Short Research Articles as Proxy Models for Research Articles: The Effects of Brevity on the Discourse Structure of Introductory Sections

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Abstract

While there is much pedagogically-oriented research on the academic written genre of research articles (RAs) and their part-genres (e.g. introductions), there has been little focus on academic shorter communications. In this paper, we examine a corpus of short research articles (SRAs) from the journal *Nature*'s Brief Communications series by performing a moves analysis of the introductory sections that correspond to the abstract and introduction sections in standard RAs. We find that part-genres in these papers are highly compressed, giving them considerably different structural features compared to standard RAs. Although first paragraphs do have the features of a typical RA abstract, they are in fact cohesively and coherently linked to the subsequent introductory text, while typical features of RA introductions are often omitted. This has implications for the use of SRAs as model texts in teaching scientific writing.

1. Introduction

There has been a considerable amount of research into the genre of scientific research articles (RAs) and their individual sections or 'part-genres' (e.g. Bruce, 2009; Ayers, 2008; Ozturk, 2007; Williams, 2006; Samraj, 2005, 2002; Swales, 2004; Swales & Feak, 2004; Lorés, 2004; Martín, 2003; Peacock, 2002; Dudley-Evans, 2000; Dubois, 1997; Holmes, 1997; Santos, 1996; Hopkins & Dudley-Evans, 1988; Wood 1982). It has been shown that while variations exist in the global structure, move structure and layout of RAs across different academic and scientific disciplines, there are

also broad similarities that render sections identifiable according to rhetorical or discourse function (Swales, 2004; Samraj, 2002). The corresponding IMRD structure of RAs is well known (Sollaci & Pereira, 2004). It is also clear, on the other hand, that variations can exist in RAs even from the same discipline (Ozturk, 2007).

The use of authentic RAs as model texts in the scientific writing classroom for non-native English speakers is widely regarded as desirable, and authentic texts can reveal features of rhetorical structure and register particular to this genre (Nazarenko and Schwarz, 2010; Cheng, 2008; Yen 2008; Swales & Feak, 2004; Cumming, 1995; Marshall, 1991). Targeting language that meets the communicative needs of learners, in our case undergraduate science students who may need to publish RAs in English in their future careers, is a priority in this modelling (Hüttner, 2008). However, in practical terms selecting an authentic science paper for use in a science writing class presents several potential problems (Swales, 2009). The content may be beyond the learners' current level of subject-specific knowledge and they may lack the background knowledge required to understand the broader context of the research; these issues may also extend to teachers of science writing. Learners may also struggle with the often large number of low-frequency technical words found in science articles. This lexical deficit is often the most debilitating factor when reading in a second language (Nation, 2001). On top of these obstacles, especially for learners who have had little or no experience with such texts, is a general lack of awareness of the rhetorical structure of the research article and the accompanying lexical bundles used to achieve the different rhetorical functions (see e.g. Simpson-Vlach & Ellis, 2010). Furthermore, the length of the paper often means that using research articles in class can be impractical or de-motivating, even for keen students. Given that teachers may wish to introduce students to several different texts (for reasons of variety and interest) rather than limit them to only one, the length of the texts becomes a particularly prominent issue.

A number of practical solutions have been proposed to deal with these issues. Firstly, some teachers consider using popular science articles, which are often considered easier for students to read and therefore potentially more motivating (Morton, 1999, p. 180). However, journalistic writing is not a suitable model for the

formal scientific register of RAs (Parkinson & Adendorff, 2004), nor indeed for other kinds of academic writing (Morton, 1999).

A second solution was proposed by Morton (1999) who suggests using the abstract as a summary of the whole text. However, this approach is clearly limited in application. For example, it would not allow exploration of move patterns for specific sections, such as those found in the introduction or methods sections. It would also require much more additional support to be provided by the teacher, as much of the explanation and elaboration, including tables and figures, is found not in the abstract, but in the main body of the text.

A third option is to modify the texts by abridging them, simplifying the language, adding glosses and so forth. This approach is not only time consuming but large-scale modification may render the text considerably different from the original in content, structure and form, giving rise to the question of whether it still serves as a useful authentic model text.

Another option is to consider using short research articles (SRAs) that fall under Swales' category of shorter communications (Swales, 2004, p. 213–215), such as those found in *Nature*'s Brief Communications (BC) and *Science*'s Brevia sections, both of which contain articles of less than 1,000 words, and this is what we shall explore in this paper.

It may be generally assumed that SRAs are simply a scaled down or even a simplified kind of standard RA, or even that a short paper might be 'easier', and thus that their use as proxy models is relatively unproblematic. In fact, little formal research has been conducted into the shorter communications genre beyond Swales' brief identification of the category (Swales 2004), and none, to our knowledge, has looked at SRAs, in either their rhetorical and linguistic structure or in their pedagogical applications. On the other hand, research in other genres indicates that strict word-count restrictions often lead to increasingly dense and complex text. Biber *et al.* (1999) observed that the word limits imposed by newspaper editors leads writers to create informationally dense texts that often employ complex noun phrases to compress detail into the available space. In terms of short research articles, this may suggest that, though RAs are already informationally and lexically dense (Fang, 2005, p. 338), SRAs are likely to be even more so. Furthermore, though Biber *et*

al. (1999) noted the impact of restricted space on the linguistic features of news texts, it is also plausible that such compression of text would lead to structural and rhetorical differences at the level of the part-genre (e.g. the introduction) of RAs; the tight word limits imposed may very well lead to unexpected differences between RAs and SRAs, which in turn constrains their use as effective models or classroom examples of 'typical' formal science writing.

The purpose of our study is threefold: firstly, we provide a genre analysis of the SRA using a small corpus of *Nature*'s Brief Communications, examining the introductory sections of these texts. Secondly, as part of this analysis, we compare the rhetorical functions typically found in the abstract and introduction sections of standard RAs with those of our SRAs. Finally, we discuss the implications of the findings in regard to pedagogical applications. This research therefore contributes to our understanding of the multiple genres of formal scientific texts and can be applied to the pedagogy of science writing.

2. Texts, Corpus and Methodology

2.1 The Texts

Brief Communications in *Nature* are SRAs and formed a featured section from September 1999 until December 2006 (The brief goodbye, 2006; Changing *Nature*, 1999). These peer-reviewed articles contain original scientific research with a broad interdisciplinary appeal, although a high proportion of papers were from the biological sciences (73% from January to June 2006; Quantified Brief Communications, 2006). In line with the increasing diffusion of scientific research and writing through the internet and the growing 'news-orientation' of scientific research (Ayers, 2008), BCs appear to incorporate some graphical journalistic features, for example in their use of the appealing deck or teaser subtitle beneath the large font headline-style titles, whilst retaining a formal scientific register. Individual papers vary in content and organization, though recognizably IMRD style papers were common, especially in papers reporting experimental results. While lacking an independent abstract in the print version, the online version allows separate access to the

'First Paragraph' and may contain supplementary materials. BCs were discontinued reportedly because submissions increasingly failed to meet the criteria for the section; one editorial noted the constraints of the short format as one possible cause (The brief goodbye, 2006).

2.2 The Corpus

We analysed a corpus of introductory sections drawn from 22 Brief Communications articles published in *Nature* between March 2005 and December 2006 (see Appendix for references). Texts were selected if they appeared to follow a largely IMRD format and reported the results of experimental scientific research, regardless of discipline; these would be texts we would consider as potential classroom material. The texts are from a variety of science disciplines, with biological sciences being by far the most common in the sample (16 of 22 texts), and with the remainder made up of physics (2), computer sciences (2), chemistry (1) and biological anthropology (1). The chosen articles have between five and nine paragraphs, which are not separated by subheadings, and feature between six and thirteen references per article. All the texts include graphic data: photographs or figures providing data. Two texts feature unlabelled photographic illustrations, indicative perhaps of a more journalistic style.

We defined the paragraphs preceding a description of methods and results as 'introductory', that is, they could contain an 'abstract' as the first paragraph followed by an 'introduction', as would be expected in a standard RA. Two of the randomly selected texts were omitted from the initial selection because they had only one paragraph preceding the methods section[i]. Thirteen texts had two paragraphs in the introductory section, eight texts had three and one text had four paragraphs. These introductory sections formed the corpus of SRAs for analysis.

2.3 Methodology

To examine the introductory sections of these SRAs, we adopted a moves analysis approach analysing the texts in terms of their communicative function. This approach is used by researchers and practitioners alike (Hüttner, 2008; Swales & Feak, 2004). For example, abstracts have received considerable attention recently (Ayers, 2008; Cross & Oppenheim, 2006; Samraj, 2005; Lorés,

2004; Martín, 2003; Santos, 1996) as have introductions (Ozturk, 2007; Swales, 2004; 1990; Samraj, 2002). A move can be defined in the context of genre analysis as 'a discoursal or rhetorical unit that performs a coherent communicative function in a written or spoken discourse' (Swales, 2004, p. 228). Moves are primarily functional rather than formal, and thus can be found across a wide range of structures, including paragraphs, sentences, or clauses (*ibid.*, p. 229). Nwogu (1997) notes that move analyses tend to follow a bottom-up approach to identification of moves, that is, lexical or grammatical markers often point out particular moves (e.g. *in conclusion*); yet simultaneously top-down knowledge of the overall features of particular genres (e.g. research articles), and part-genres (e.g. introductions) can guide move identification in terms of the placement of particular moves.

Since we were interested in how these introductory sections were structured, we undertook two analyses. In the first place, we examined the first paragraphs of the BC texts as abstracts, applying a five-move pattern (Figure 1) for journal article abstracts used by both Hyland (2000) and Santos (1996). Whilst some studies have adopted a four-move approach, directly applying IMRD structure to abstracts (Samraj, 2005; Lorés, 2004; Martín, 2003; Bhatia, 1993, p. 78–79), we recognize that the five-move structure introduced a helpful distinction between introducing the background research area and presenting the research purpose. It should be noted that this model represents non-structured, 'informative' abstracts, as defined by Swales and Feak (2004, p. 282) and Lorés (2004), that is, short continuous texts without subheadings, that summarize the whole paper.

Move 1. Background/introduction/situation
Move 2. Present research purpose
Move 3. Methods/materials/subjects/procedures
Move 4. Results/findings
Move 5. Discussion/conclusion/significance

Figure 1: The 5-move structure of non-structured informative abstracts (after Hyland, 2000)

Next, we applied Swales' (2004) revised CARS model to the

paragraphs following the first paragraph in the introductory section and preceding the methods section. The move structure is well known, but for clarity is summarized below (Figure 2).

Move 1. *Establishing a territory* (citations required)
Via
Topic generalizations of increasing specificity
Move 2. *Establishing a niche* (citations possible)
Via
Step 1A Indicating a gap, or
Step 1B Adding to what is known
Step 2 (optional) Presenting positive justification
Move 3. *Presenting the present work* (citations possible)
Step 1 (obligatory) Announcing present research descriptively and/or purposively
Step 2* (optional) Presenting research questions or hypotheses
Step 3 (optional) Definitional clarifications
Step 4 (optional) Summarizing methods
Step 5 (PISF**) Announcing principal outcomes
Step 6 (PISF) Stating the value of the present research
Step 7 (PISF) Outlining the structure of the paper.
*Steps 2–4 are not only optional but less fixed in their order of occurrence than the others
**PISF: Probable in some fields, but unlikely in others

Figure 2: Swales revised 'create a research space' (CARS) model (after Swales, 2004)

The analyses of the abstracts and introductions are presented in the following two sections, sections 3 and 4 respectively; section 5 brings the two parts together in order to highlight the characteristic structure of the whole introductory section of the articles.

3. Analysis: First Paragraphs as Abstracts

The first paragraphs typically contain 3–4 sentences (average 3.41, SD 0.59). The moves appear to be compatible with the five-move structure of abstracts; most of the first paragraphs contain all five of the moves outlined above in Figure 1 (15 texts, 68.2%).

However, a number of texts do not appear to include move 3, outlining the method (7 texts, 31.8%). It is interesting to note that this finding concurs with previous studies of RA abstracts (Samraj, 2005; Hyland, 2000). Ayers suggests (2008, p. 31) that the increasing omission of methods moves in *Nature* abstracts may be because they lack 'news value'.

The number of moves realized within a single sentence boundary varies considerably, but two or three moves can be found within a single sentence in all of the texts. This compact structuring can be viewed in the example below:

> Bats famously orientate at night by echolocation[1], but this works over only a short range, and little is known about how they navigate over longer distances[2]. Here we show that the homing behaviour of *Eptesicus fuscus*, known as the big brown bat, can be altered by artificially shifting the Earth's magnetic field, indicating that these bats rely on a magnetic compass to return to their home roost. This finding adds to the impressive array of sensory abilities possessed by this animal for navigation in the dark. (Text 6, Para. 1)

The first sentence carries the function of move 1, introducing background research. The formulaic chunk *Here we show* serves to present the current research and its purpose (move 2); the *that*-clause which follows provides an overall description of the research, including a definition of *Eptesicus fuscus*. It could be argued that the purpose of this paper is to present the new knowledge that bats rely on a magnetic compass. Therefore, the common chunk *here we show* indicates purpose and heads a description of the study, similar to the patterns observed by Myers (1992) in regard to introductions. In the corpus, *here we show* occurred in ten texts, and *here we + verb* occurs in almost all of the papers (18 of 22 texts), highlighting the highly formulaic nature of the BC texts. These exponents also occurred very frequently in standard RA abstracts in *Nature* (Ayers, 2008)[ii].

The second underlined section suggests something about the methods of the experiment, albeit obliquely (move 3). Finally, the results are announced by the lexical construction *indicating that*, giving a statement of the main finding of this research

(move 4). Therefore, three moves are found in one sentence of this first paragraph, a pattern displayed in eight (36.4%) of the texts in this study. The final sentence highlights the significance of the research and its contribution to scientific knowledge (move 5). The importance of this final move in standard RA abstracts in *Nature* was shown by Ayers (2008, p. 27), who noted the increasing requirement to show how the published research has moved the field on, providing validation for research in terms of finance and utility.

Overall, the first paragraph provides a summary of the research, moving through background research, to aims, usually some brief indication of methods, findings, and finally mentioning the value or applications of the research. As all of the five moves attested in unstructured IMRD style standard RA abstracts are clearly accounted for in the BCs examined here, we conclude that this paragraph is functionally similar to a standard RA abstract. The general functions of summarizing the contents and acting as screening devices, as well as seeking to appeal to *Nature* readers and presenting the macro-propositions of the main article (Salager-Meyer, 1991 cited in Martín, 2003), are all served by this first paragraph. Furthermore, the fact that the first paragraph can be accessed separately in the online journal supports the view that they can function as abstracts.

However, the BC first paragraphs differ from standard RA abstracts in a number of significant respects. Firstly, the number of sentences in the first paragraph (mean 3.41, SD 0.59) is about half that of standard RA abstracts, in which the average is 6.5 (Feak & Swales, n.d). This condensing of information, and hence moves, leads to the employment of multiple moves within single sentences in all of the BC abstracts analysed. Secondly, BC abstracts may identify a gap in the field that is not then identified in the introduction sections (see next section). Finally, although typical abstracts of standard RAs function as 'stand-alone' summaries, the first paragraphs of BC SRAs appear to be both cohesively and coherently linked to subsequent paragraphs, suggesting they are part of a continuous text (we return to this point in section five).

4. Analysis: Introductions

In this section we examine the paragraphs following the first paragraph and preceding the method section as part-genre introductions. Table 1 below shows the frequency of standard RA introduction moves across the texts.

Moves based on CARS model (Swales, 2004)	Number of texts in which the move is featured
Move 1 Establishing a territory	22
Move 2.1 Indicating a gap/Adding to what is known	10
Move 2.2 Presenting positive justification	0
Move 3.1 Announcing present research	0
Move 3.2 Presenting research questions/hypotheses	3
Move 3.3 Definitional clarifications	1
Move 3.4 Summarizing methods	1
Move 3.5 Announcing principal outcomes	2
Move 3.6 Stating the value of the present research	0
Move 3.7 Outlining the structure of the paper	0

Table 1: Frequency of moves occurring in introduction paragraphs

4.1 Move 1: Background Information

The most striking observation is that for most of the articles move 1, presenting background information, is the most prominent of all moves. Not only does move 1 appear in all of the introduction paragraphs, but in some cases, move 1 is the only move to appear in the introduction sections of the texts (7 texts). Although one of the main functions of any introduction section is to provide background information to contextualize a study, the lack of other functions is unusual. By looking at the example provided below, it is clear that this introduction paragraph contains only background information:

> The site of Mehrgarh in Baluchistan lies along the principal route connecting Afghanistan to the Indus valley. After intermittent occupations by hunter-gatherers, Mehrgarh's subsistence economy shifted to the cultivation of barley and wheat, cotton domestication and cattle breeding[4]. Diachronic archeological evidence records an increasingly rich cultural life, with technological sophistication based on

> diverse raw materials. Excavation of the Neolithic cemetery known as MR3 yielded more than 300 graves created over a 1,500-year time span[4]. (Text 14, Para.2)

4.2 Move 2.1: Indicating a Gap

A gap indication is found in almost half (10 texts) of the introductions of the texts in the current corpus. Therefore it would seem that, although not obligatory, indicating a gap in research is not uncommon in these SRAs. Furthermore, a gap indication is repeated in both the introduction and the abstract in six texts; this is illustrated below:

> Bats famously orientate at night by echolocation[1], but this works over only a short range, and little is known about how they navigate over longer distances[2]. Here we show that the homing behaviour of *Eptesicus fuscus*, known as the big brown bat, can be altered by artificially shifting the Earth's magnetic field, indicating that these bats rely on a magnetic compass to return to their home roost. This finding adds to the impressive array of sensory abilities possessed by this animal for navigation in the dark.
>
> For some taxa, navigation behaviour can be readily investigated in the laboratory[3]. To study the wide-ranging navigation of bats, however, their flights path needs to be tracked in a natural setting. Limitations of the available technology make this a labour-intensive process, so bat navigation is relatively poorly understood compared with that of other animals[2] (Text 6, Para. 1–2)

In the example above, the gap indication is made clearly with reference to background research (move 1). In the second paragraph this gap is restated but also reframed as a result of *limitations of the available technology*.

Samraj (2005) found that of 12 conservation biology article abstracts, six had gap indications but these same article introductions also featured comparable gap statements. However, of her 12 wildlife behaviour articles only two abstracts had gap indications, yet 10 featured this function in the introduction sec-

tion[iii]. It appears that though the persuasive function of the gap indication is most prominent in the introduction section it may also feature in some abstracts, and this may depend on the discipline or the particular publication.

4.3 Move 3: Presenting the Present Work

Move 3.1, announcing the present research descriptively or purposively, is not found in the introductions examined here. This is significant as this move has been noted as obligatory for RA introductions (Swales, 2004). In many academic disciplines introductions begin move 3.1 with phrases such as *The purpose of the paper is to . . . ,* as Myers (1992) found in linguistics papers. However, Myers also noted that the *Here we* + V (e.g. *Here we show*) exponents are more typical of science texts. As was discussed in section 3, such phrases are typical of BC abstracts, but are not observed in the introduction paragraphs.

Move 3.2, presenting research hypotheses and questions, occurs three times in the corpus. There are two possible reasons for this low frequency: firstly, they can be inferred from the abstract; secondly, they are indicated shortly afterwards in the initial sentence of the method section, which is highly formulaic and often begins with the phrase *To test* and is followed by a *wh*-clause which includes the hypothesis/question. If this last point could be confirmed by further investigation, it would further show the cohesion across sections of these short papers, and where expected RA moves are omitted in SRAs due to brevity.

Move 3.3, a definitional clarification, occurs only once in the corpus (below; also see section 5.2 for paras.1–2 of text 3).

> *Panulirus argus* virus 1 (PaV1) is a lethal pathogenic virus that infects juvenile spiny lobsters[4]. (Text 3, Para. 2, line 1)

However, whether this is the best categorization here is not clear as it also could be labelled as a move 1, or even considered as providing information for understanding the method that follows (although it cannot be classed as move 3.4). Samraj (2002, p. 12) noted a similar problem in distinguishing and classifying background description of species in wildlife behaviour RA introductions and considered it as embedded within step 1 of move 3. Clear definition of this step (step 3 of move 3), as with

other move definitions, may be ambiguous (see Ozturk, 2007, p. 27).

Move 3.4, outlining methods, is also absent from all but one example (text 4), possibly due to it being less newsworthy, or because increasingly complex methods defy meaningful summary (Ayers, 2008), or possibly because the methods immediately follow this section. This 'proximity effect' may result in different structuring of SRAs as compared to RAs; because the sections are short and not separated into sections by subheadings, overall coherence will not be lost if some typical moves are omitted or moved. Methods and processes are prominent throughout Text 4, since it describes the construction and testing of robotic whiskers modelled on rats' whiskers. This finding suggests that within the BC genre the nature of the research may influence the prominence of certain moves over others.

Move 3.5, announcing principle outcomes, only occurs only once in the BC introductions. Swales (2004) notes that move 3.5 is Probable In Some Fields (PISF), but unlikely in others. In science articles, the principle aim of publications is to present the results of research and add to knowledge; stating the significance, contribution and principle outcomes would seem essential for science publications. Though the results move is absent from most of the introductions, it is obligatory in the abstracts (abstract move 4), and this is in line with the abstract's role as 'an ideal vehicle for projecting news value' (Ayers, 2008, p. 23); it is usually unnecessary to repeat the move a few sentences later in the introduction.

In the example below, announcing principle outcomes, introduction move 3.5, does occur in the second paragraph. In the first paragraph, abstract move 4 already signalled these results together with abstract move 2, presenting research purpose, indicated by the stem *Here we* (*pinpoint*).

> Discoveries of the larvae of the European and American eels, *Anguilla anguilla* and *A. rostrata,* in the Sargasso Sea[1,2] and of the Japanese eel, *A. japonica,* in the Philippine Sea[3] indicate that these freshwater eels migrate thousands of kilometres into the open ocean to spawn. Here we pinpoint a spawning location for Japanese eels after genetically identifying newly hatched larvae that we collected from the site.

> The restricted size of this spawning area ensures that the eel larvae enter a particular current that transports them to the freshwater areas in east Asia where they mature, and it also prevents them from being carried southwards away from their species range by a different local current.
>
> It has been suggested that changes in oceanic conditions[4] are contributing to the recent drastic decline of anguillid eels worldwide[5], by disrupting their spawning areas and the transport of their larvae (leptocephali)[4]. But little is known about such spawning areas. On the basis of data collected on leptocephali over almost 50 years and analysis of their hatching dates, we have proposed that the Japanese eel spawns near seamounts west of the Mariana Islands (14–17_ N, 142–143_E), close to the time of the new moon[6]. We have now verified the location and timing of spawning by Japanese eels after collection and analysis of the newly hatched pre-leptocephali. (Text 21, Para.1–2)

Moves 3.6 and 3.7 are absent from these introductions. Move 3.6, stating the value of the research, is apparently absent because it has been covered in the first paragraph (abstract move 5), where it is obligatory. Finally, move 3.7, outlining the structure of the paper, is absent from all of these articles. Due to the size of the article and the associated restrictions in the number of words it is presumably unnecessary.

In sum, many elements which are considered obligatory in typical RA introductions are missing from BC introductions: move 3 is absent from 16 of 22 texts; move 3.1 is not found in any of the introductions, and moves 3.5 and 3.6, which are considered Probable in Some Fields (Swales, 2004), such as the hard sciences, are also absent. The dominance of move 1, giving background information, provides the primary function of these introductions. Other common functions of the introduction are given over to the abstract. This finding thus suggests that the abstract and introduction often work together in Brief Communications articles to accomplish the function of a unified 'introductory section'. This is further illustrated by the use of definitions, citations, move recycling and features of textual cohesion.

5. Analysis of Introductory Sections

Here we relate evidence for considering the first paragraph and the subsequent background paragraphs as interconnected and interdependent constituents of an introductory section, that is, a mixture of the part-genres of abstract and introduction.

5.1. Terminological Definitions

In most of the biological science texts (12 of 16 texts) the Latinate name is provided for a species in the first paragraph and is not defined elsewhere. This is different from the typical conventions of RA abstracts where, regardless of whether terminological definitions are given in the abstract, they should also appear in the main body of the text. In text 12, a similar terminological clarification is made in the abstract for a medical condition (*X-linked severe combined immune deficiency*, defined by the acronym *X-SCID*).

Text 7 below also has a clear definition of *parthenogenesis* in the first line of the abstract (paragraph 1) and which is subsequently treated as assumed knowledge in the last line of the introduction (paragraph 2). In other words, the use of definitions in the first paragraph provides 'new' information which is then treated as 'given' in the subsequent text. Such information progression is not typical; readers are not usually *required* to read the abstract to understand the main text. However, as BC texts are continuous and short, with the abstract presented as part of the main text, this information progression is to be expected. The variation between standard RA abstracts and the BC abstracts is nonetheless highlighted by these differences. Accordingly, the abstracts are also shown to be embedded within the introduction and, of course, the main body of the text.

> Parthenogenesis, the production of offspring without fertilization by a male, is rare in vertebrate species, which usually reproduce after fusion of male and female gametes. Here we use genetic fingerprinting to identify parthenogenetic offspring produced by two female Komodo dragons (*Varanus komodoensis*) that had been kept at separate institutions and isolated from male ones; one of these females subsequently produced additional offspring sexually. This

reproductive plasticity indicates that female komodo dragons may switch between asexual and sexual reproduction, depending on the availability of a mate — a finding that has implications for the breeding of this threatened species in captivity. Most zoos keep only females, with males being moved between zoos for mating, but perhaps they should be kept together to avoid triggering parthenogenesis and thereby decreasing genetic diversity.

Komodo dragons, the largest of the lizards, are under threat[1] as wild populations become smaller and more fragmented, as are 341 other species of reptile. At least 52 zoological institutions are cooperating in a successful international breeding programme with these lizards, but until now parthenogenesis has never been reported. (Text 7, Para. 1–2)

5.2 Citations

Another characteristic of the BC articles that shows how the abstracts are embedded within introductions is the use of citations. In most of the texts (17 of 22 texts) citations are used in the first paragraph in addition to subsequent paragraphs. While text 7 above is somewhat unusual as it features no citations in the first paragraph (and only one in the whole introductory section), in text 3 below, four citations are used in the first paragraph. These provide support for the claims being made as the discourse progresses from general to more specific background. In many of the texts (15 of 22 texts) these citations are not repeated elsewhere in the introductory section, which shows how the first paragraph assumes the role of introducing much of the previous research. However, it is typically the introduction rather than the abstract which serves to present background research and review the relevant literature (e.g. Nwogu, 1997 for medical articles).

Transmissible pathogens are the bane of social animals[1], so they have evolved behaviours to decrease the probability of infection[2,3]. There is no record, however, of *social animals* avoiding diseased individuals of their own species in the wild. Here we show how healthy, normally gregarious

> *Caribbean spiny lobsters* (*Panulirus argus*) avoid *conspecifics* that are infected with a lethal virus. Early detection and avoidance of infected, though not yet infectious, individuals by healthy *lobsters* confers a selective advantage and highlights the importance of host behaviour in disease transmission among natural populations.
>
> *Panulirus argus* virus 1 (PaV1) is a lethal pathogenic virus that infects *juvenile spiny lobsters*[4]. It is transmitted by physical contact and, among *the smallest juveniles*, through seawater. *Spiny lobsters* are social and share communal dens, so these modes of viral transmission could have devastating consequences in the absence of a mechanism to check its spread. (Text 3, Para. 1–2)

5.3 Recycling Moves

Moves are often repeated across the abstract-introduction paragraphs in the BCs, similar to the pattern of 'recycling of increasingly specific topics' identified for introductions (Swales, 2004, p. 230). This is likely because the second move 1 often has a slightly different focus, which can be indicated by the citations as well as the content. The patterns also funnel the introduction, from general to more specific topics; for example, the recycling of move 1 is shown above in text 3. While the first move 1 (underlined) in sentence 1 refers to the effects of transmissible pathogens among social animals in general, the second move 1 (underlined) restricts the focus to the more specific topic of the research: introducing a specific transmissible pathogen that infects spiny lobsters. Such move recycling is also evident in the repetition of the gap indication in a number of texts (5 of 22 texts).

5.4 Cohesive Lexical Chains

A final point is the use of various lexical forms of reference which create cohesive co-referential chains across the paragraphs. As can be seen in text 3 above (co-referents are italicised), *Caribbean spiny lobsters* has multiple lexical referents across the first and second paragraphs. This lexical chain is commonly seen in continuous sections of text and is one way in which texts gain cohesion (Halliday and Hasan, 1976). The spe-

cific type of lobster is identified in the first paragraph by the place where it is found (*Caribbean*) and by its Latinate term (*Panulirus argus*), but is referred to more generally thereafter with *juvenile spiny lobsters, juveniles, lobsters* and *spiny lobsters*. The reader is primed for this by the cataphoric referent *social animals*.

5.5 Identified Move Structure for Introductory Sections

Following the analysis of the introductory sections from this corpus the following move structure outline has been identified for BCs' introductory sections (figure 3). We adopt the introduction/conclusion distinction as noted by Ayers (2008, p. 26–27) for *Nature* RA abstracts as the distinction also seems to apply to BC first paragraphs, in which results are incorporated into the conclusion move. One major reason for following this is that abstract move 2, which signals the purpose of the paper is usually found alongside move 4, stating the main findings, in the BC abstracts. This suggests that a departure is made from the background information, presented in the introduction move, to the findings of the paper, shown in the conclusion move.

Based on our findings, the first paragraph seems to have a dual role as an abstract and as part of the introduction section – by providing background information supported by citations, by introducing terms and providing definitions and by being coherently and cohesively linked to the main body of the text. While this result may be specific to SRAs appearing in Brief Communications, it is clear that some shorter papers can have compressed structures which mix RA part-genres, and are thus functionally and structurally distinct from typical RAs.

First paragraph	
Move 1: Introduction*	(Citations Possible)
1.1 Establishing a territory	(Obligatory)
1.2 Identifying a gap	(Optional)
1.3 Providing definitions of terms	(Optional)
Move 2: Conclusion	(Citations Possible)
2.1 Present research purpose	(Obligatory)
2.2 Indicate methods used	(Optional)
2.3 Present main research findings	(Obligatory)
2.4 State value or significance of the research	(Obligatory)

Background paragraph(*s*)	
Move 1: Introduction*	(Citations Required)
1.1 Present background research/knowledge	(Obligatory)
1.2 Gap identification	(Optional)
Move 2: Presenting the current study	(Citations Possible)
2.1 Definitional clarifications	(Optional)
2.2 Present research questions or hypothesis	(Optional)
2.3 Indicating methods	(Optional)
2.4 Present principle outcomes	(Optional)
* Recycling of increasingly specific topics	

Figure 3: Move structure for introductory sections of Brief Communications short research articles (SRAs)

5.6. Further Part-Genre Mixing in BCs

In addition to this move structure, which accounts for the majority of texts in the corpus, there are two texts which follow an exceptional pattern in the background section. In texts 10 and 20, the paragraph containing the background moves also contains the method section. In both texts the method section is clearly indicated with the formulaic phrases used in many BCs: in text 10 the section begins with *To test this idea . . .* and in text 20 the method is initialized with *By using . . . we have been able to . . .* Text 20 is shown below using the move structure identified in Figure 3 to highlight the unique nature of this textual progression. Note that although the beginning of the method may appear similar to introduction move 3.4, this paragraph is immediately followed by the results section, confirming its role as the primary method section. Readers are also directed to the supplementary materials for more details of the methods used in the experiment.

> Backswimmers are remarkable in that they are the only insects to inhabit mid-water environments as adults and are also the only ones to have haemoglobin throughout their entire life cycle[3] [*Move 1.1 Present background research*]. Although it has been suggested that haemoglobin must play a role in buoyancy control[4–6], this has not been directly confirmed [*Move 1.2 — Gap identification*]. By using new technol-

> ogy involving a sensitive electronic balance and fibre-optic oxygen sensors (for details of methods, see supplementary information), we have been able to measure changes in buoyancy and oxygen partial pressure (*p*O2) within the bubble of the Australian backswimmer *Anisops deanei* [*Method*]. (Text 20, Para. 3)

This finding appears to further support the notion that the SRAs examined here are susceptible to various forms of part-genre mixing.

6. Discussion and Pedagogical Implications

Our analysis of the introductory sections of a small corpus of short research articles published in *Nature*'s Brief Communications revealed a number of organizational differences in move structure and function between these texts and standard RAs. While first paragraphs recognizably function as abstracts and contain most typical moves for this part-genre, though some omit or only briefly imply methods, they are shorter than typical RA abstracts. The need to condense information can lead to a higher incidence of multiple moves in a single sentence and could also lead to more dense and difficult texts, realized by more complicated language, such as complex noun phrases, as noted by Biber *et al*. (1999) for news text. As Halliday observes (1993), these features can make texts ambiguous and difficult to comprehend, the more so for non-native English speakers. One study of Spanish learners of English (Carrió Pastor, 2008), which investigated the variety of ways in which premodified complex noun phrases drawn from medical articles were translated, suggests that the more complex phrases are, the more difficult identification of the key words becomes. Although in this study we do not evaluate complexity at the phrasal level as Carrió Pastor does, it is possible that for apprentice scientific writers SRAs could in some ways potentially less accessible and more difficult to comprehend than typical RAs. Whether this is indeed the case could be tested by a comparison of lexical density between our corpus and a corpus of standard RAs from *Nature*.

We found that first paragraphs tend to be cohesively linked to subsequent background paragraphs. This is achieved through

citation use, through funnelling of background information, which is introduced in the first paragraph and subsequently developed, but not repeated, through definitions given in the first paragraph, which are then required reading as part of the whole text, and through the use of cohesive lexical chains that span the introductory section. These features combine to embed the first paragraph as abstract into a fuller introduction. This is significantly different from the stand-alone abstract that can be regarded as a separate text that accompanies a standard RA, describing its findings (Ayers, 2008; Cross & Oppenheim, 2006; Lorés, 2004).

The introductory paragraphs that followed the first paragraph also differed from typical RA introductions in the prominence of the informational and contextualizing move 1 at the expense of other moves. The indication of a gap in the field was found in slightly less than half the texts and there was little explicit use of the presenting research questions or hypotheses move. Move 3.1, announcing the present research, identified by Swales (2004) as obligatory, was not found at all, although a similar function was performed by the obligatory move 2 in the first paragraph We suggest that the first paragraphs in our corpus combine the roles and features of the abstract and introduction found in standard RAs, and therefore that these SRAs differ significantly from standard RAs. Although we only studied the initial sections and did not systematically analyse the methods, results and discussion sections, we suspect that similar part-genre mixing probably occurs in these sections, and that this is a feature of the SRA per se, not simply the initial sections studied here. Further research would reveal whether this is the case. In addition, our research has demonstrated the utility of genre analysis as a tool for exploring the texts which teachers use in the classroom.

In terms of pedagogical applications, the findings suggest that SRAs do not provide straightforward short proxy models of typical RAs, and that teachers selecting authentic texts to teach the discourse structure of particular part-genres or sections of an RA should consider using more than just SRAs for identifying target functions that will be useful to their students. Nevertheless, using SRAs such as Brief Communications papers to model the basic IMRD organization of an RA as a whole and to teach

students how to identify prominent and visible features of each section can be effective. The overall size and lexical formulaicity of BCs, the well known function expressing chunks such as the abstract's *here we* or the method section's *To test... we + past tense verb*, are advantages here. Even though these SRAs do not have subheadings identifying individual sections, which adds a level of difficulty to identifying the sections, it is straightforward to devise tasks that focus students on the transferable structural features, the moves, found in the SRAs, and which avoid the need to read and comprehend potentially complex and dense content. Analysis of SRAs can be a practical and achievable point of entry for novice scientific writers, and success here can be motivating.

A further use of the SRA is identifying, comparing and contrasting the moves and their expression with those found in standard RAs. Such awareness-raising activities are useful for extending and consolidating learners' abilities to analyse and understand scientific texts. Comparisons encourage consideration of difference and similarity in structure, style and detail, of authorial intention and audience, of editorial policy and constraints, and do transfer into students' writing (Nazarenko and Schwarz, 2010; Sutton, 2000). We find that even novice students are able to identify and reflect on multiple levels (e.g. lexicogrammatical, audience, content, utility, appeal) on the similarities and differences between a Brief Communications first paragraph, a typical RA abstract and a structured abstract, for example. Awareness of genre features is a valuable part both of encouraging skills in writing, but also in thinking in the style of the discourse community learners are joining (Nazarenko and Schwarz, 2010; Mustafa, 1995; Hammond 1987).

In addition to their uses in modelling some aspects of rhetorical structure and function, SRAs can also play a role in familiarizing students with important register differences between formal scientific writing and other textual genres (Fang 2005, p. 344) that they may be more familiar with, such as popular magazines or essays in English tests. Nazarenko and Schwarz (2010) note that increased focus on genre in the writing class can help students focus on the audience and purpose of particular types of text, rather than on the creation of error-free texts that lack a specific purpose or intention.

In considering the use of authentic texts for modelling scientific writing for non-native English speaking novice scientists, choice of model texts depends on many contingent factors such as student needs, specialism, ability, focus, class size, and course duration, to name but a few. Our research suggests that while SRAs can certainly be useful models, they have their own genre-specific features, some of which may result from their size, and are not straightforwardly RAs in miniature.

Notes

i Although omitted from this analysis these two texts are interesting examples of how the first paragraph, which might be expected to function as an abstract, can be sufficient to contextualise a study as an introduction.

ii However, Ayers identifies these as signaling a 'conclusion' move.

iii It is unclear in Samraj's study (2005) whether the same gaps were repeated in both abstract and introduction.

References

Ayers, G. (2008). The evolutionary nature of genre: An investigation of the short texts accompanying research articles in the scientific journal *Nature*. *English for Specific Purposes, 27*(1), 22–41.

Bhatia, V. K. (1993). *Analysing Genre: Language Use in Professional Settings*. Harlow: Longman.

Biber, D., Johansson, S., Leech, G., Conrad, S. & Finegan, E. (eds.). (1999). *Longman Grammar of Spoken and Written English*. London: Longman.

Bruce, I. (2009). Results sections in sociology and organic chemistry articles: A genre analysis. *English for Specific Purposes, 28*(2), 105–124.

Carrió Pastor, M. L. (2008). English complex noun phrase interpretation by Spanish learners. *Spanish Journal of Applied Linguistics (RESLA), 21*, 27–44.

Changing *Nature*. (1999). *Nature, 401* (September 2), 1.

Cheng, A. (2008). Analyzing Genre Exemplars in Preparation for Writing: The Case of an L2 Graduate Student in the ESP Genre-based Instructional Framework of Academic Literacy. *Applied Linguistics, 29*(1), 50–71.

Cross, C. & Oppenheim, C. (2006). A genre analysis of scientific abstracts. *Journal of Documentation, 62*(4), 428–446.

Cumming, A. (1995). Fostering writing expertise in ESL composition instruction: Modeling and evaluation. In D. Belcher & G. Braine (eds.).

Academic writing in a second language: Essays on research and pedagogy. Norwood, NJ: Ablex, pp. 277–291.

Dubois, B. L. (1997). *The Biomedical Discussion Section in Context*. Greenwich: CT, Ablex.

Dudley-Evans, T. (2000). Genre analysis: a key to a theory of ESP? *Ibérica, 2*, 3–11.

Fang, Z. (2004). Scientific literacy: A systemic functional linguistics perspective. *Science Education 89*(2), 335–347.

Feak, C. B. & Swales, J. M. (n.d.). Journal article abstracts. Available at: http://turkey.usembassy.gov/uploads/images/WX6duzqT06rI9geYcx3UrA/FeakAbstracts_and_the_Writing_of_Abstracts_March_2.pdf (Accessed 21/06/09).

Halliday, M. A. K. (1993). Some grammatical problems in scientific English. In M. A. K Halliday & J. R. Martin (eds.). *Writing Science: Literacy and Discursive Power*. Pittsburgh, PA: University of Pittsburgh Press, pp. 69–85.

Halliday, M. A. K. & Hasan, R. (1976). *Cohesion in English.* London: Longman.

Hammond, J. (1987). An overview of the genre-based approach to the teaching of writing in Australia. *Australian Journal of Applied Linguistics, 10*, 163–181.

Holmes, R. (1997). Genre analysis, and the social sciences: an investigation of the structure of research article discussion sections in three disciplines. *English for Specific Purposes, 16*(4), 321–377.

Hopkins, A. & Dudley-Evans, T. (1988). A genre-based investigation of the discussion sections in articles and dissertations. *English for Specific Purposes, 7*(2), 113–22.

Hyland, K. (2000). *Disciplinary discourses: Social interactions in academic writing*. London: Pearson.

Hüttner, J. (2008). The genre(s) of student writing: developing writing models. *International Journal of Applied Linguistics, 18*(2), 146–165.

Lorés, R. (2004). On RA abstracts: from rhetorical structure to thematic observation. *English for Specific Purposes, 23*(3), 280–302.

Marshall, P. (1991). A genre-based approach to the teaching of report-writing. *English for Specific Purposes, 10*, 3–13.

Martín, P. M. (2003). A genre analysis of English and Spanish research paper abstracts in experimental social sciences. *English for Specific Purposes, 22*(1), 25–43.

Morton, R. (1999). Abstracts as authentic material for EAP classes. *ELT Journal, 53*(3), 177–182.

Mustafa, Z. (1995). The effect of genre awareness on linguistic transfer. *English for Specific Purposes, 14*(3), 247–256.

Myers, G. (1992). 'In this paper we report . . .': Speech acts and scientific facts. *Journal of Pragmatics, 17*(4), 295–313.

Nation, I. S. P. (2001). Learning Vocabulary in Another Language. Cam-

bridge: Cambridge University Press.
Nazarenko, L. and Schwarz, G. (2010). A refocused approach to writing instruction: incorporating a focus on genre into the writing process. *Writing & Pedagogy, 2*(1), 103–116.
Nwogu, K. N. (1997). The medical research paper: Structure and functions. *English for Specific Purposes, 16*(2), 119–138.
Ozturk, I. (2007). The textual organisation of research article introductions in applied linguistics: Variability within a single discipline. *English for Specific Purposes, 26*(1), 25–38.
Parkinson, J. & Adendorff, R. (2004). The use of popular science articles in teaching scientific literacy. *English for Specific Purposes, 23*(4), 379–396.
Peacock, M. (2002). Communicative moves in the discussion section of research articles. *System, 30*(4), 479–497.
Quantified Brief Communications. (2006). *Nature, 441* (June 1), xi.
Salager-Meyer, F. (1991). Reading expository prose at the post-secondary level: the influence of textual variables on L2 reading comprehension (a genre-based approach). *Reading in a Foreign language, 8*(1), 645–662.
Samraj, B. (2002). Introductions in research articles: variations across disciplines. *English for Specific Purposes, 21*(1), 1–17.
Samraj, B. (2005). An exploration of a genre set: Research article abstracts and introductions in two disciplines. *English for Specific Purposes, 24*(2), 141–156.
Santos, M. B. (1996). The textual organization of research paper abstracts in applied linguistics. *Text, 16*(4), 481–499.
Simpson-Valch, R. & Ellis, N. C. (2010). An Academic Formulas List: New Methods in Phraseology Research. *Applied Linguistics,* 31, 4, 487–512.
Sollaci, L. B. & Pereira, M. G. (2004). The introduction, methods, results and discussion (IMRAD) structure: a fifty-year survey. *Journal of the Medical Library Association, 92*(3), 364–371.
Sutton, B. (2000). Swales' "Moves" and the Research Paper Assignment. *Teaching English in the Two-Year College, 27*(4), 446–451.
Swales, J. M. (1990). *Genre analysis*. Cambridge: Cambridge University Press.
Swales, J. M. (2004). *Research genres: Explorations and applications.* Cambridge: Cambridge University Press.
Swales, J. M. (2009). When there is no perfect text: Approaches to the EAP practitioner's dilemma. *Journal of English for Academic Purposes, 8*, 5–13.
Swales, J. M. & Feak, C. B. (2004). *Academic Writing for Graduate Students*. 2nd edition. Ann Arbor: The University of Michigan Press.
The brief goodbye. (2006). *Nature, 443* (September 21), 246.
Williams, I. A. (1999). Results Sections of Medical Research Articles: Analysis of Rhetorical Categories for Pedagogical Purposes. *English for Specific Purposes, 18*(4), 347–366.
Wood, A. S. (1982). An Examination of the Rhetorical Structures of Authentic Chemistry Texts. *Applied Linguistics, 3*(2), 121–143.
Yen, S-C. (2008). Teaching EFL Undergraduates Research Writing through

Modeling: Students' Difficulties, Perception and Their Use of Rhetorical Patterns in the Introduction Section. *25th International Conference of English Teaching and Learning 2008 Conference on English Instruction and Assessment*.

Appendix: Corpus of *Nature* Brief Communications Texts

1. Anderson, B., Cole, W. W. & Barrett, S. C. H. (2005). Specialized bird perch aids cross-pollination. *Nature, 435* (5 May), 41.
2. Hill, R. A. & Barton, R. A. (2005). Red enhances human performance in contests. *Nature, 435* (19 May), 293.
3. Behringer, D. C., Butler, M. J. & Shields, J. D. (2006). Avoidance of disease by social lobsters. *Nature, 441* (25 May), 421.
4. Solomon, J. & Hartmann, M. J. (2006). Robotic whiskers used to sense features. *Nature, 443* (5 October), 525.
5. Lelieveld, J., Lechtenböhmer, S., Assonov, S.S., Brenninkmeijer, C. A. M., Dienst, C., Fischedick, M. & Hanke, T. (2005). Low methane leakage from gas pipelines. *Nature, 434* (14 April), 841–842.
6. Holland, R. A., Thorup, K., Vonhof, M. J., Cochrane, W. W. & Wikelski, M. (2006). Bat orientation using Earth's magnetic field. *Nature, 444* (7 December), 702.
7. Watts, P. C., Buley, K. R., Sanderson, S., Boardman, W., Ciofi, C. & Gibson, R. (2006). Parthenogenesis in Komodo dragons. *Nature, 444* (21 December), 1021–1022.
8. Ley, R. E., Turnbaugh, P. J., Klein, S. & Gordon, J. I. (2006). Human gut microbes associated with obesity. *Nature, 444* (21 December), 1022–1023.
9. Rome, L. C., Flynn, L. & Yoo, T. D. (2006). Rubber bands reduce the cost of carrying loads. *Nature, 444* (21 December), 1023–1024.
10. Catania, K. (2006). Underwater 'sniffing' by semi-aquatic mammals. *Nature, 444* (21 December), 1024–1025.
11. Corder, R., Mullen, W., Khan, N. Q., Marks, S. C., Wood, E. G., Carrier, M. J. & Crozier, A. (2006). Red wine procyanidins and vascular health. *Nature, 444* (30 November), 566.
12. Woods, N-J., Bottero, V., Schmidt, M., von Kalle, C. & Verma, I. M. (2006). Therapeutic gene causing lymphoma. *Nature, 440* (27 April), 1123.
13. Friedman, R. S., McAlpine, M. C., Ricketts, D. S., Ham, D. & Lieber, C. M. (2005). High-speed integrated nanowire circuits. *Nature, 434* (28 April), 1085.
14. Coppa, A., Bondioli, L., Cucina, A., Frayer, D. W., Jarrige, J.-F., Quivron, G., Rossi, M., Vidale, M. & Macchiarelli, R. (2006). *Nature, 440* (6 April), 755.
15. Zykov, V., Mytilinaios, E., Adams, B. & Lipson, H. (2005). Self-reproducing machines. *Nature, 435* (12 May), 163.

16. Taylor, J. R. A. & Kier, W. M. (2006). A pneumo-hydrostatic skeleton in land crabs. *Nature, 440* (20 April), 1005.
17. Lane, T. W., Saito, M. A., George, G. N., Pickering, I. J., Prince, R. C. & Morel, F. M. M. (2005). A cadmium enzyme from a marine diatom. *Nature, 435* (5 May), 42.
18. Ponton, F., Lebarbenchon, C., Lefèvre, T., Biron, D. G., Duneau, D., Hughes, D. P. & Thomas, F. (2006). Parasite survives predation on its host. *Nature, 440* (6 April), 756.
19. Dyer, A. G., Whitney, H. M., Arnold, S. E. J., Glover, B. J. & Chittka, L. (2006). Bees associate warmth with floral colour. *Nature, 442* (3 August), 525.
20. Matthews, P. G. D. & Seymour, R. S. (2006). Diving insects boost their buoyancy bubbles. *Nature, 441* (11 May), 171.
21. Tsukamoto, K. (2006). Spawning of eels near a seamount. *Nature, 439* (23 February), 929.
22. Dejean, A., Solano, P. J., Ayroles, J., Corbara, B. & Orivel, J. (2005). Arboreal ants build traps to capture prey. *Nature, 434* (21 April), 973.