

Background Information in the Discussion Sections of Forestry Journals: A Case Study

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ABSTRACT

The Discussion section constitutes a powerful closing argument used by a researcher to highlight key findings in relation to the existing knowledge with the aim of facilitating readers' comprehension of the entire study. As previous research has yet to identify the frequencies of the different types of background information and the language resources used to present them, this study sought to identify the types of background information employed by expert writers, ascertain the frequencies and positions of the information concerned, and explore how expert writers use lexico-grammatical resources to present such information in the Discussion sections of Forestry research reports. Using a genre-based analytical framework, 60 Discussion sections in Forestry journals were studied. The findings revealed that provision of essential background information is a principal communicative move appearing in 95% of Forestry Discussion sections. This section comprises (i) contextual and theoretical information aimed at facilitating readers' comprehension of the findings to be presented, and (ii) a reiteration of objectives, methods and/or hypotheses of the research. Based on the findings, it is suggested that background information be highlighted to learners as a segment that serves a promotional function which emphasises the significance of their research topic in relation to the plenitude of past studies. Using the language resources identified in this study, it is recommended that lecturers teaching English for Research Purposes (ERP) focus on the use of (i) adjectives denoting prominence, (ii) investigative and procedural verbs, (iii) means and purposive adjuncts, and (iv) infinitive clauses describing expected behaviours in order to help learners clearly furnish relevant background information.

Keywords: research articles; genre analysis; Discussion sections; background information; Forestry

INTRODUCTION

While numerous universities in the world are becoming more internationalised and competitive, novice researchers and postgraduate students are also under increasing pressure to publish their work in high-impact journals (Flowerdew, 2016). Publications are the most important measure by which researchers are evaluated, while peer review provides a critical validation of the research methods and findings. It follows that professional progress and visibility depend not only on the content of research, but also on the researcher's ability to conform to the rhetorical conventions and language standards set by journals. Writing research articles (RAs) in English, therefore, is a critical skill to be imparted to all aspiring members of various disciplinary communities (Hyland, 2006; Kanoksilapatham, 2015). To

accommodate the needs concerned, programmes in English for Research Purposes (ERP) at tertiary level have now focused more attention on research articles given that the acculturation of students to this exemplar of scientific discourse constitutes a factor that impacts their academic success (Huang, 2017). In this context, studies of research articles using genre-based approaches have gained wide acceptance because they provide a framework within which the text is linked to a wider social context (Hyland 2004; Kuteeva, 2013).

Specifically, the English for Specific Purposes (ESP) approach to genre analysis aims to make the link between the writer's communicative strategies and the textual realization of a genre evident to novice writers (Bawarshi & Reiff, 2010). It provides the learners with a conscious awareness of the rhetorical structures of texts in their disciplines, thus enabling them to use the knowledge to produce their own texts (Hyland, 2007). In this study, the term 'learners' refers to novice writers and researchers who are non-native speakers of English and who receive instruction on writing research articles in ERP classrooms. Likewise, the term 'lecturers' refers to ERP academicians who teach the learners by applying the data available from a linguistic analysis of research articles written by expert writers in second language classrooms. One of the well-established rhetorical structures was based on the Create-a-Research Space (CARS) model proposed by Swales (1990, 2004). Swales (1990, 2004) demonstrated how textual units within research article Introductions could be classified into 'moves' and 'steps' based on their communicative functions. The approach, currently known as 'move analysis', lends itself well for extension into other parts of the empirical research article, namely, the Methods, Results and Discussion sections. The need to guide novice writers in writing well-crafted research articles has led to a number of studies on the rhetorical structure of the research article in the last three decades (e.g., Hopkins & Dudley-Evans, 1988; Kanoksilapatham, 2005; Lim, 2012; Nwogu, 1997; Peacock, 2002; Samraj, 2002; Tessuto, 2015; Yang & Allison, 2003).

Among the four main sections of the RA, the Discussion section is known to be more difficult for novice scholars (Loi et al., 2016) because writers are expected to go beyond the direct reporting of what have been conducted and found. This means that writers need to structure their Discussion section appropriately to make a powerful "closing argument" (Annesley, 2010, p. 1671) using various information elements, such as objectives, key findings, explanations for the findings, and strengths and/or limitations of their study (Basturkmen & Bitchener, 2005). It is therefore important for students to receive guidance in writing an interesting and meaningful Discussion section in order to enhance the readability and perceived merit of a research paper (Annesley, 2010).

The present study aims to provide input on the types of background information to be provided, the level of detail considered adequate by expert writers, and the lexico-grammatical features recurrently employed. The objectives of this study were to (i) identify the types of background information employed by expert writers, (ii) ascertain the frequencies and positions of the information concerned, and (iii) explore how expert writers use lexico-grammatical resources to present such information in the Discussion sections of Forestry research reports. Specifically, this study was guided by the following research questions:

- i. What types of background information are employed by expert writers in the Discussion sections of Forestry research reports?
- ii. To what extent do expert writers incorporate background information and how is it positioned in the Discussion sections of Forestry research reports?

- iii. How do expert writers use lexico-grammatical resources to present background information in the Discussion sections of Forestry research reports?

The term “expert writers” is used in this paper to refer to writers of texts or papers in established international peer-reviewed journals (Basturkmen, 2009, p. 243; Lim, 2017, p. 64).

LITERATURE REVIEW

In view of the importance of the Discussion section, a number of genre-based studies have looked into this major section of a research article. While some of the earlier models, including the influential eleven-move model proposed by Hopkins and Dudley-Evans (1988) were linear, the later models (Basturkmen, 2012; Kanoksilapatham, 2005; Yang & Allison, 2003) included constituent steps in each move. In general, there is agreement that the Discussion section covers background information, statements of findings, explanations for findings, generalisations, comparisons of results with past research findings, indications of the significance of the study, and recommendations for future research (Lim, 2008a, 2008b; Yang & Allison, 2003). These information elements, as reflected in Yang and Allison’s (2003) model, have been categorised by Lim (2005, p. 34) as preparatory (i.e. ‘background information’), presentational (i.e., ‘reporting findings’, ‘summarising results’, and ‘summarising the study’) and commentary (‘commenting on results’, ‘evaluating the study’ and ‘deductions from the study’).

While the presentational and commentary moves take the centre-stage in the Discussion section, the ubiquitous preparatory move draws its value from a clear facilitative function. Kanoksilapatham (2005) labelled it ‘contextualizing the study’ and indicated that it is a move that is employed in 90.0% of the Discussion sections in Biochemistry and realized by means of two steps: (i) ‘describing existing knowledge’, and (ii) ‘presenting generalizations, claims, deductions or research gaps.’ These strategies are employed to state the importance of the topic, refer to past studies and indicate the limitations of such studies. The description of the context of a study allows writers to “go beyond the results” and relate their findings to existing knowledge in the discipline, which is in fact the very purpose of Discussion sections (Kanoksilapatham, 2005, p. 283). The steps proposed by Kanoksilapatham (2005) is reflected in Tessuto’s (2015, p. 21) study of the Discussion sections in Law. He found that 100% of the Discussion sections in Law contained ‘providing background knowledge’, out of which 40.0% involved a restatement of ‘aims, methodology, theory and concepts’, while 60.0% involved the presentation of claims, generalizations, and research gaps (Tessuto, 2015, p. 19). However, this reference to claims, generalizations and research gaps is not evident in other models (Basturkmen, 2012; Loi et al., 2016; Peacock, 2002; Yang & Allison, 2003), which largely consider background information as consisting of references to the context, theory, objectives and methods of the study being reported. For instance, Basturkmen (2012, p. 137) reported that in Dentistry Discussion sections, ‘background information’ is referred to “research purposes, theory (and) methodology.” It is conceivable that claims, generalizations and research gaps form part of the context of the research. The move was employed in 60.0% of Dentistry Discussion sections (Basturkmen, 2012). Loi et al. (2016) also reported the same function, although the percentage of articles in Education employing the move was 95.0%. In terms of the percentages of articles containing an information move, Peacock’s (2002) study, covering the Discussion sections of RAs in seven disciplines, indicated wide disciplinary variations. The results included a high

of 71.5% in Biology to a low of 19.5% in Environmental Science, which is a discipline closer in nature to Forestry.

Taken together, the functions of preparatory information can be summarised as a review or recapitulation of research purposes, theory and methodology (Basturkmen, 2012, Peacock, 2002, Yang & Allison, 2003) and/or the presentation of claims, generalizations, and research gaps aimed at providing a context to the study (Kanoksilapatham, 2005; Tessuto, 2015). This explains why Swales (2004, p. 236) referred to such information elements as “a general resetting of the research scene. This study follows the two-step model proposed by Tessuto (2015) to explore the specific types of information that expert writers include in the Discussion sections of Forestry research articles. In many disciplines (e.g., Dentistry, Irrigation and Drainage, Biology, Applied Linguistics), the Discussion section opens with the move ‘background information’ (Basturkmen, 2012; Hopkins & Dudley-Evans, 1988; Yang & Allison, 2003), which constitutes a freestanding move that can occur anywhere in the cycle, thus serving to refresh readers’ memory of the main points and the technical and theoretical aspects of the study (Hopkins & Dudley-Evans, 1988; Swales, 1990).

Although the aforementioned past studies (e.g., Basturkmen, 2012; Kanoksilapatham, 2005; Loi et al., 2016; Tessuto, 2015) did indicate the function of background information using some brief explanations and instances, they have not explored in greater detail how expert writers provide background information regarding the study being reported. Moreover, in these studies the language mechanisms used to provide preparatory information have not been studied in sufficient detail. Lim (2011, p. 127) has noted that such uncertainty regarding salient linguistic features of specific steps poses problems for novice writers in terms of “content and language.” The review of studies on this topic has shown that analysis of this move is likely to furnish useful information for novice writers who are uncertain about how background information can be presented in the Discussion section.

METHODOLOGY

SAMPLE

A sample of 60 Discussion sections of research articles in the field of Forestry was collected. It needs to be pointed out here that the minimum requirement for the number of cases (or texts) to be included for a quantitative analysis could be 20 (Warner, 2008, as cited in Corder & Foreman, 2009) or 30 (Salkind, 2004, as cited in Corder & Foreman, 2009). For instance, in a comparative genre-based study of abstracts in Economics and Applied Linguistics, Chan and Ebrahimi (2012) included 30 texts from each of the two disciplines. However, in this study that focuses on Forestry, it was decided to include 60 research articles in order to ensure a more comprehensive coverage of the discipline in terms of both content and language choices.

The articles were selected from four Forestry journals published in 2011 and 2012, namely *Forest Science*, *Forest Ecology and Management*, *Canadian Journal of Forest Research* and *Agricultural and Forest Meteorology*. A purposive sampling procedure was used to select 15 research articles from each journal. The sampling procedure was purposive in that it followed three basic criteria relating to the purpose of the study. First, it was ensured that all the articles were published in Quartile 1 journals (in Web of Science) to ensure that all the journals were reputed and established. Following Lim (2012), these journals were chosen not only because of their extensive coverage of topics in Forestry, but also in view of their high-impact values in the field of Forestry. As reported in the 2011 *Journal Citation Reports* (Thomson Reuters, 2011), the four journals mentioned above were all Quartile 1 journals with impact values of 1.047, 2.487, 1.685 and 3.389 respectively. Second, due to the

focus of the study, it was ensured that all the articles included a distinct Discussion section. Third, the articles had to be selected from the most recently published issues when the investigation began. Journals published in 2011 and 2012 were chosen in order to ensure that the articles represented what were the most recent in writing practices in the discipline at the time when the study commenced.

DATA ANALYSIS PROCEDURE

Data analysis was carried out using Swales' (1990, 2004) move-step analytical framework to identify the communicative functions of text segments in the Discussion sections. The communicative focus of each sentence as well as linguistic clues such as specific lexical items, discourse markers, tense and modality changes, and verb forms (Connor & Mauranen, 1999; Nwogu, 1997; Yang & Allison, 2003) were examined to distinguish text segments which provided background information to the study. On the basis of previous models (Basturkmen, 2012; Yang & Allison, 2003), separate functional labels (or codes) were assigned to indicate whether the text segments included related information or a restatement of study objectives, hypotheses and methods. A text segment identified as providing relevant contextual or theoretical information was marked by a code 'M1-S1', thus indicating that it represented Move1-Step 1 (i.e., 'providing background information' via 'presenting related information'). Such coding based on discourse functions aimed to assign a "summative, salient, essence-capturing" attribute for the text segments (Saldaña, 2013, p. 3). The codes assigned to each step subsequently aided the detection of the frequency and distribution of 'providing background information' in Forestry Discussion sections. The reliability of the coding process was tested using the intra-coder reliability test, whereby the text was revisited three months after the first coding to check if the researchers agreed with the functional labels assigned in the first round. Examples of text segments which were given a different functional label during the recoding process are shown in Table 1.

The first example was initially labelled as a restatement of a research question in order to provide a background to the study; however, it was found that the Introduction section did not include any research question. Hence, in the second round of coding, it was appropriately relabelled as 'presenting related information' to refer to text segments that explained the context of the study being reported. In the second example, the adjective 'speculative' was initially construed to be a form of reference to the findings of the study being reported; nonetheless, during recoding, it was noticed that the statement should be read in conjunction with the ensuing text which clearly pointed to a previous study. In addition, the usage of the present tense to indicate the state of knowledge in the field also pointed to a gap indication which constitutes a provision of background information relating to the current study. After the recoding exercise, the percentage of agreement was calculated using the formula $A-B/A \times 100$, where A refers to the total number of text segments, and B stands for the number of coding disagreements in each round (Lim, 2014).

TABLE 1. Examples of Changes in Functional Labels during the Recoding Process

Instance of Text Segment	Original Functional Label	Revised Functional Label
We questioned whether the climate signal in our chronologies would match that of other chronologies from the region because the riparian setting of our samples contrasted with the typical upland setting of existing chronologies. (RA 1: 159)	'restating objectives, hypotheses or methods'	'presenting related information'
The ecological effects of <i>A. rubrum</i> proliferation are still <u>largely speculative as empirical tests are lacking</u> . However, Alexander	'indicating limitations of the	'presenting related

and Arthur (2010) examined seasonal variations of precipitation throughfall (the part of rainfall or other precipitation which falls to the forest floor from the canopy) and stemflow quantity and quality and assessed net nitrogen mineralization rates in underlying soils of *A. rubrum*, *Quercus prinus L.* and *Q. coccinea* on the Cumberland Plateau. (RA42: 131)

The intra-coder agreement attained after the second round of coding was 95.8%, thus meeting the requirement that code-recode reliability should be at least 90.0% (Miles & Huberman, 1994) to be satisfactory. The process was repeated after a further three months, eventually resulting in complete intra-coder agreement.

Subsequently, the numbers of occurrences of the move and the constituent steps in the corpus were assessed. The move was categorised as “obligatory,” if it occurred in all (100%) of the Forestry RAs, “quasi-obligatory” if it occurred in 51% to 99% of the texts, and “optional” or “peripheral” if it appeared only in 50% or less of the texts (Soler-Monreal et al., 2011, p. 8; Joseph et al., 2014; Wong & Lim, 2014, p. 151; Yang & Allison, 2003, p. 372-374). A move sequence analysis was also carried out to assess the positioning of background information and to investigate the prominent “inter-move shifts” (Lim, 2012, p. 233; Lim et al., 2015, p. 71) or “recurrent connections between information elements” (Lim, 2014, p. 72) between background information and other information elements in the section. Finally, a qualitative analysis was carried out to identify frequent and recurring instances of lexicogrammatical features which could be directly linked to the provision of background information (Lim, 2014; Mur Dueñas, 2009).

INTERVIEWS WITH SPECIALIST INFORMANTS

Subsequently, eight specialist informants were invited to provide their views in interviews about the presentation of background information relating to this study. It should be pointed out that our analysis was largely focused on the excerpts of the writers’ published reports (relating to background information), and the interviews were meant to provide only additional information about an aspect in which answers could not be obtained via a textual analysis. The criteria for selecting the specialist informants matched Bhatia’s (1993, p. 34) recommendation that they should be (i) “a practising member of the disciplinary culture in which the genre is routinely used” and (ii) an experienced individual who was able to confirm the researcher’s findings and provide “validity to his insights”. The specialist informants were experienced academicians in public universities and Forestry research centres based in Malaysia and India. They were selected because they (i) held doctorates relating to Forestry, and (ii) had published in ISI-indexed journals on Forestry. The interviews focused on the promotional aspect of background information in the Discussion section. Only one major question was posed to the specialist informants. The question was developed because our preliminary textual analysis showed that when researchers presented background information which was relevant to their research, they often used strategies that indicated the importance of the research field or signalled that it was an area of active research. Given that this type of promotional information usually appeared in the Introduction section in Forestry, the researchers asked the specialist informants to explain why it was necessary for them to highlight the importance of their research field/subfield/topic in the Discussion section of their research report. The interviews lasted about 20 minutes during which the opinions of the specialists were digitally recorded and transcribed manually.

RESULTS AND DISCUSSION

The findings of the study are presented and discussed in the following sections. First, the types of background information (relating to research question 1) are reported before the frequencies and positions of background information (relating to research question 2) are presented. Next, each communicative step is further discussed using examples in order to discuss how writers use the lexico-grammatical resources (relating to research question 3) to perform the rhetorical functions associated with each step.

FINDINGS ON THE TYPES OF BACKGROUND INFORMATION PROVIDED IN FORESTRY DISCUSSION SECTIONS

The analysis of 60 Discussions sections revealed that ‘providing background information’ constitutes an important quasi-obligatory move occurring in 95.0% (57/60) of the Discussion sections of the Forestry research reports. The principal rhetorical move performs two major communicative functions: (i) depicting a contextual and theoretical background to the reported research, and (ii) reminding readers of the objectives, hypotheses and methods of the study. The rhetorical move is realised using two constituent steps, namely (i) ‘presenting related information’ in Step 1, and (ii) ‘restating objectives, hypotheses or methods’ in Step 2 (as shown in Table 2).

FINDINGS ON THE FREQUENCIES AND POSITIONS OF BACKGROUND INFORMATION

In this context, ‘related information’ is used as a blanket term to cover the description of the context of the study, explanation of technical aspects, or provision of theoretical background related to the findings. For this reason, it is not restricted to the initial parts of the Discussion section, but appears in different portions of the Discussion section, thus reflecting Forestry researchers’ tendency to manipulate useful information. Step 2 (i.e., ‘restating objectives, hypotheses or methods’), on the other hand, refers to the objectives and assumptions of the study or indicates the methods used therein. Table 2 shows that compared to Step 1 (i.e., ‘presenting related information’), which is employed in 86.7% (52/60) of the Discussion sections, Step 2 (i.e., restating objectives, hypotheses or methods’) is employed in only 56.7% (34/60) of the texts. Such findings need to be considered from a critical point of view. To be specific, the difference across the two steps appear to suggest that expert writers in Forestry are relatively more confident of the readers’ ability to recall the objectives, hypothesis and methods of the study (via Step 2). In contrast, a vast majority of them have the propensity to remind readers of technical details or the contextual motivations of the study (in Step 1), thus signalling that relevant information based on previous research is used by Forestry researchers to pave the way for their main findings to be placed in a more pivotal position in the Discussion section.

TABLE 2. Constituent Steps of ‘Providing Background Information’

Constituent Step(s)	Number of Research Reports (n=60)	Percentage Research Reports (%)
Step 1: Presenting related information	52	86.7
Step 2: Restating objectives, hypotheses or methods	34	56.7
Step 1 and/or Step 2	57	95.0

Writers also prefer to begin their Discussion sections with a provision of background information. While 43.3% (26/60) of the Discussion sections begin with a provision of background information, only 35.0% (21/60) of them open with a text segment that highlights

a key finding. A possible explanation is that writers prefer to begin the section with some background information as it allows them to set the stage for subsequent findings instead of making an abrupt presentation of their results. As such, when ‘providing background information’ is employed as the opening move, it is most often followed by the presentation of a finding. Therefore the inter-move rhetorical shift between background information and the presentation of findings generally occurs at the beginning of several Discussion sections, as illustrated in Figure 1.

‘Providing background information’ as the opening move in Forestry Discussion sections	‘Highlighting a finding’ as the second move in Forestry Discussion sections
<p>Fuels treatments are designed to reduce fire severity and consequently should also reduce forest carbon loss from wildfire. (RA 33: 1118)</p>	<p>We found that treatments did reduce wildfire emissions by 57% but when carbon removed from the site during treatment (50.3Mg C ha⁻¹) is added to wildfire emissions, the total carbon loss is greater in fuels treated (80Mg C ha⁻¹) than untreated (67.8Mg C ha⁻¹) forest. (RA 33: 1118)</p>
<p>The process domain concept predicts that consistent associations should exist between the geomorphic structure of stream reaches and the physical processes that move wood from the adjacent forest into the stream channel. (RA18: 2239)</p>	<p>Our data support this view. We found that the processes by which wood entered alluvial streams from the adjoining forest varied with the geomorphology and size of the channel... (RA 18: 2239)</p>
<p>Our goal was to determine if forest management plans prepared with the involvement of the Innu people are different from those prepared without such involvement. (RA 19: 2255)</p>	<p>The results show an important change of approach in the Labrador plans between 1999 and 2003. Plan L00, with 29 pages focused on timber production, was replaced by longer documents addressing a wider range of issues. (RA 19: 2255)</p>
<p>We measured water use by young Alpine Ash trees that grew from seed after a stand-replacing fire in 2003, and by mature trees in adjacent plots that survived the fire. (RA36: 6)</p>	<p>Our data suggest plot-level transpiration is about 120% greater, or $1.3 \pm 0.3 \text{ mm d}^{-1}$ ($460 \pm 100 \text{ mm year}^{-1}$) greater in the regrowth than in the mature plots, seven years after the 2003 bushfire. (RA36: 6)</p>

FIGURE 1. Rhetorical Shifts from ‘Providing Background Information’ to ‘Highlighting a Finding’

The instances in Figure 1 show that the expert writers begin the Discussion section with research-related or theoretical information regarding a topic, such as information on how fuel treatments can reduce fire severity or the relationship between the geomorphic structure of channels and the manner in which wood enters the stream channel. Against this background, writers move on to reiterate their findings in the final Discussion section. For example, in RA 33, the writer points out how fuel treatment did in fact reduce wild fire emissions in specific conditions. In another example (RA 19), the writer states the goal of the current study which was to determine whether a difference existed in forest management plans before stating the result that a difference indeed could be found in plans involving the local population. Such a presentation of main findings against the backdrop of what is already known about a topic (or against the initial purpose) can be interpreted as an attempt to set the stage for a fuller appreciation of their major findings. These two steps constituting background information are discussed more thoroughly in the following sections.

FINDINGS ON THE LEXICO-GRAMMATICAL RESOURCES USED TO PRESENT BACKGROUND INFORMATION IN FORESTRY

STEP 1: PRESENTING RELATED INFORMATION

Performing a context-building function, Step 1 (i.e., ‘presenting related information’) is reflective of the territory establishment move in the Introduction section as it aims to remind the reader once again of the importance of conducting the study, as shown in the following examples.

- (1) Historical analysis is a necessary first step when considering the likely impacts of climate change on chill accumulation. (RA 5: 1081)
- (2) One major emphasis of soil monitoring efforts, particularly in the USDA Forest Service, is the amount of DSD generated from ground-based harvesting and keeping this level below the threshold of 15% areal extent. (RA 28: 825)
- (3) The long-term impact of atmospheric deposition inputs on unglaciated forested soils in Pennsylvania has been proposed as a major factor limiting oak regeneration success by those who discount the alternative hypothesis of excessive deer browsing (Mulhollem 2002; Frye 2006). (RA 27: 698)
- (4) Coarse wooden debris is an important stand legacy that provides habitat for saproxylic organisms (Siitonen, 2001), which in turn plays essential ecological roles in nutrient cycling and decomposition (McGill and Spence, 1985). (RA 16: 2189).

As illustrated in the selected examples, adjectives indicating prominence (i.e., ‘necessary’, ‘major’, ‘important’, ‘essential’, etc.) are employed to pre-modify nouns denoting effort, aspect or function (e.g., ‘step’, ‘emphasis’, ‘factor’, ‘legacy’, ‘role’, etc.), thus signalling that the study is by no means trivial; on the contrary, it constitutes a momentous action in the right direction.

While referring to past research, with which their current findings may agree or disagree, expert writers cite a large body of research (which resemble centrality claims in the Introduction section) to project the impression that their research field actually occupies a vibrant area of research activity. This means that the expert writers have the propensity to invoke relevant past research in their Discussion sections so as to accentuate a sizeable quantity of previous studies that potentially support or require further information, which will be subsequently highlighted in their final Discussion section. Instances of such information are illustrated in the examples that follow:

In these examples, writers refer to a considerable body of existing research to highlight what is currently known regarding the object of their enquiry, whether it be a forest phenomenon (e.g., ‘wind damage following partial cuts’, ‘leaf angle’, etc.) or a relationship between certain variables (e.g., ‘influence of environment on development of *Cyclaneusma*’, ‘correlations between soil-to-leaf hydraulic conductance and g_s or E ’, etc.).

- (1) Many studies have examined how stand characteristics and species composition influence SBW defoliation and mortality in balsam fir and spruce stands (MacKinnon and MacLean 2003). (RA16: 2188)
- (2) Numerous studies have quantified wind damage following partial cuts and related it to stand features (e.g., Ruel et al. 2003; Thorpe and Thomas 2007). (RA16: 2189)
- (3) A series of recent studies has demonstrated the potential use of high-frequency repeat photography with conventional digital cameras to continuously monitor vegetation canopies for phenological research (Ahrends et al., 2008, 2009; Ide and Oguma, 2010; Kurc and Benton, 2010; Richardson et al., 2007, 2009a; Sonnentag et al., 2011). (RA7: 170)
- (4) Considerable research has demonstrated a moderate influence of environment on development of *Cyclaneusma* over a number of important stages in the lifecycle. (RA26: 672)
- (5) Sources of error for particular C pools, and model aptness, have been described by numerous authors (e.g. Dean et al., 2004; Dean and Wardell-Johnson, 2010; Köhl et al., 2008; Lindner et al.,

- 2008; Nabuurs et al., 2008; Seidl et al., 2008). (RA14: 164)
- (6) Bank erosion has frequently been reported as an important mechanism for LWD recruitment to large, low-gradient alluvial streams but few studies report quantitative data on the proportion of LWD entering by erosion. (RA18: 2241)
 - (7) The chemistry of the NO-O₃-NO₂ triad has been extensively studied (De Arellano and Duynkerke, 1992; De Arellano et al., 1993; Duyzer et al., 1995, 1997; Krammet al., 1995, 1996). (RA3: 676)

For this purpose, adjectives denoting plenitude are used to pre-modify nouns referring to research or writers themselves (e.g., ‘numerous studies’, ‘many studies’, ‘a series of recent studies’, ‘considerable research’, ‘numerous authors’, etc.). What these studies have revealed or investigated are then presented using reporting verbs (e.g., ‘shown’, ‘demonstrated’, ‘reported’, ‘described’, etc.) and investigative verbs (e.g., ‘studied’, ‘examined’, etc.). Alternatively, verb phrases referring to frequent or wide-ranging research (e.g., ‘has frequently been reported’, ‘has extensively been studied’, etc.) are employed to perform the same communicative function. While it is known that the present perfect tense can be employed to refer to an action “which has occurred a number of times during a period extending from a definite time in the past until now” (Lim, 2007, p. 374), it is also observed that the present perfect is recurrently used by Forestry researchers to refer to past research undertaken up to the point of the current study. The reference to active research or the importance of the topic supports Basturkmen’s (2012) suggestion that there is a distinctive promotional element in Discussion sections aimed at attracting the readers who read the Discussion section first to assess the relevance of the study to their needs.

The specialist informants engaged in this study differed in their opinions on the promotional aspect of referring to the importance of the study or the abundance of significant past studies. Four out of the eight specialist informants were of the view that repeating what has been presented in the Introduction section causes redundancy and hence should be avoided. For instance, Specialist Informant A (SIA) said that when a writer refers to what past studies have found, it is with the purpose of juxtaposing what the current study has found on the same aspect. However SIA said that “it is not really necessary.” This sentiment was echoed by Specialist Informant C (SIC) who said that “it is already in the Introduction, then if it is mentioned again in the Discussion, it is redundant.”

Regarding the promotional function of reiterating the study background, Specialist Informant H (SIH) opined that “many people do that” and that was “mainly because you (they) are in a particular field of research and you (they) want to highlight that it is an important field.” To be specific, three of them opined that it is important to remind readers of the significance of the research in the final section, especially in the light of new findings. According to Specialist Informant B (SIB), the Discussion section is where researchers would like to once again point out that “their paper is relevant to the current context,” particularly if there are policy issues involved. In addition, Specialist Informant G (SIG) stated that references to the study background are meant “to make the audience aware (of) how important the finding is.” SIG went on to explain that in the Introduction section a researcher may refer to several past studies but the finding or the values of the present research are not mentioned because “in the discussion you are comparing your value and their value.”

Specialist Informant F (SIF) took a different view of the references to active past research and stated that “this is not so much an important statement.” To SIF, “numerous studies” is basically used to show that “it is a consistent result” rather than an importance-related statement. To sum up, in referring to a substantial number of past studies, Forestry researchers only state that something is clearly known about a research field and they do not particularly call attention to the large number of studies in the research area.

Aside from referring to past research, Step 1 (i.e., ‘presenting related information’) serves a more obvious explicatory function, whereby the writer provides explanations or descriptions that facilitate readers’ understanding of a concept or method, as shown in these examples:

- (1) Slash necromass is a function of pre-logging biomass (Ellis et al., 1982), the proportion of timber recovered, the relative biomass of non-target species, and stand age (Ximenes et al., 2008). (RA14: 164)
- (2) Patterns of spread in natural systems are inherently anisotropic, with impacts varying greatly depending on the complexity of the environment in which the spread occurs. (RA10: 114)
- (3) Leaf hydrophobicity measures the contact angle between the leaf surface and the water droplet. (RA6: 14)
- (4) The scale of an ecological investigation is typically described in terms of spatial extent and grain and duration or temporal extent (O’Neill et al. 1986; Wiens 1989; Allen and Hoekstra 1992). Grain refers to the size of individual units of observation, and spatial extent is the overall area included in the study. (RA17: 2199)
- (5) Long oak tree-ring chronologies such as ours are typically constructed from trees growing in or near wet environments, as water is the cause for burial and preservation. (RA1: 159)

The aforementioned examples indicate that expert writers insert background information in the Discussion section in order to help the reader grasp (i) a concept with reference to its key characteristics, and (ii) a method in terms of how variables are measured or described. In explaining the technical and/or theoretical aspects of the study being reported, the term explained is deployed in the sentence-subject position (e.g., ‘Slash necromass’, ‘Long oak tree chronologies’, etc.), followed by a copular verb (as in ‘is a function of pre-logging biomass’, ‘are inherently anisotropic’, etc.) or a procedural verb in the simple present (e.g., ‘is described’, ‘is constructed’, ‘measures’, etc.) which describes a regular occurrence in the field of Forestry.

STEP 2: RESTATING OBJECTIVES, HYPOTHESES, OR METHODS

The second major type of background information that was found in Forestry Discussion sections has to do with the restatement of study objectives, hypothesis and methods. Writers reiterate the goals and hypotheses of the study not only to refresh the reader’s memory, but also to foreground the fact that their study has indeed attained these objectives or arrived at a conclusion regarding the hypotheses presented earlier in the study. A concise statement of methodology, often preceding the presentation of a particular finding, is written to help the reader to recall how the finding was arrived at. The presentation of study objectives in the Discussion section is also comparable to its presentation in the Introduction section in that it can either be descriptive or purposive in terms of communicative functions. While descriptive announcements inform readers about what the study sets out to do without overt lexical references to goals, purposive announcements are characterised by purpose-related lexemes (e.g., ‘goal’, ‘objective’, etc.), as illustrated in Table 3.

As shown in Table 3, writers employ the subject-predicator-object (SPO) structure to provide a concise description of the study. The sentence-subject referring to the research or the report (e.g., ‘this study’, ‘this paper’, etc.) is linked by investigative verbs (e.g., ‘explored’, ‘examined’, etc.) or illustrative verbs (e.g., ‘demonstrates’, ‘presents’, etc.) to the sentence-object that depicts the focus of the study (e.g., ‘the frequency of cloud cover’, ‘the hypotheses’, ‘one method’, etc.).

TABLE 3. Re-announcing the Study Descriptively or Purposively in the Discussion Sections of Forestry Research Reports

Linguistic Mechanism	Instances of Restating Study Objectives in the Discussion Sections
Using investigative and reporting verbs to describe the study	<p><u>This study explored the hypotheses</u> that leaf angle is greater than the contact angle of leaf hydrophobicity and leaf angle is greater than the angle of water droplet retention for 11 species in a semi-arid region of the western United States. (RA6: 15)</p> <p><u>This study examined stands in two different provinces</u> with some unavoidable differences. (RA16: 2188)</p> <p><u>This paper demonstrates one method</u> for predicting daily minimum air temperatures in complex terrain using in situ air temperature measurements from inexpensive sensors. (RA4: 1073)</p> <p><u>This paper presents a DLMP modelling framework and demonstrates this method</u> through a case study that evaluates the impacts of forest management scenarios on the rebacked salamander. (RA21: 1101)</p>
Using purpose-related lexemes to state the objectives of the study	<p><u>Our goal was to compare</u> the frequency of cloudy, cloud-immersed, and clear sky days for both the morning and afternoon periods. (RA15: 32)</p> <p><u>Our secondary objective was to document</u> the effects of liming on soil and foliar chemistry. (RA27: 707)</p> <p><u>The impetus</u> for our moving-window approach, <i>per90</i>, was to propose a simple statistical methodology that can be easily implemented and applied to any high-frequency archive of digital landscape images... (RA7: 173)</p> <p><u>Our primary objective was to compare</u> these two hypotheses and to test whether forest liming promoted NRO seedling growth more than excluding deer through fencing. (RA 27: 705)</p>

In Step 2, the verb in the simple past is usually preceded by a noun denoting research (e.g., ‘this study explored’, ‘this study examined’, etc.) and the verb in the simple present is preceded by a noun denoting the research report concerned (e.g., ‘this paper presents’, ‘this paper demonstrates’, etc.). Likewise, expert writers employ the subject-predicator-adverbial (SPA) structure to refer to their study objectives. In this context, the sentence-subject referring to the goal of the researchers (e.g. ‘our goal’, ‘our primary objective’, ‘the impetus’, etc.) is linked by a copular verb in the simple past to a purposive adjunct describing the objective of the study (e.g., ‘to document...’, ‘to compare...’, ‘to determine...’, etc.).

Instead of stating the objectives, expert writers include a reference to the study hypothesis. Such reiteration of the hypotheses, as illustrated in the following examples, aids readers to evaluate the results and their interpretations against the original assumptions that motivated the entire research. Instances of such information elements are given as follows:

- (1) In doing so, we assumed that balsam fir dominated stands follow similar stand dynamics after a severe SBW outbreak, regardless of region. (RA16: 2188)
- (2) It was assumed that a large portion of Pg fine roots would be present in the organic surface layer and that roots in this layer would provide a reasonable representation of the general lateral distribution. (RA 23: 1574)
- (3) We hypothesized that food availability would be linked to hardwood cover (Hammond and Miller 1998; Hagar et al. 2007. (RA30: 924)
- (4) We expected exposure to wind or sudden increase in insolation to result in greater mortality of trees around gaps than in controls. (RA40: 118)
- (5) We expect inputs of LWD by bank erosion at forested alluvial streams to be scale dependent, increasing with channel size and decreasing with tree height. (RA18: 2241)

The statements of assumptions and hypotheses in the Discussion sections of Forestry research reports are easily distinguished by means of verb phrases indicating expectations or hypotheses following sentence-subjects referring to the researchers (e.g., ‘we expected’, ‘we assumed’, ‘we hypothesized’, etc.). Writers present such sentences in the subject-predicator-

object (SPO) structure, whereby the verb denoting an assumption is followed by a nominal *that*-clause describing the study hypothesis (e.g., ‘we assumed that...’, ‘we expected that...’, etc.). Alternatively, the sentence-object appears in the form of a noun phrase referring to the variable being studied with an embedded infinitive clause describing the expected behaviour of the variable (e.g., ‘we expect inputs of LWD...to be scale dependent’, ‘we expected exposure to wind...to result in greater mortality of trees’, etc.).

More interestingly, background information in the Discussion section could also be a reference to a method used in the writers’ own research, especially in cases where the method is considered as having a significant impact on the results being interpreted. Such references to methods are recognizable from the use of a variety of procedural verbs in the simple past, particularly in the passive voice as shown in Table 4.

Table 4 shows that verbs generally found in Forestry Discussion sections refer to procurement/usage of data (e.g., ‘obtained’, ‘produced’, ‘used’, etc.), measurement of variables (e.g., ‘estimated’, ‘quantified’, ‘determined’, etc.), analysis of data (e.g., ‘calculated’, ‘analysed’, etc.), simulation and projection (e.g., ‘modelling’, ‘prediction’, etc.), and the inclusion/exclusion of data (e.g., ‘included’, ‘restricted’, ‘limited’, etc.). Compared to the Methods section, there is a limited repertoire of procedural verbs used in the Discussion section. A possible reason is that Forestry researchers provide very concise methodological details only in the Discussion section, just enough to indicate the sample included, the measurements made and the analyses carried out. Means adjuncts (e.g., ‘using a subset of landmarks’, ‘using conservative assumptions’, ‘by multiplying the density of ‘realized’ reserve trees’, etc.) and purpose adjuncts (e.g., ‘to partially mitigate the difficulties’, ‘to reduce use at the site by about one-third’, ‘to further reduce the influence of factors unrelated to climate patterns’, etc.) are employed in these methodological reiterations to inform readers of ‘how’ and ‘why’ the procedures were conducted.

TABLE 4. Procedural Verbs Used for Reiterating Methods in Forestry Discussion Sections

Linguistic Resource	Instances of Restatement of Methods in the Discussion Sections
Procedural verbs denoting procurement/usage	<p><u>We used the tree-ring standardization</u> of running a horizontal line through the mean for each ring-width series. (RA59: 373)</p> <p><u>An estimate of the space</u> occupied by reserve trees <u>was obtained</u> by multiplying the density of ‘realized’ reserve trees (3, 6, or 9 trees/ha) by their mean exposed crown area (140 m2). (RA37: 102)</p> <p><u>Predicted values</u> for the areal extent of DSD <u>were produced</u> from 167 harvest units and extrapolated over millions of pixels encompassing many variations of physical composition. (RA28: 828)</p>
Procedural verbs denoting measurement	<p><u>A comparison</u> of days with precipitation during all hours to days without precipitation <u>was estimated</u> to reduce use at the site by about one-third. (RA46: 288)</p> <p><u>In the model, the duration of net C uptake was determined</u> by the timing of germination and senescence...(RA8: 198)</p>
Procedural verbs indicating analysis	<p><u>Within these units of observation, we quantified wildfire activity</u> on a nominal scale in an effort to further reduce the influence of factors unrelated to climate patterns. (RA17: 2199)</p> <p>As much of the length of such fires is typically defined by distance travelled before the wind change, <u>optimal rotation was calculated</u> using a subset of landmarks dextral to the fire spread pattern to sample only the primary vector. (RA10: 116)</p> <p>Although the focus of this study was on lateral distribution, <u>some vertical distribution data were analyzed</u> to support the sampling protocol. (RA23: 1574)</p>
Procedural verbs denoting modelling/prediction	<p>With use of a regression tree of only past climate anomalies and autocorrelation terms as predictor variables, <u>mortality in whitebark pine habitat</u> (measured by EWDI) <u>was predicted</u>, with 38% of the data set deviance explained. (RA47: 331)</p> <p><u>We have modelled LTE and STE using</u> conservative assumptions for all the uncertain variables. (RA14: 166)</p>
Procedural	<p><u>In this work, g_i was included</u> in model configurations 2 and 3 as a constant, using the mean <i>g_i</i></p>

verbs denoting inclusion/exclusion	value measured in unstressed <i>P. nigra</i> trees over the course of the experimental period. (RA9: 249) To partially mitigate the difficulties inherent in the use of FIA plot data, we <u>restricted</u> our forest cover agreement assessment to <u>homogeneous 3 X 3 pixel blocks</u> . (RA53: 126) To mitigate this potential source of bias, we <u>limited</u> our analyses to <u>only those trees with a reconstructed 1900 DBH >10 cm</u> . (RA22: 1514) Climate change effects <u>were not included here</u> in the calculation of LTEs as the relative impact on logged and unlogged forests was not determined. (RA14: 164)
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It can also be noted that restatements of methodology are often accompanied by deictic references to the study or a section of it using position adjuncts (e.g., ‘in the model’, ‘in this work’, ‘within these units of observation’, etc.). Overall, such references to the study or a model used in the study, when referring to the methods used, signal the writers’ attempt to explain how a commonly used variable was processed in a Forestry study.

To find out how our findings have some theoretical implications, it is important to consider how previous research findings can be meaningfully linked with the findings of this study. ‘Theory’, in the context of this study, refers to the general statements that describe the behaviours of writers in the provision of background information in the Discussion section. Such behaviours need to be considered by comparing the tendencies of the writers to incorporate background information in different fields. The aforementioned tendencies are reflected through the disciplinary variations in the writers’ incorporation of background information as shown in Figure 2.

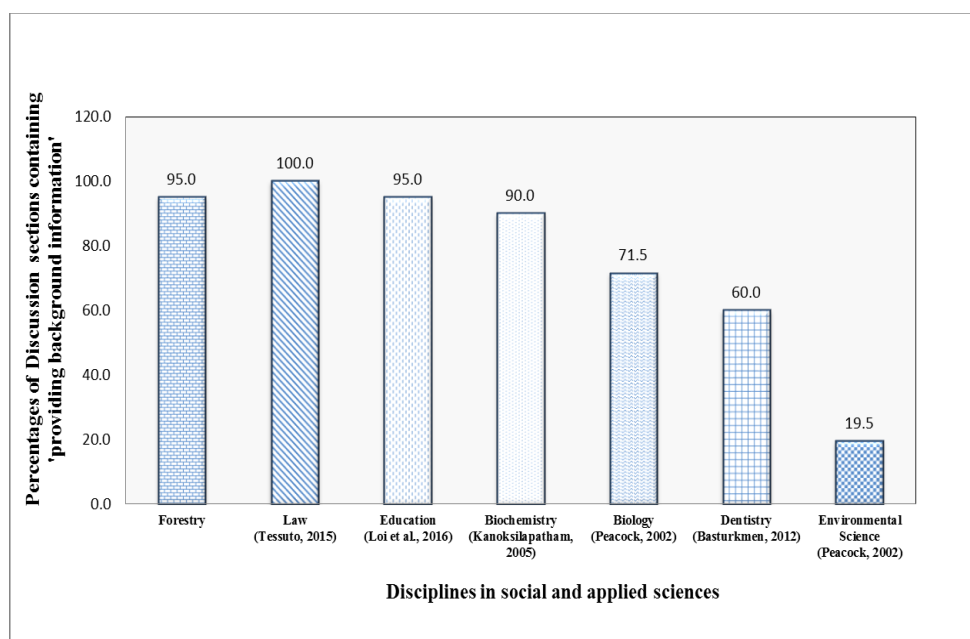


FIGURE 2. Disciplinary Variations in the Provision of Background Information

Given that the provision of background information is found in 95% of the Forestry Discussion sections, this study has demonstrated the near-obligatory status of ‘providing background information’ in Forestry. Such a finding matches the values reported by previous researchers in other disciplines. For instance, although ‘providing background information’ is incorporated in 100% of the Discussion sections in Law (Tessuto, 2015), 95.0% in Education (Loi et al., 2016), and 90.0% Biochemistry (Kanoksilapatham, 2015), it is included in only 71.5%, 60.0% and 19.5% of the Discussion sections in Biology (Peacock, 2002), Dentistry (Basturkmen, 2012) and Environmental Science (Peacock, 2002) respectively. It is important

to note that writers' tendency to include background information in certain applied sciences, such as Dentistry and Environmental Science, may differ considerably from that in other applied sciences, such as Forestry. Such comparisons are likely to help us minimise some confusion over the extent to which findings reported in other disciplines are applicable to novice writers and students in the field of Forestry. The knowledge of such cross-disciplinary differences also has some implications for the teaching of English for Research Purposes, which will be discussed in relation to the concluding statements of this study in the next section.

CONCLUSION AND IMPLICATIONS FOR THE TEACHING OF ENGLISH FOR RESEARCH PURPOSES

Our objective in carrying out this study was to identify the information elements and recurrent language resources that expert writers employ to provide background information in the Discussion sections of research reports in Forestry, which is a discipline involving a large number of undergraduate and postgraduate students in many universities across the globe. Our genre-based study has shown that 'providing background information' is largely context-building, explicatory and indicative of the overall direction of the study, and it tends to be used by expert writers in Forestry to make their Discussion section a stand-alone summary of the research report. It constitutes a noteworthy principal move employed in the vast majority of Forestry Discussion sections. Step 1 (i.e., 'presenting related information') and Step 2 (i.e., 'restating objectives, hypotheses or methods') are employed in most of the Forestry Discussion sections respectively. While Step 1 includes promotional elements which are interestingly tacit and subtle, Step 2 involves a direct and explicit restatement of objectives, methods and hypotheses of the study being reported.

Overall, given that multiple types of background information appear in a majority of the Forestry Discussion sections, lecturers may first enlighten novice writers on the range of information elements (such as theoretical information, statements of objectives, methods and hypotheses) which can possibly be used to help readers view the research context that paves the way for the eventual presentation of their key findings. While the figures reported in this study suggest that background information constitutes an integral part of almost all Discussion sections in the Forestry corpus, novice researchers can be further enlightened on the disciplinary differences through a comparison made between what has been presented in this study and the findings reported by previous researchers for other disciplines. It is recommended that ERP lecturers avoid making over-generalizations while guiding learners in the use of background information to lay the ground for major findings in the Discussion section. What is recommended for a discipline may not always be applicable to another discipline. To ensure that learners appreciate the related functions of 'providing background information', the actual use of the move needs to follow disciplinary practices. In the case of Forestry, the different categories of information presented in this study can be used to enlighten novice researchers on how to link their findings with theoretical approaches, their own research objectives, hypotheses, and methodological information in order to set the stage for their findings.

In terms of positions of occurrence, we found that the provision of background information is employed as an opening move in over two-fifths of the Forestry Discussion sections. In contrast, less than a fifth of the Discussion sections in social sciences opened with the provision of background information although half of them opened with statements of results (Holmes, 1997). This suggests that ERP lecturers need to avoid making over-generalizations while guiding novice writers to open a Discussion section in different disciplines. To be specific, lecturers may encourage novice writers to consider using the

provision of background information as a key strategy to begin a Discussion section in Forestry, instead of starting the section with statements of findings. In this regard, the instances of the Discussion sections that begin with a restatement of research objectives, questions or hypotheses also corroborate Annesley's (2010, p. 1671) observation that many researchers consider it necessary to recapitulate the purposes or research questions of the study at the beginning of the Discussion section given that the Introduction and Discussion sections are "separated by other sections of the paper."

It is widely known that genre-based writing instruction requires teachers "to hone students' mastery of the subject content and language use" (Ong, 2016, p. 35). Likewise, in the context of guiding novice writers to present subject content in Forestry Discussion sections, our study suggests that specific language resources need to be identified and highlighted by ERP lecturers while guiding learners to furnish related background information in the final section. More specifically, it is recommended that adjectives denoting prominence be introduced to learners to remind readers of the noteworthiness of their research area even though some form of centrality may have already been indicated in their introductory section. This finding echoes Basturkmen's (2012, p. 142) suggestion that the provision of background information performs a "promotional function as well as the pragmatic function of highlighting important information." Novice writers can therefore be given exercises requiring them to (i) select appropriate adjectives denoting plenitude to pre-modify nouns referring to research or writers, and (ii) match noun phrases in sentence-subject positions with procedural verbs in the simple present.

Likewise, in guiding learners to restate objectives, hypotheses and methods in Step 2, lecturers may show learners how expert writers reiterate the goals and hypotheses of their studies by employing the SPO structure that links investigative and illustrative verbs with noun phrases denoting the research or report in order to refresh readers' memory of the overall focus of their investigations. This is also the point at which learners can be briefed on the major differences between (i) present-tense verbs which are used after nouns denoting the research report concerned, and (ii) past-tense verbs which collocate with noun phrases denoting the writers' own research goals. To further help learners distinguish research purposes from hypotheses in the Discussion section, lecturers may devise some gap-filling exercises that require novice writers to use a range of verb phrases indicating expectations, assumptions and infinitive clauses that describe expected behaviours.

In line with the need to highlight writers' own research methods, it is suggested that lecturers place greater emphasis on the use of a repertoire of verbs indicating procurement of data, measurement of variables, analysis, prediction and inclusion/exclusion of data (as exemplified in Table 3). This is the juncture at which learners can be encouraged to use a range of verbs, means adjuncts and purposive adjuncts in sentence completion exercises aimed at raising their consciousness of the linguistic strategies for refreshing readers' memory of the overall direction of their studies. In brief, communicative functions and specific linguistic strategies need to be closely linked with specific language resources when ERP lecturers engage novice writers in the process of presenting relevant background information in the Discussion section.

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