowledge needs to be properly accounted for.

Therefore, this study not only contributes to an understanding of the

organization of discourse in experimental research reports, but also demonstrates how an overall move analysis can give an insight into the shape of texts in a manner which section studies cannot.

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REFERENCES

Adams-Smith, D. E. (1983). *Prescribing and general practice: Style in medical journals.* Paper presented at TESOL Conference, February 1983.

Adams-Smith, D. E. (1984). Medical discourse: Aspects of authors' comments. *The ESP Journal, 3,* 25–36.

Adams-Smith, D. E. (1987). Variation in field-related genres. *ELR Journal, I,* 10–32.

Belanger, M. (1982). *A preliminary analysis of the structure of the discussion sections in ten neuroscience journal articles.* (Mimeo), LSU, Aston University Reference Collection.

Bley-Vroman, R., & Selinker, L. (1984). Research design in rhetorical/grammatical studies: A proposed optional research strategy. *English for Specific Purposes, 82/83,* 1–4 and *84,* 1–6.

Brandt, D. (1986). Text and context: How writers come to mean. In B. Couture (Ed.), *Functional approaches to writing: Research perspective.* Norwood, NJ: Ablex.

Bruce, N. J. (1983). *Rhetorical constraints of information structure in medical research report writing.* Paper presented at the ESP in the Arab World Conference, August 1983. Aston University, U.K.

Cooper, C. (1985). Aspects of article introductions in IEEE publications. Unpublished M.Sc. dissertation, Aston University, U.K.

Crookes, G. (1986). Towards a validated analysis of scientific text structure. *Applied Linguistics, 7,* 57–70.

Dubois, B. L. (1981). The construction of noun phrases in biomedical journal articles. In J. Hoedt, L. Lundquist, H. Picht & J. Quistgaard (Eds.), *Pragmatics and LSP.* Copenhagen: Copenhagen School of Economics.

Dudley-Evans, T. (1986). Genre analysis: An investigation of the introduction and discussion sections of M.Sc. dissertations. In M. Coulthard (Ed.), *Talking about Text.* Birmingham, U.K.: English Language Research, Birmingham University.

Gosden, G. (1992). Discourse functions of marked themes in scientific research articles. *English for Specific Purposes, 11(3),* 207–224.

Gosden, G. (1993). Discourse functions of subject in scientific research articles. *Applied Linguistics, 14(1),* 5775.

Hemminki, E. (1982). Quality of clinical trials — A concern of three decades. *Methods in Information in Medicine, 21,* 81–85.

Hibberd, P. L., & Meadows, A. J. (1980). Information contained in clinical trial reports. *Journal of Information Science, 2,* 165–168.

Hopkins, A. (1985). An investigation into the organizing and organizational

features of published conference papers. Unpublished M.A. dissertation, University of Birmingham, U.K.

Hopkins, A., & Dudley-Evans, A. (1988). A genre-based investigation of the discussion sections in articles and dissertations. *English for Specific Purposes, 7*, 113–122.

Huckin, T., & Olsen, L. (1984). On the use of informants in LSP discourse analysis. In A. Pugh & J. Ulijn (Eds.), *Reading for professional purposes*. London: Heinemann.

Knorr-Cetina, K. D. (1981). *The manufacture of knowledge: An essay on the constructivist and contextual nature of science*. Oxford: Pergamon.

Malcolm, L. (1987). What rules govern tense usage in scientific articles? *English for Specific Purposes, 6*, 31–44.

Mckinlay, J. (1983). An analysis of discussion sections in medical journal articles. Unpublished M.A. dissertation, University of Birmingham, U.K.

Mcphill, A. (1911). Style and medical writing. *Medical Journal*, 70–73.

Nwogu, K. N. (1991). The structure of science popularizations: A genre-analysis approach to the schema of popularized medical texts. *English for Specific Purposes, 10*, 111–123.

Peng, J. (1987). Organisational features in chemical engineering research articles. *ELR Journal, 1*, 315–331.

Pettinari, C. (1982). The functions of grammatical alternation in fourteen surgical reports. *Applied Linguistics, 4*, 55–76.

Pindi, A. M. K. (1988). Schematic structure and the modulation of propositions in economics forecasting texts. Unpublished Ph.D. thesis, Aston University, Birmingham, U.K.

Rumelhart, D. E. (1975). Notes on a schema for stories. In D. G. Bobrow & A. M. Collins (Eds.), *Representation and understanding. Studies in cognitive science*. New York: Academic Press.

Rumelhart, D. E. (1980). On evaluation of story grammars. *Cognitive Science, 4*, 313–316.

Rumelhart, D. E. & Ortony, A. (1977). The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro & W. E. Montague (Eds.), *Schooling and the acquisition of knowledge*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Rumelhart, D. E. & Norman, D. A. (1987). Representation of knowledge. In A. M. Aitkhead and J. M. Slack (Eds.), *Issues in cognitive modelling*. London: Lawrence Erlbaum Associates/The Open University.

Salager, F. (1986). Specialist medical English lexis: Classificatory framework and rhetorical function — A statistical approach. *EMP Newsletter, 2(2)*, 5–17.

Selinker, L. (1979). On the use of informants in discourse analysis and language for specialised purposes. *IRAL, 7(3)*, 189–215.

Skelton, J. (1994). Analysis of the structure of original research papers: An aid to writing original papers for publication. *British Journal of General Practice, 44*, 455–459.

K. N. Nwogu

Swales, J. M. (1981). Aspects of article introductions, *ESP Research Report*, (*1*). Aston University, Birmingham, U.K.

Swales, J. M. (1987). Communication skills for the public sector. In Proceedings of the southern Africa Conference on *Communication skills for the Public Sector*, Lusaka, National Institute of Public Administration.

Swales, J. M. (1990). *Genre analysis: English in academic and research settings*. Cambridge: Cambridge University Press.

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Appendix

1. Controlled trial of treatment of recurrent spontaneous abortion by immunization with paternal cells. *The Lancet*, 27 April 1985.
2. Oral contraceptives and breast cancer in young women. *The Lancet*, 2 November 1985.
3. Low-dose aspirin prevents pregnancy-induced hypertension and pre-eclampsia in angiotensine-sensitive primigravidae. *The Lancet*, 4 January 1986.
4. Epstein-Barr virus receptors on human pharyngeal epithelia. *The Lancet*, 1 February 1986.
5. Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales. *The Lancet*, 10 May 1986.
6. Association between transfusion of whole blood and recurrence of cancer. *British Medical Journal*, 30 August 1986.
7. An outbreak of meningococcal disease in Gloucestershire. *The Lancet*, 6 September 1986.
8. The relation of apolipoproteins A-1 and B in children to parental myocardial infarction. *The New England Journal of Medicine*, 18 September 1986.
9. Optic-nerve degeneration in Alzheimer's disease. *The New England Journal of Medicine*, 21 August 1986.
10. Human papilomavirus in clinically and histologically normal tissue of patients with genital cancer. *The New England Journal of Medicine*, 23 October 1986.
11. Is relationship between serum cholesterol and risk of premature death from coronary heart disease continuous or graded? *Journal of American Medical Association*, 28 November 1986.
12. Linoleic and eicosapentaenoic acids in adipose tissue and platelets and risk of coronary heart disease. *The Lancet*, 24 January 1987.
13. Detection of tissue kilikrein in the bronchalveolar lavage fluid of asthmatic subjects. *Journal of Clinical Investigation*, January 1987.
14. A progress report on the treatment of 157 patients with advanced cancer using lymphokine-activated killer cells and interleukin-2 of high-dose interleukin-2 alone. *The New England Journal of Medicine*, 9 April 1987.
15. Effects of analapril on mortality in severe congestive heart failure. *The New England Journal of Medicine*, 4 June 1987.