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## **Index**

- |   |                |
|---|----------------|
| <b>1.</b> Foreword. Professor Winnie Cheng  | <b>4</b>       |
| <b>2.</b> Laurence Anthony and Mark Bowen. The Language of Mathematics:<br>A Corpus-based Analysis of Research Article Writing in a Neglected Field.            | <b>5-25</b>    |
| <b>3.</b> Yuyang Cai. Validating a Scale Measuring Strategic Competence in ESP Reading<br>Test Context: An Application of Bifactor-MGRM                         | <b>26-51</b>   |
| <b>4.</b> Yuqin Hei, Wen Guo, and Yufen Hei. 'This paper thinks...'/ 'I argue...': English<br>and Chinese Author Identities in Linguistics Conference Abstracts | <b>52-74</b>   |
| <b>5.</b> Ling Lin. The Use of Reporting Verbs in Mechanical Engineering Articles:<br>A Cross-generic Study   | <b>75-98</b>   |
| <b>6.</b> Jane Lockwood. English for (Very) Specific Business Purposes: A Pedagogical<br>Framework  | <b>99-118</b>  |
| <b>7.</b> Andy Seto. Speech Acts Annotation for Business Meetings   | <b>119-147</b> |
| <b>8.</b> Min Zhang. A Corpus-based Comparative Study of Semi-technical and Technical<br>Vocabulary   | <b>148-172</b> |

## Foreword

Welcome to the Special Issue of *The Asian ESP Journal* 2013!

This Special Issue is a collection of articles from the Joint International Conference: CAESP 1 and ESP in Asia 4 which was held in The Hong Kong Polytechnic University on 13-16 December 2012.

We are happy to publish seven articles that cover a range of research topics contributed by authors from China, Hong Kong and Japan, namely:

1. The language of Mathematics: a corpus-based analysis of research article writing in a neglected field, by Laurence Anthony and Mark Bowen
2. Validating a scale measuring strategic competence in ESP reading test context: an application of bifactor-MGRM, by Yuyang Cai
3. 'This paper thinks...'/'I argue...': English and Chinese author identities in linguistics conference abstracts, by Yuqin Hei, Wen Guo and Yufen Hei
4. The use of reporting verbs in mechanical engineering articles: a cross-generic study, by Ling Lin
5. English for (very) Specific Business Purposes: a pedagogical framework, by Jane Lockwood
6. Speech acts annotation for business meetings, by Andy Seto
7. A corpus-based comparative study of semi-technical and technical vocabulary, by Min Zhang

I hope you will enjoy reading the papers and recommend them to your colleagues and students to further disseminate the findings and enhance the impact of the research studies.

Last but not least, I would like to take this opportunity to express my heartfelt gratitude to the professional contribution of our Associate Editors and Academic Editors\* whose quality review work has made the current issue possible. I also wish to thank our proof readers for their great work!

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\* Details about our Associate Editors, Academic Editors and proof readers can be found on [http://asian-esp-journal.com/asian-esp-journal-beta/index.php?option=com\\_content&view=article&id=90&Itemid=53](http://asian-esp-journal.com/asian-esp-journal-beta/index.php?option=com_content&view=article&id=90&Itemid=53).



## **The Language of Mathematics: A Corpus-based Analysis of Research Article Writing in a Neglected Field**

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### **Abstract**

Research article writing has received a great deal of attention from ESP researchers. Analyses of the general structure of Introduction-Method-Results-Discussion (IMRD) articles, as well as detailed analyses of individual sections, including introductions, results, and discussions sections, have dominated the ESP literature, especially following Swales' pioneering work on introductions in the early 1980s. Surprisingly, however, the writing of mathematics research articles has been almost completely neglected to date. A few reasons for this can be speculated, including a) the assumption that mathematics writing is similar to that in the well-covered areas

of science and engineering, b) the difficulty in analyzing mathematics research articles due to their often extremely specialized content, and c) the difficulty in locating expert mathematicians who would be willing to serve as specialist informants. In this paper, we present an overview of mathematics writing based on a corpus-based analysis of 410 refereed journal articles covering one complete year of publications in a high-impact mathematics journal. The two-million word corpus was divided into sections, and then analyzed using various corpus tools. Next, the analysis was interpreted by the authors, both of whom have a background in mathematics and one of whom is an active and well-published researcher in mathematics. Results of the study reveal that some macro-level aspects of mathematics writing, such as the basic structuring of titles and introductions, can resemble writing in the fields of science and engineering. On the other hand, many features of mathematics writing diverge greatly from the established norms. We offer reasons for these differences and suggest strategies for teaching writing to a mixed group of science and engineers that may include mathematics majors.

**Keywords:** ESP, mathematics, research article writing, corpus-based analysis

## 1. Introduction

Research article writing has received a great deal of attention by ESP researchers, especially in the 1990s and early 2000s following Swales' (1981) seminal study of research article introductions (Swales, 1981) and his follow up study that introduced the CARS model (Swales, 1990). To date, studies of research article writing have focused almost exclusively on articles that follow a standard Introduction-Methods-Results-Discussion (IMRD) structure, which has been described extensively in the literature on report writing (e.g., Day, 1979; Swales & Feak, 2004; Robinson et al., 2008). A review of journal articles published in *English for Specific Purposes*, for example, reveals two articles on research article titles, eleven on introductions, one on the methods section, four on the results section, three on discussions, and one covering the conclusion section. The interest in research article writing is highlighted further by noting that five of the top ten most cited papers listed in 2012 in *English for Specific Purposes* are related to research article writing (e.g., Ozturk 2007, Matsuda & Tardy 2007).

Despite the strong interest in research article writing among ESP researchers, there has been a huge variation in the extent to which the genre has been investigated across different

fields and disciplines. Figure 1 shows the results of a keyword search for various field and discipline names in the titles of published articles in three of the top international ESP journals, i.e., *English for Specific Purposes*, *Asian ESP Journal*, and *ESP World*. Clearly, research on business, science, and medical English has dominated the ESP literature. Also, studies on legal English, engineering English, and economics English (possibly a sub-category of business) have been featured although less prominently. What is interesting to observe from Figure 1, however, is the neglect of another major field of study, i.e., Mathematics. To date, only one research paper focusing specifically on mathematics has been published in *English for Specific Purposes*, and no papers have been featured in the other two journals under study.

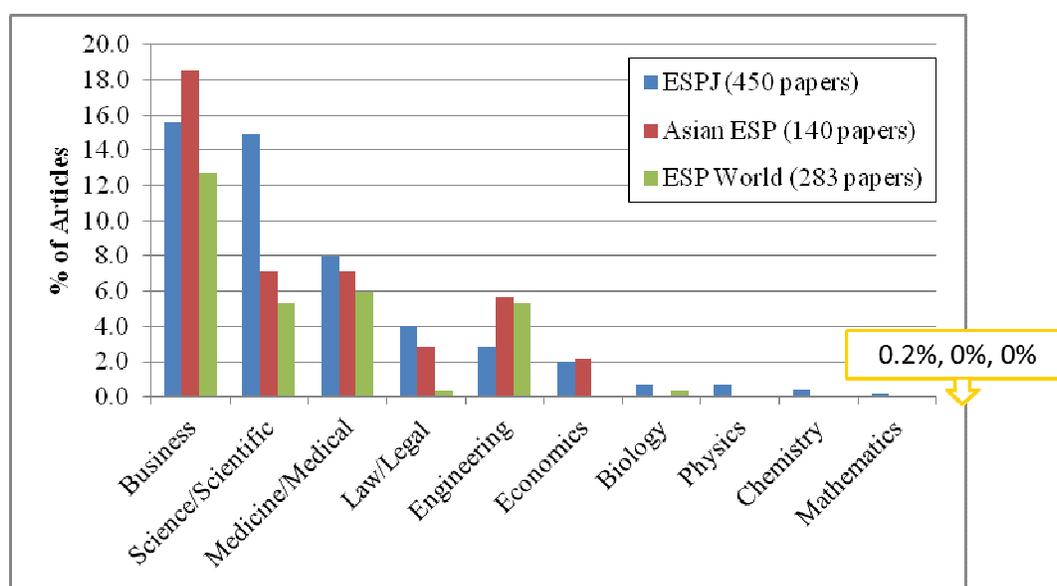


Figure 1: Search terms appearing in titles of research articles in three ESP Journal

It is difficult to ascertain the reasons why mathematics has been neglected as an area of ESP research to date. However, McGrath & Kuteeva (2012), the authors of the only published ESP paper on mathematics, offer three possibilities. First, they argue that researchers may assume that the language of mathematics is similar to that of hard sciences, such as physics, chemistry, and biology, or theoretical disciplines, such as astrophysics, biostatistics and theoretical physics. Indeed, Swales & Feak (2004) follow the latter view. Second, it is possible that ESP researchers consider mathematics to deviate too much from the 'norm' of other sciences to be included in a research study on cross discipline differences, such as that by Hyland (2006).

Third, McGrath & Kuteeva suggest that researchers may consider mathematics discourse to be a type of standardized code that requires little analysis. There is also a fourth possibility. To do a detailed study of mathematics writing inevitably requires a specialist informant from the target field. However, a myth continues that mathematicians are misunderstood, antisocial loners (Devlin 1996). Therefore, ESP researchers may consider that finding an expert mathematician that is willing to serve as a specialist informant is difficult. In fact, the opposite is generally the case. Mathematicians are increasingly providing specialist knowledge of mathematics as part of cross-discipline teams in order to solve complex real-world and theoretical problems. The point is highlighted by the fact that this study is also a cross-discipline endeavor with specialist knowledge of mathematics provided by a practicing mathematician.

Although the study of mathematics English has been largely ignored in the ESP literature, it has featured in other areas of research. For example, there has been a great deal of research that looks at how mathematics is taught in the classroom (e.g., Rowland 1995, 1999; Artemeva & Fox 2011; Street 2005; Leung 2005; Barwell 2005; Morgan 2005; Pimm 1984). Researchers have also looked at how language (not English per se) is used to explain mathematical concepts (e.g., Huang & Normadia 2007; Borasi & Rose 1989; Connolly & Vilaridi 1989; Buerk 1990; MacGregor 1990; Countryman 1992; Johanning 2000). In the area of English language, some rare studies on mathematics language can be found, such as an analysis of imperatives (Swales et al. 1988), language and symbolism (O'Halloran 2005), authorial identity (Burton & Morgan 2000), and the above study by McGrath & Kuteeva (2012) on stance and engagement. Clearly, educationalists are interested in the language of mathematics and would find great value in the results of ESP studies on mathematics. Not only would the results help to improve classroom teaching of mathematics, they would also help to build better metacognitive views of mathematics, and of course, help ESP teachers meet the needs of mathematicians in academic and technical reading/writing classes.

In this paper, we report on a study of the writing of research articles in mathematics at both the macro and micro level. At the macro level, we investigate the presence and positioning of the major sections of the research article and compare the results with those for a more traditional science/engineering field, namely mechanical engineering. As a result of this analysis, we hope to establish to what extent mathematics writing (and indeed mechanical engineering writing) follows an IMRD structure.

At the micro level, we look at the writing style of mathematics research articles and identify in what ways the style of mathematics writing resembles or differs from that in a more traditional science/engineering field science and engineering (again, mechanical engineering). Previous literature on research article writing in science and engineering (e.g. Robinson et al. (2008), Sales (2006) and Swales & Feak (2004)) has suggested that a formal style is predominantly used by authors. A formal style manifests itself in many ways, including the *infrequent* use of imprecise, general conversation words and expressions such as "stuff," "things," "bunch," and "whole lot of," the *infrequent* use of phrasal verbs (e.g. "figure out," "make up", "go down"), and the *infrequent* use of connectives such "and," "so," and "but" that even tools such as *Microsoft Word* mark as being informal (Swales & Feak, 2004: 17-24). Here, we investigate the features of these three styles in the hope of establishing whether mathematics writing adopts a formal or informal style. We address the following two research questions:

1. Does mathematics research article writing diverge from the 'norm' of science and engineering research article writing in terms of macro-level structuring, i.e., the presence and positioning of the IMRD ("Title", "Abstract," "Introduction," "Methods," "Results," and "Discussion") sections? If yes, in what way does it diverge from the 'norm'?
2. Does mathematics research article writing diverge from the 'norm' of science and engineering research article writing in terms of style (i.e. does it deviate from a formal writing style)? If yes, in what way does it diverge from the 'norm'?

For the analysis, we use a large corpus of 410 refereed journal articles comprising one complete year of published works in a high-impact mathematics journal. First, we create a structural model of mathematics research article writing based on a qualitative analysis of the texts by the two authors, both of whom have degrees in mathematics and one of whom is an active and well-published researcher in the field. Next, we conduct a quantitative corpus-based analysis of the texts to confirm or reject the structural model and to identify characteristic features of style. We then compare these corpus-based results with those of a comparable reference corpus of texts from a more traditional science/engineering field. Finally, we discuss the results and offer implications for ESP teaching in mathematics.

## 2. Methodology

### 2.1 Corpus design

For a corpus-based analysis of writing, it is necessary for the target corpus to be both balanced and representative of the target language (Biber, 1993). It is also important that the corpus has extrinsic validity, i.e., users of the results of the study can understand the relevance and applicability of the results. To ensure a reasonably balanced selection of mathematics topics, an ideal corpus would contain articles from a wide range of research journals covering both pure and applied mathematics. Also, to ensure that each journal was represented accurately in the corpus, a large number of articles from each journal would need to be selected. However, maintaining balance and representativeness would necessitate including many articles from less-prestigious journals. Thus, the validity of the study may be questioned, especially considering that the aim of the study is to provide useful results to teachers of ESP.

For this study, we chose to relegate the importance of balance and focus instead on creating a representative and valid corpus comprised of all articles published in one year of a single, high-impact mathematics journal. To ensure that the corpus was valid, we employed the following journal selection criteria:

- The journal should be ranked in the top 10 highest impact factor journals in the area of applied mathematics, according to the Thomson Reuters (formerly ISI) Web of Knowledge (<http://wokinfo.com/>).
- The journal should not be a review article journal.
- The journal should cover a broad range of mathematics domains.
- The journal should appeal to a broad audience of both pure and applied mathematicians.

Based on the above criteria, we selected *Nonlinear Analysis: Real World Applications* (hereafter NARWA) for the analysis and collected all 410 articles (approx. 1.9 million words) from Volume 11 (year 2010) of the journal. Details of the target corpus are given in Table 1.

Table 1: Target corpus details

JOURNAL TITLE:	Nonlinear Analysis: Real World Applications (NARWA)
PUBLISHER:	Elsevier
IMPACT FACTOR (2012):	2.043
DATES:	February 2010 - December 2010 (Volume 11: Issues 1-6)
SAMPLING:	Whole population approach (410 articles: 1 entire year)
CORPUS SIZE:	1,917,422 tokens; 30,700 types

It was also necessary to create a corpus of research articles from a more traditional science/engineering field to serve as a comparison. For this study, we chose to analyze articles from the field of mechanical engineering. This is a traditional applied engineering field, which in some ways can be considered to be the exact opposite of mathematics. The following selection criteria were employed:

- The journal should be ranked in the top 10 highest impact factor journals in the area of mechanical engineering, according to the Thomson Reuters (formerly ISI) Web of Knowledge (<http://wokinfo.com/>).
- The journal should not be a review article journal.
- The journal should cover a broad range of mechanical engineering domains.
- The journal should appeal to a broad audience of mechanical engineers.

Based on the above criteria, we selected the *Journal of Engineering Materials and Technology* (JEMT) for the analysis and collected all 318 articles (approx. 1.6 million words) from Volume 122 (year 2000) of the journal. Details of the target corpus are given in Table 2.

Table 2: Target corpus details

JOURNAL TITLE:	Journal of Engineering Materials and Technology (JEMT)
PUBLISHER:	American Society of Mechanical Engineers (ASME)
IMPACT FACTOR (2012):	0.56
DATES:	January 2000 – December 2000 (Volume 122: Issues 1-4)
SAMPLING:	Whole population approach (318 articles: 1 entire year)
CORPUS SIZE:	1,643,576 tokens; 24,637 types

## **2.2 Software tools**

The analysis of the corpus data was carried out using the *AntConc* 3.3.5 concordancer analysis toolkit (Anthony, 2012), and specially written Python scripts developed by one of the authors (Anthony).

## **2.3 Qualitative analysis**

In order to create an intuitive model of mathematical papers that was not influenced by the corpus data or later quantitative analysis, we (the authors) first discussed at length our own experiences of writing and reviewing mathematics papers. Next, we formulated a preliminary model and then critiqued this model, clarifying, simplifying, or expanding each of its steps to arrive at a final model that the results of the quantitative analysis could be compared against. On completion of the quantitative analysis, we also reviewed the results and discussed the interpretations and implications of the findings with a view to formulating recommendations for future ESP teaching in mathematics.

## **3. Results**

### **3.1 Macro-level structure of mathematics papers – Intuitive model**

Our intuitive model of mathematical research articles is shown in Figure 2. First, it is important to note that mathematics papers can generally be classified on a cline between analytical papers (pure mathematics) and application papers (applied mathematics). We considered the general structure of the two to be equivalent, i.e., they would both include a title, an abstract, and an introduction, and they would discuss the background to the research, explain the methods and results, and optionally finish with some kind of discussion/conclusion section. However, we also agreed that the purpose and details included in each section would reflect the nature of the study and thus vary greatly. For example, in an analytical paper, the purpose is often to prove some mathematical result (stated in the background) and thus the result 'section' would simply offer a closure to the study and may consist of just a single sentence. On the other hand, in an application paper, the aim of the research would be to propose a number of mathematical relationships relating to some real-world applications. Thus, the results of the study could be of three different types: a) details of the relationships, b) experimental results that are used to validate the mathematical relationships in a real-world setting, and/or c) computer simulations

that verify the validity of the relationships and perhaps offer further insights into the relationships. Also, we anticipated that the nature of the study would also dictate the actual section headings used in the research articles. We anticipated few would use "Background," "Methods," "Results," or "Discussion/Conclusion" as heading labels.

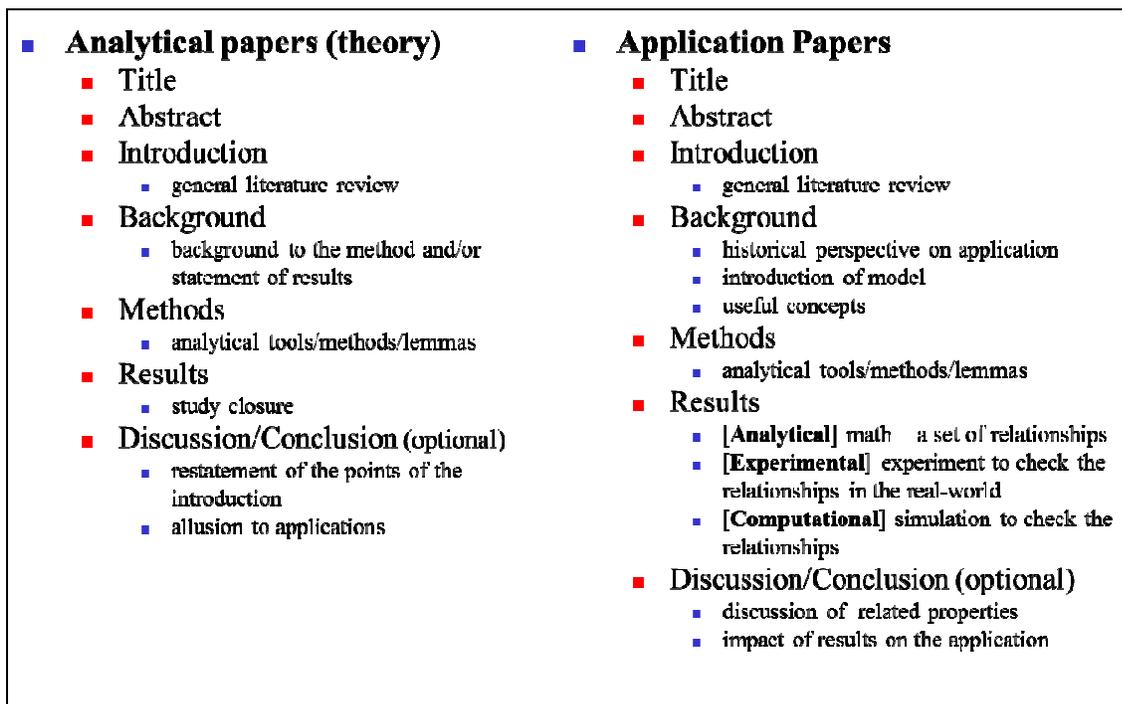


Figure 2: Intuitive model of mathematics research article structure

### 3.2 Macro-level structure of mathematics papers – Corpus-based model

To confirm or reject the intuitive model presented in section 3.1, we first wrote a Python script that would extract and count the number of section headings from each article in the target and reference corpora. Figures 3 and 4 show the results of the analysis.

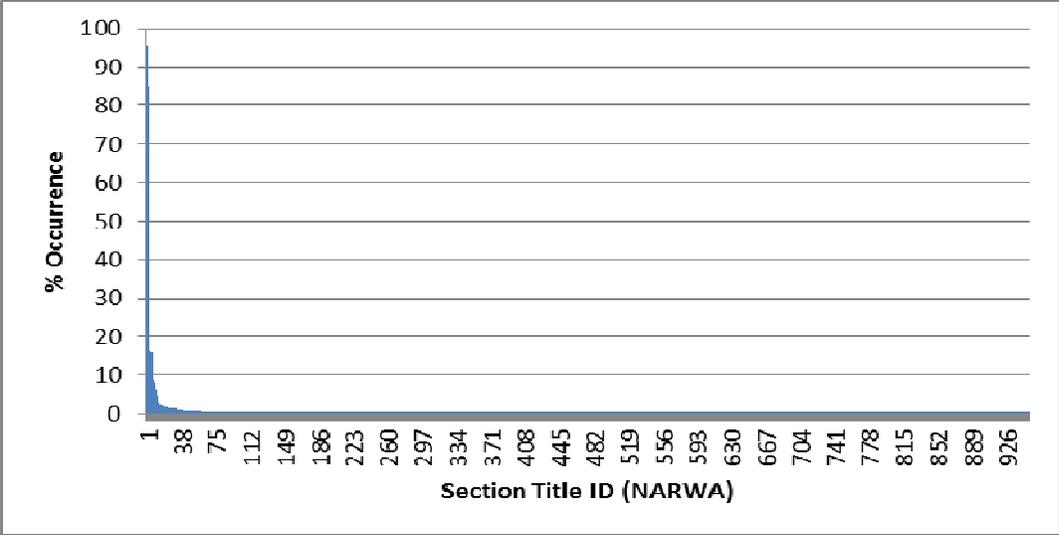


Figure 3: Percentage Occurrence of Section Headings in NARWA

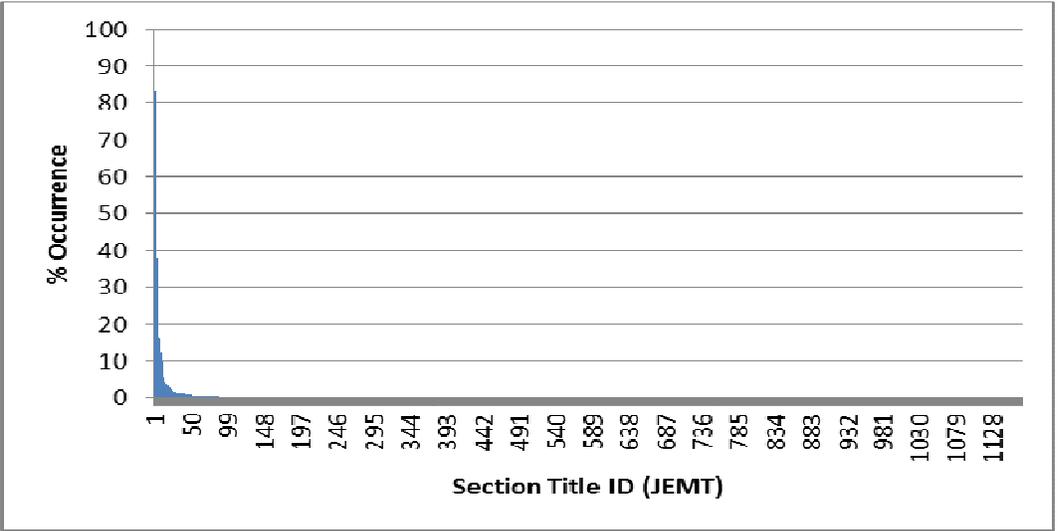


Figure 4: Percentage Occurrence of Section Headings in JEMT

Figures 3 and 4 show the percentage occurrence of different labels in the mathematics (NARWA) and mechanical engineering (JEMT) articles, respectively. In both figures, individual headings in the articles are given an identification (ID) number and arranged in order from the most frequent to the least frequent one. In both figures, the most frequent heading (ID = 1) is "Introduction". Figures 3 and 4 highlight that research articles in both mathematics (NARWA) and mechanical engineering (JEMT) show a great variation in the headings used. In NARWA, 951 different main headings were used (ave. 6.0 per article) with 832 (87%) of them occurring just once. Examples of single occurrence headings are "Exponential convergence," "Blow up phenomenon," and "Classical global solutions." In JEMT, 1167 different headings were used

(ave. 7.1 per article) with 1081 (93%) of them occurring just once. Examples of single occurrence headings are "Density measurement," "Previous work," and "Thermal and mechanical analyses."

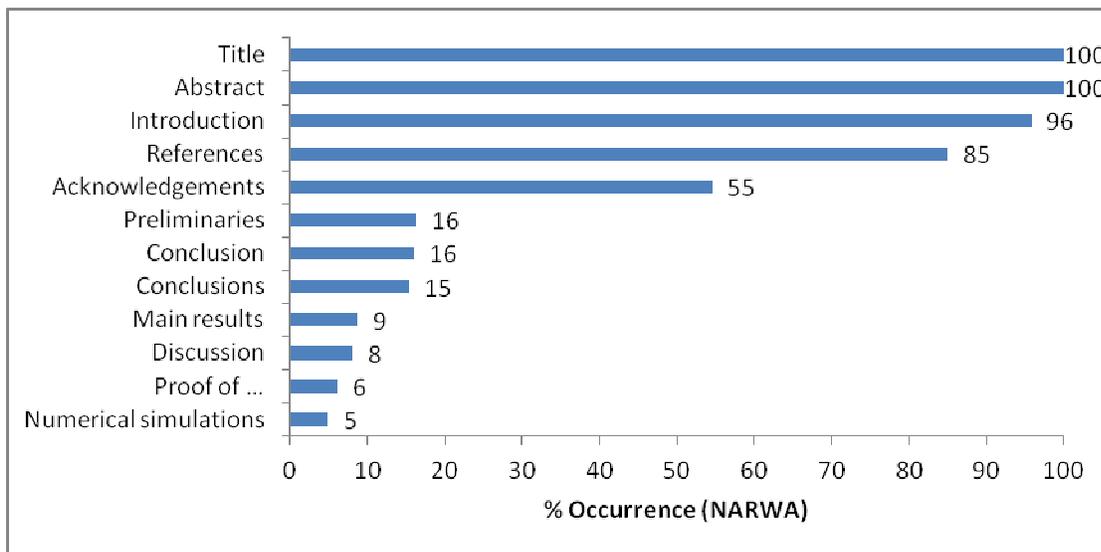


Figure 5: Percentage Occurrence of Title, Abstract and Top 10 Sections in NARWA

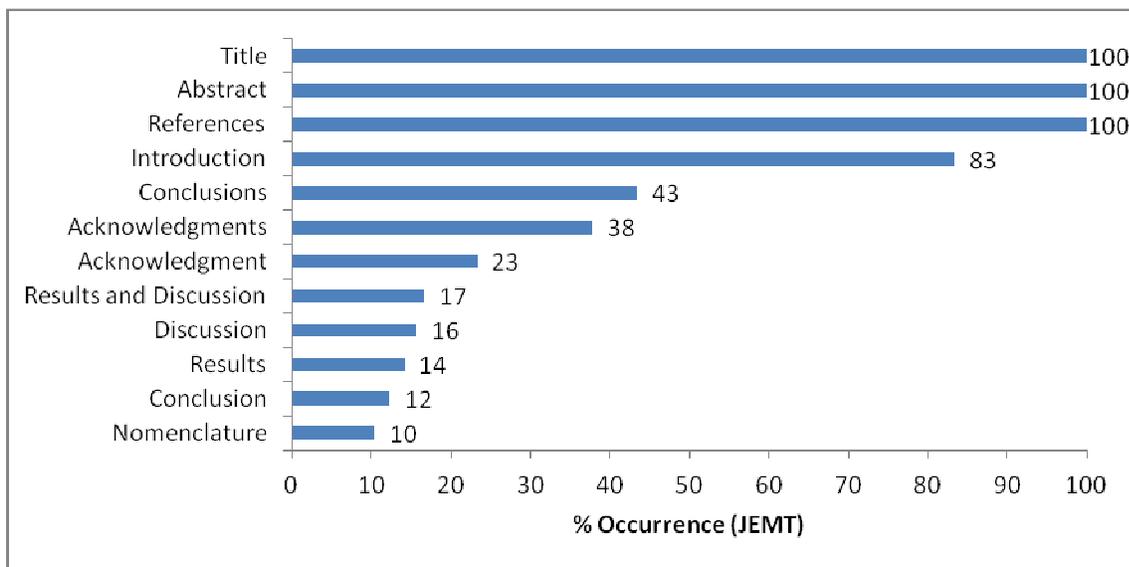


Figure 6: Percentage Occurrence of Title, Abstract and Top 10 Sections in JEMT

Figures 5 and 6 show the frequency of occurrence of the title, abstract, and top ten most commonly used section headings in the NARWA and JEMT corpora. Not surprisingly, most articles in both corpora include an introduction and references. Just over half the articles in both corpora have acknowledgments. However, beyond these very typical sections, few other

generalizations can be made. Clearly, mathematics articles do not typically include "Methods," "Results," or "Discussion" sections; a fact that was predicted from the intuitive model. However, surprising to these authors was the fact that mechanical engineering papers also did not show the typical IMRD pattern.

### **3.3 N-gram analysis of NARWA section titles**

The results in Figures 3 and 5 show that mathematics research articles in the NARWA corpus do not show a general IMRD labeling of section headings. This was predicted by the intuitive model given in Figure 2. However, in order to confirm or reject the basic structuring of mathematics article content predicted by the model, it was necessary to clarify whether the variously named sections of the NARWA corpus articles showed any general patterns in terms of content, and if so, establish what these were.

In view of the fact that most section headings occurred only once in the corpus, a complete analysis would require all the articles to be read in full and subsequently analyzed for content structuring. Not only would this be extremely time consuming, it would also introduce the danger of researcher bias, i.e., seeing patterns in the data that did not exist. To counter this danger, we decided to adopt a quantitative analysis of the section structuring based on counts of N-grams (contiguous word sequences of length N) of varying lengths in the different sections. We could then relegate the qualitative analysis to only interpretations of the N-gram frequency tables.

To carry out the analysis, first, the section headings of each article in the NARWA corpus were grouped according to their order of appearance in the article as a whole. In this way, the opening sections of the articles, with headings such as "Introduction," "Introduction and Preliminaries," and "Introduction and Main Results" were grouped together. Similarly, the headings used for the second sections of the articles were grouped together and so on until all headings were accounted for. Next, common patterns of structuring in each group were established by counting N-grams of size one to six using the *AntConc* 3.3.5 (Anthony, 2012) N-gram tool, and ranking them according to frequency. The maximum size of N-gram was chosen based on the frequency distribution of section headings in the corpus, where 374 (91%) of the articles contained six or less sections and just 36 (9%) of corpus articles included seven sections

or more. Following this approach, the highest ranked N-grams would represent the most commonly used patterns in each section.

Due to space restrictions, Table 3 shows the results of the analysis for N-grams of size one to three for the first six sections of the corpus articles. Raw frequencies are given for each N-gram in the column adjacent to the N-gram. The N-gram results show several very commonly used headings, For example, Section 1 of the articles reveals a very strong preference for the single word heading "Introduction" although minor variations are possible, such as "Introduction and Preliminaries".

Table 3: Top 10 N-Grams of size 1-3 for each section of the NARWA corpus.

<b>Section 1</b>					
introduction	401	introduction and	11	introduction and <i>main</i>	7
and	13	<i>and main</i>	7	<i>and main results</i>	4
<i>main</i>	7	<i>and preliminaries</i>	4	<i>and main result</i>	3
<i>preliminaries</i>	5	<i>main results</i>	4	introduction and <i>preliminaries</i>	3
<i>results</i>	4	<i>main result</i>	3	<b>a kinetic model</b>	1
<i>result</i>	3	and background	2	<b>basic physical concepts</b>	1
the	3	<i>the problem</i>	2	introduction and background	1
background	2	<b>a kinetic</b>	1	introduction notations and	1
<b>model</b>	2	<b>basic physical</b>	1	<b>kinetic model q</b>	1
<i>problem</i>	2	<i>introduction notations</i>	1	notations and background	1
<b>Section 2</b>					
the	110	of the	42	<i>of the problem</i>	14
of	108	<i>existence of</i>	17	<i>formulation of the</i>	10
and	78	<b>the model</b>	17	<i>existence and uniqueness</i>	6
<i>preliminaries</i>	76	<i>main results</i>	15	the mathml source	6 <sup>#</sup>
<b>model</b>	65	<i>the problem</i>	14	view the mathml	6 <sup>#</sup>
<i>formulation</i>	42	<i>preliminary results</i>	13	<b>of the model</b>	5
<i>problem</i>	35	<i>problem formulation</i>	11	<i>positive periodic solutions</i>	5
<i>results</i>	31	<i>formulation of</i>	10	<i>and existence of</i>	4
<i>existence</i>	28	<b>governing equations</b>	10	<i>and uniqueness of</i>	4
<b>mathematical</b>	27	<b>mathematical model</b>	10	<i>existence of hopf</i>	4
<b>Section 3</b>					
of	141	of the	49	<i>of the main</i>	8
the	113	<i>main results</i>	32	<i>proof of the</i>	7
and	68	<i>existence of</i>	22	<i>existence and uniqueness</i>	6
<i>main</i>	45	<i>stability of</i>	16	<i>the existence of</i>	6
<i>results</i>	44	<i>proof of</i>	15	<b>analysis of the</b>	5
<i>existence</i>	40	<b>periodic solutions</b>	11	<i>existence of the</i>	5
<i>stability</i>	39	<i>main result</i>	10	<b>of the problem</b>	5
solutions	33	<i>existence and</i>	9	solution of the	5
solution	28	<i>hopf bifurcation</i>	9	<b>a priori estimates</b>	4

<i>analysis</i>	26	<i>the existence</i>	9	<i>and uniqueness of</i>	4
<b>Section 4</b>					
of	95	of the	30	<i>and uniqueness of</i>	5
the	65	<i>proof of</i>	16	<i>existence and uniqueness</i>	5
and	48	<b>numerical simulations</b>	12	<b>analysis and discussion</b>	3
<i>numerical</i>	43	<i>existence of</i>	10	<i>and stability of</i>	3
<i>results</i>	22	and discussion	9	<i>convergence of the</i>	3
<i>stability</i>	21	<b>numerical results</b>	8	<i>direction and stability</i>	3
<i>analysis</i>	20	<b>periodic solutions</b>	7	<i>existence of the</i>	3
discussion	19	<b>stability of</b>	7	<b>numerical results and</b>	3
conclusions	18	<i>existence and</i>	6	<i>of limit cycle</i>	3
<i>existence</i>	17	<b>analysis and</b>	5	<i>of the solution</i>	3
<b>Section 5</b>					
of	52	of the	15	<b>results and discussion</b>	6
conclusions	36	and discussion	8	<b>an illustrative example</b>	3
the	36	<b>numerical simulations</b>	8	<i>asymptotic behavior of</i>	2
and	33	concluding remarks	7	<i>behavior of the</i>	2
<b>numerical</b>	28	<i>proof of</i>	7	discussion and conclusions	2
conclusion	26	<b>results and</b>	7	<i>nonconstant positive solution</i>	2
discussion	23	<b>numerical results</b>	6	<i>nonexistence of nonconstant</i>	2
<b>results</b>	18	discussion and	5	<b>numerical results and</b>	2
<b>simulations</b>	11	<b>illustrative example</b>	4	<i>of nonconstant positive</i>	2
a	10	<b>numerical simulation</b>	4	<i>proof of the</i>	2
<b>Section 6</b>					
conclusion	21	concluding remarks	7	results and discussion	3
of	21	of the	7	<i>existence of nonconstant</i>	2
the	17	<b>numerical results</b>	4	<i>nonconstant positive solutions</i>	2
discussion	14	results and	4	<i>of nonconstant positive</i>	2
conclusions	13	and discussion	3	<i>of the positive</i>	2
and	9	<b>numerical examples</b>	3	<i>stability of the</i>	2
<b>numerical</b>	9	<i>proof of</i>	3	<i>the existence of</i>	2
remarks	9	<i>existence of</i>	2	<b>a convective condition</b>	1
concluding	7	final remarks	2	<b>a critical point</b>	1
<b>results</b>	7	<i>nonconstant positive</i>	2	<b>a heat flux</b>	1

\*Numbers in the adjacent columns are the raw frequency counts. N-grams in italics are likely to reflect sections from analytical papers. N-grams in bold are likely to reflect sections from application papers. The classifications of the N-grams were determined by the subjective judgments of this paper's authors based on their experience reading and writing mathematics papers.

#These entries relate to the markup of equations in the body of the text. They should be considered as noise.

However, the main result from Table 3 is that the majority of sections in mathematics papers show a complex pattern of section structuring. To understand these patterns more clearly, we went through the N-gram list and attempted to classify each N-gram into one of three categories; a) those that are likely to relate to analytical work (shown in italics in Table 3), b)

those that are likely to relate to applications (shown in bold in Table 3), and c) those that are generic in nature (unmarked in Table 3). A summary of this analysis is shown in Table 4 with characteristic N-gram patterns for each type of article appearing below a general description of the section purpose.

Table 4: Summary of N-gram categorization of NARWA section headings.

<b>Section 1 (introduction)</b>	
Analytical Papers	Application Papers
introduction introduction and main results introduction and preliminaries	
<b>Section 2 (background/methods)</b>	
Analytical Papers	Application Papers
main results preliminary results	the model mathematical model problem formulation model formulation governing equations mathematical formulations
<b>Section 3 (methods/results)</b>	
Analytical Papers	Application Papers
proof of the main result solution of the problem main result and its applications linear stability and Hopf bifurcation analysis direction and stability of the Hopf bifurcation existence and uniqueness of theorem/solutions	analysis of the data/model/problem a priori estimates of positive solutions existence of a positive periodic solution the main result/results
<b>Section 4 (results/application)</b>	
Analytical Papers	Application Papers
existence and uniqueness of equilibrium point existence and uniqueness of limit cycle direction and stability of the Hopf bifurcation convergence of the series solutions solution and equilibrium points	application equation for the pressure control design for the RTAC system results and discussion
<b>Section 5 (results/application)</b>	
Analytical Papers	Application Papers
proof of the principal theorem proof of the main results nonexistence of nonconstant positive solution periodic solutions	numerical results and discussion numerical results numerical simulations simulation results experimental results results and discussion illustrative example an example
<b>Section 6 (conclusions)</b>	
Analytical Papers	Application Papers
concluding remarks final remarks	concluding remarks final remarks

results and discussion proof of ...	results and discussion numerical examples numerical results
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The analysis in Table 4 is largely consistent with the intuitive model presented in Figure 2. Clearly, there is a general ordering of information in terms of introduction, background, methods, results, and discussion/conclusion. However, this ordering may not be immediately apparent unless the reader is well trained in the theories and practices of mathematics. Also, it is clear from Table 4 that the choice of section structuring differs greatly depending on whether the mathematics paper has a focus on analytical methods or applications.

### 3.4 Comparison of writing styles in the NARWA and JEMT corpora

A preliminary analysis of the NARWA corpus articles revealed multiple occurrences of imprecise, general conversation words and expressions, phrasal verbs, and the connectives "and," "so," and "but," that were described by Swales & Feak (2004) as indicative of informal language. Several examples are shown below, where the informal word or expression is highlighted in bold.

- *It is **easy** to verify that  $U$  and  $F$  satisfy the operator equation.*
- *There **you can see** the precise conditions...*
- *Here, **you note** that the condition (%%%) above is satisfied.*
- *We **say that**, the problem (%%%) and (%%%) is maximal regular...*
- ***Anyway**, we have that  $EQT$  is bounded ...*
- *It should be **pointed out** that discrete-time neural networks become more important...*
- *Similarly the second-order solution **works out** to be  $EQT$ ...*
- *It **turns out** that depending on the locations...*
- ***So** the stability of neural networks has been one of the most active areas of research.*
- ***But** for the Lotka–Volterra predator–prey systems, it is more difficult to discuss.*
- ***And** we arrive at the purpose of the present article.*

In mathematics writing, the researcher is often taking the reader on a journey through various theorems and lemmas to arrive at a proof or new model. In this exposition, a commonly held view among mathematicians is that formality can be sacrificed in exchange for clarity (Halmos, 1973). To investigate if this phenomenon is unique to mathematics writing, we looked in both the NARWA and JEMT corpora at the frequency of occurrence of various imprecise

words and expressions, the frequency of occurrence of phrasal verbs, and the frequency of occurrence of the informal connectives "and," "so," and "but." The results are shown in Table 5.

Table 5: Frequency of occurrence of informal features in NARWA and JEMT

Informal Language Feature	% Occurrence	
	NARWA	JEMT
use of adjective "easy"	552 hits (0.46% of all adj.)	52 hits (0.04% of all adj.)
phrasal verbs	4697 hits (18% of all verbs)	7776 hits (16% of all verbs)
informal connectives	714 hits (7.6% of all connectives) and (155 hits: 1.6%) so (372 hits: 4.0%) but (187 hits: 1.9%)	182 hits (2.4% of all connectives) and (91 hits: 0.61%) so (48 hits: 0.97%) but (43 hits: 0.84%)

The results in Table 5 suggest that mathematics articles do indeed show a greater tendency to use informal expressions than articles from mechanical engineering. In particular, the adjective "easy" was used almost ten times as often in NARWA than in JEMT, and the word "so" was used four times as often in the mathematics corpus. However, all the informal expressions investigated also appeared in the mechanical engineering corpus. For this study, we did not calculate if the differences in occurrence of informal expressions were significant. However, there was a large variation in occurrence of informal expressions between different articles, and so we anticipate that the differences are not significant.

#### 4. Discussion

The first research question asked if mathematics research article writing diverges from the 'norm' of science and engineering research article writing in terms of macro-level structuring. Although our results revealed that mathematics articles are structured in widely varying forms and consistently break the traditional IMRD model of Introduction-Methods-Results-Discussion, we also discovered that this is also the case for mechanical engineering research papers. This was a surprising result as we anticipated that mechanical engineering research papers would reveal a more consistent pattern in view of its status as a well-established and traditional engineering field. This result has profound implications for ESP teachers of writing in science and engineering. Many textbooks focus on the IMRD structure of research papers. However, this

assumed 'norm' of writing may be less 'normal' than previously assumed. In a real-world scenario, rather than following the IMRD structure, students may be well advised to write their research articles following a less rigid format. In mathematics, the best advice to give to students may be to let the research determine the flow of the research article. For example, if the writer anticipates that the reader will need some preliminary knowledge before understanding the proposed model, then a preliminary knowledge section should be included. Similarly, if the results naturally lead to some interesting applications, then the writer should feel able to include an additional section describing these applications even if it comes between the results and the discussion.

The second research question asked if mathematics research article writing diverged from the 'norm' of science and engineering research article writing in terms of style. Again, the results were surprising. Although expert researchers in mathematics did include informal expressions in their writing, this phenomenon was not unique to their field. In fact, the same informal expressions were observed in mechanical engineering writing, although to a lesser extent. Writers in both mathematics and mechanical engineering used vague terms such as "easy", wrote using phrasal verbs, and linked ideas together using the connectives "and," "but, and "so". All these features are traditionally considered to be inappropriate for a formal academic writing style (see Swales & Feak, 2004) and are even explicitly signaled as inappropriate by style checking tools such as that in *Microsoft Word*. Clearly, ESP teachers need to be aware that informal expressions can be used in advanced technical writing within some disciplines, and they need to inform students of this fact in the writing classroom. Although it may be useful in beginner level classes for teachers to encourage students to follow traditional models of writing style, as students advance in their writing, perhaps a more relaxed view of style is necessary. One way to achieve this is to expose students to corpora in the classroom and allow them to investigate patterns in writing using a data-driven learning approach.

## **5. Conclusion**

In this paper, we have investigated the structure of research article writing in the field of mathematics and compared it to that in mechanical engineering. The results show that the structuring of mathematics papers varies considerably from article to article and that few consistent patterns in the choice of sectioning can be found. However, the same result was found

for mechanical engineering papers, suggesting that the traditional IMRD model is not as prevalent in the research literature as it is depicted in textbooks on writing. At a deeper level, however, mathematics papers do reflect the research process itself, starting with an introduction and review of background work, continuing with a description of methods and results, and finishing with a discussion or conclusion. This basic pattern is followed regardless of whether the research is focused more on analytical methods or applications of mathematical models. In terms of style, mathematics articles include various informal expressions that are often considered inappropriate in writing textbooks. However, these same expressions were also found to occur in mechanical engineering articles although to a lesser degree. Again, these findings question the advice given in textbooks on writing and suggest that ESP teachers should encourage learners to be more flexible in their writing and become more aware of actual patterns of writing in professional journals in their field, perhaps through a data-driven learning approach utilizing specialized corpora in the classroom.

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## **Validating a Scale Measuring Strategic Competence in ESP Reading Test Context: An Application of Bifactor-MGRM**

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### **Biodata**

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### **Abstract**

Strategic competence is perceived by English for Specific Purposes (ESP) theorists as a combination of metacognitive strategies. Recent developments in second language acquisition tend to favor an extended view to include cognitive strategies. The purpose of this study was to validate a questionnaire, Strategic Competence Scale (SCS), which assesses strategic competence combining both metacognitive and cognitive strategies in an ESP reading test context. Participants were 1,491 second-year nurse students from eight medical colleges in China. After completing a medical and nursing English reading test, they were immediately asked to respond to the SCS measuring the efficacy of their use of metacognitive and cognitive strategies during the reading test process. Results of bifactor-MGRM show that strategic competence combining metacognitive and cognitive strategies can distinguish between a general factor of strategic competence and six domain-specific strategy factors, that is, planning,

monitoring, evaluating, comprehending, memory and evaluating; and that cognitive strategy factors played a more important role in determining the general factor of strategic competence than their counterparts. These results provide tentative suggestions for future studies that examine strategic competence and convey messages for strategy use training in the ESP reading context.

**Keywords:** strategic competence, strategy use, English for Specific Purposes (ESP), bifactor-multidimensional graded response modeling (bifactor-MRGM)

## 1. Introduction

Strategic competence has long been perceived to play an important role in explaining second or foreign language test performance (Bachman, 1990; Bachman & Palmer, 1996, 2010; Canale, 1983; Canale & Swain, 1980). This importance has also been acknowledged in testing English for Specific Purposes (ESP). In defining the concept of ESP ability, Douglas (2000) argued for strategic competence to be a major component of ESP ability. Most recently, with the efforts of language testing researchers (e.g., Purpura, 1996, 1997, 1998, 1999; Phakiti, 2006, 2008a, 2008b), the concept of strategic competence in language testing has evolved to merge with the construct of strategy use in second language acquisition (SLA), the former being assumed to consist of a package of metacognitive and cognitive strategies (e.g., Phakiti, 2008a, 2008b). Regardless of these theoretical advances, systematic empirical enquiries on the construct in ESP reading testing context are still absent. While there have been a few studies addressing strategy use in the ESP reading context, the focus has been on contextual factors such as text types (e.g., Daoud, 1991; Golinkoff, 1975; Jimenez, Garca, & Pearson, 1996), reading purposes (e.g., Bazerman, 1985), language proficiency (e.g., Martinez, 2008), gender (e.g., Martinez, 2008; Sheorey & Mokhtari, 2001), and cultural backgrounds (e.g., Mokhtari & Reichard, 2004; Sheorey & Mokhtari, 2001), with rare exceptions that directly approach the core concept of strategy use (e.g., Avand, 2009; Dhieb-Henia, 2003; Griva, 2005; Li & Munby, 1996). It is believed that a systematic and intensive enquiry into the nature of strategic competence in ESP context is important.

The current study, hence, was motivated in part by the curiosity to see whether or not, and the extent to which, advances on strategic competence in the general field of language testing can apply to strategic competence in ESP reading test process. It is hoped that results of

the study would provide a list of strategies based on students' responses to which strategic competence in ESP reading test setting could be inferred. It is also hoped that facilitating messages would be conveyed to ESP reading strategies training. In particular, this study sought to answer the following questions:

- 1) Do the Strategic Competence Scale (SCS) tasks combining metacognitive and cognitive strategies measure a general common factor of strategic competence, in addition to six domain-specific factors: planning, monitoring, evaluating, comprehending, memory and retrieving?
- 2) What is the relative importance of the general common factor of strategic competence and other specific domain factors in explaining the SCS tasks?

## **2. Literature review**

### **2.1 Strategic competence and language testing**

The concept of strategic competence had its root in coping strategy in SLA, a term referring to efforts good language learners take only when confronted with language problems (Leu et al., 2008; Ruddell & Unrau, 2004). Canale and Swain (1980) and Canale (1983) adapted this term to refer to the verbal and non-verbal communication strategies. Language learners and users used these strategies “to compensate for breakdowns in communication due to performance variables or to insufficient competence” (Canale & Swain, 1980: 30), or to enhance language performance for rhetorical purpose (Canale, 1983). This concept evolved further and was later included as a constituent of Communicative Language Ability (CLA) (Bachman, 1990; Bachman & Palmer, 1996, 2010), the well-known model for language testing. In CLA, strategic competence was perceived as a set of metacognitive strategies, or a higher order executive mechanism that regulated online language use and other cognitive processes. Specifically, this strategic competence involved three components, i.e., goal setting (i.e., deciding what one is going to do), assessment (i.e., taking stock of what is needed, what one has to work with, and how well one has done), and planning (i.e., deciding how to use what one has). This CLA view of strategic competence was adopted by Douglas (2000) in defining the construct of ESP ability. However, Bachman and Palmer's depiction of strategic competence has been criticized as being “extremely preliminary” (see McNamara, 1996) and not based on empirical studies (Purpura, 1999). These problems should have found their way to Douglas' adoption. McNamara called for full

examination of strategic competence through cross-referencing in the literature of other relevant areas, such as strategy use studies in SLA and cognitive psychology.

Indeed, strategy use has been a well-studied topic in the area of SLA. Among the number of such attempts, Oxford's (1985, 1986, 1990) work has perhaps been mostly referred to. Her latest version contains 64 individual strategies which can be put into six groups, i.e., memory strategies (strategies used for storage of information), cognitive strategies (mental strategies for meaning making), compensations strategies (making-up strategies), metacognitive strategies (regulatory strategies), affective strategies (emotional requirements such as confidence), and social strategies (strategies leading to increased interaction). A parallel taxonomy was developed by O'Malley and Chamot (1990). Based their work on information processing theory (Anderson, 1983, 1985), the researchers distinguished between three groups of strategies: metacognitive strategies (regulatory activities), cognitive strategies (direct manipulating strategies), and social mediation strategies (social-mediating and transacting activities). Compared with Oxford's (1990) taxonomy, O'Malley and Chamot's (1990) effort has received greater attention from strategy researchers in the area of language testing, for its simplicity as well as for several other reasons. First, the latter was developed with a sound theoretical basis while the former has been criticized for its no underlying theoretical account. Second, despite their minor differences in emphasis, they were highly compatible with each other in terms of inventories provided. To illustrate, O'Malley and Chamot (1990) divided strategies into three clusters: cognitive strategies, metacognitive, and social/affective strategies. These clusters can find their correspondences in Oxford (1990) as cognitive and memory groups, metacognitive strategies group, and social, affective, compensation groups, respectively (Dörnyei & Skehan, 2003). As the third category is obviously not appropriate for language testing situation, the first two categories have functioned as the baseline framework for development of strategy use in language testing literature (e.g., Purpura, 1997, 1998, 1999; Phakiti, 2008a, 2008b), the content to cover in the next section.

## **2.2 Assessing strategic competence in language testing**

Purpura (J. E. Purpura, 1999; J.E. Purpura, 1996, 1997, 1998) was among the pioneers attempting to link the concept of strategic competence in language ability to that of strategy use in SLA and cognitive psychology. Building on Bachman (1990), Bachman and Palmer (1996,

2010), O'Malley and Chamot (1990) and on human information processing theory, Purpura developed a 40-item cognitive strategy questionnaire (addressing three groups of strategies, i.e., comprehending, storing/memory, and using/retrieval) and a 40-item metacognitive strategy questionnaire (dealing with three groups of strategies, i.e., goal setting, assessment, and planning). The survey was administered to a pool of 1,382 student participants before they took the FCE Anchor Test. Results of confirmatory factor analysis supported a three-factor structure of cognitive strategy, i.e., comprehending, storing/memory, and using/retrieval, and a unidimensional structure of metacognitive strategy use, which was represented by four processes, namely planning, monitoring, self-evaluating, and self-testing.

Compared with previous conceptualizations, Purpura's work showed several new features. First of all, unlike Bachman (1990) and Bachman and Palmer (1996, 2010), Purpura (1999) added cognitive strategies as a new class of strategies to the strategic competence and removed the element of execution of plan from metacognitive strategies. Another feature was related to the structure of cognitive strategies. While different elements of cognitive strategies in O'Malley and Chamot (1990) were treated as independent components and listed in a parallel way, they were packed up into subcomponents by Purpura (1999). This treatment provides much detailed information about the relationships between different elements of cognitive strategies. The third feature is that social mediation strategies that were the third class of strategies in O'Malley and Chamot's (1990) model were not included for its obvious inappropriateness in testing context. Purpura's (1999) extended view of strategic competence has inspired a few later empirical studies (see Phakiti, 2006, 2008a, 2008b; Song & Cheng, 2006).

Phakiti (2006) adjusted Purpura's (1999) strategy use questionnaire for reading test situation and designed a 27-item instrument, with comprehending and retrieving representing cognitive strategies and planning and monitoring representing metacognitive strategies. He then delivered the questionnaire to 358 students at a government university in Thailand immediately after they had completed a reading comprehension test and asked them to report the strategies they used during the test. The results supported the following structure: 1) cognitive strategies represented by three factors, i.e., comprehending, retrieving, and storing, and 2) metacognitive strategies by three factors, i.e., monitoring, assessing, and evaluating. This general structure pattern of strategy use during L2 reading test performance was later confirmed by the same researcher in his other two reports (Phakiti, 2008a, 2008b). Nevertheless, the appropriateness of

the strategy tasks and the underlying structure need to be verified when applied to other cultural and social contexts.

### **2.3 The Strategic Competence Scale (SCS) for ESP reading test context**

Building on previous theoretical positions and empirical evidence, the current study developed a scale (to be addressed in the next section) to measure strategic competence in ESP reading test context. The development was based on perceptions of Bachman and Palmer (1996), Douglas (2000), Purpura (1999) and Phakiti (2006, 2008a, 2008b). To illustrate, strategic competence in ESP testing is perceived as a set of conscious<sup>1</sup> mental or behavioral activities that individuals use to process language to understand the meaning conveyed in written texts addressing discipline-related issues. Following Purpura (1999) and Phakiti (2006, 2008a, 2008b), strategic competence in this study is perceived to consist of two categories: metacognitive strategies and cognitive strategies. The concept of metacognitive strategies is defined to include elements such as planning (for future actions and goal attainment, such as goal-setting, overseeing tasks, planning actions beforehand), monitoring (for checking ongoing comprehensions or performance, such as noticing comprehension failure or errors, double checking comprehension) and evaluating strategies (for evaluations of past and current actions or performance such as assessing level of difficulty self-questioning, evaluating performance/product accuracy) (Phakiti, 2006, 2008a, 2008b; Purpura, 1999). The concept of cognitive strategies is defined to consist of comprehending (for understanding, such as identifying main ideas, author's attitudes, translation, predicting, inferencing), memory (for storing information in memory, such as rereading or repeating, note-taking or underlining, paraphrasing) and retrieval strategies (for recalling information, such as using prior knowledge/experience, applying grammatical rules/knowledge)(Phakiti, 2006, 2008a, 2008b; Purpura, 1999) .

## **3. Methods**

### **3.1 Participants**

The targeted population was nurse students<sup>2</sup> studying in medical and healthcare colleges in China. With the use of both cluster and convenient sampling, a pool of 1,598 eight medical and

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<sup>1</sup> This is different from Purpura (1999), who regarded strategies as also including unconscious or subconsciously mental activities. However, strategic competence is perceived to include only conscious activities in this study. The argument is that, if strategies are not consciously applied, it would be very hard or even impossible for strategy users to report and evaluate by themselves. This statement agrees with another strategy expert Cohen(2011).

<sup>2</sup> The second-year students were targeted, as usually the medical and nursing English course was not offered until the end of the

healthcare colleges from four geographical areas in China were recruited: two from Northeast China, two from North China, two from Central China, and two from Southeast China. After removing those with 5% of the total response information missing, the sample size was reduced to 1,491. The distribution of sample size across the four geographical areas was 372 students (24.9%) from Northeast China, 255 (17.1%) from North China, 234 students (15.7%) from Center China and 630 students (42.3%) from Southeast China. Among the participants, an overwhelming majority of 1,453 (97.5% of the participants) were females and only 38 (2.5%) were males. In addition, all students aged from 17 to 23. Among them, 216 (14.5%) were at the age of 17 or 18, 913 (61.2%) were at the ages of 19 or 20, 349 (23.4%) were at the ages of 21 or 22, and only 13 (0.9%) were at the age of 23. With regard to their English language background, they had studied English for about six years before college. Their exposure to English at college included a 12-month general English course and a two-month nursing English course. Nevertheless, according to their college-intake scores, they were generally considered to be non-proficiency English users.

### **3.2 Instrument**

To assess students' strategic competence, a 38-items 6-point-scale Strategic Competence Scale (SCS) was designed. The SCS encompassed two clusters of strategies: cognitive strategies (23 items) and metacognitive strategies (15 items). The cognitive subscale covered comprehending (11 items), memory (3 items) and retrieving (9 items); the metacognitive subscale covered planning (5 items), monitoring (5 items) and evaluating (5 items) (see Appendix A). It was delivered to participants immediately after they took a medical and nursing English reading test<sup>3</sup> in simulated situation. This is a high-stakes ESP test especially designed for nurse students in medical and healthcare colleges in China. It consisted of four passages, each addressing one of the four topics: gynecology nursing, pediatrics nursing, emergency nursing and medical nursing. After each text were five questions designed to examine participants' ability in reading for implicit or explicit meanings. For each question, there was only one correct answer to be selected from the four options provided. Each text had a length of 190 to 300 words. The test was designed to be at intermediate English proficiency level. All information necessary for the

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second academic year.

<sup>3</sup> For copyright reason, the author cannot provide the authentic test papers in this paper, but it is available from the author upon the audience's request.

answers was provided and all terminologies were accompanied Chinese translations. The only reason for choosing medical and nursing English reading rather than other purposes is due to the convenience of data collection.

### **3.3 Data collection and analyses**

The 38-item SCS was delivered to second-year nurse students in eight medical and healthcare colleges across China after a medical and nursing English reading test. Before starting the test, students were explained the purpose, background, and general steps to follow when responding to the questionnaire. Immediately after the reading test, participants were asked to evaluate and report their strategy use efficacy during the reading comprehension process with no time limit, after reporting their demographic characteristics. The researcher hired six research assistants to help enter students' original responses into Excel 12.0 (Microsoft Corporation, 2007), with one assistant assigned to double-check his and other assistants' possible entering/typing errors. After that, the researcher double-checked it again to make sure that data entry was accurate. Data were then exported to NORM (Schafer, 2000) for missing value computations. After that, these processed data were exported to SPSS 17.0 (SPSS Inc, 2008) for descriptive and reliability statistics calculation and to IRTPRO (Cai, du Toit, & Thissen, 2011) for bifactor-multidimensional graded response modeling (bifactor-MGRM).

To answer the first research question 'Do Strategic Competence Scale (SCS) tasks combining metacognitive and cognitive strategies measure a general common factor of strategic competence, in addition to six domain-specific factors: planning, monitoring, evaluating, comprehending, memory and retrieving?', bifactor-MGRM estimation was used. Bifactor-MGRM is a plausible factorial structure for psychological and educational tests assuming a general factor and one or more uncorrelated domain-specific factors (Gibbons et al., 2007). This psychometric model was applied to validate the SCS for its promising strengths such as permitting large number of group factors and conditional dependence within identified subsets of items and providing more parsimonious factor solutions than conventional factor analysis. This application involved dimensionality assessment, local dependence (LD) detection (Reckase, 2009), bifactor-MGRM calibrating and scoring (Cai, Yang, & Hansen, 2011; Reise, 2011). The dimensionality assessment followed three steps: 1) performing a bifactor-MGRM model with the scale and obtaining the deviance and degrees of freedom; 2) adding the six domain factors,

planning, monitoring, evaluating, comprehending and memory successively and obtaining the significance of model improvement due to the added factor; and 3) testing the significance of chi-square decrease due to the added group factor, with the additional number of parameters estimated due to applying a complex model as the degrees of freedom (Cai, du Toit, et al., 2011; Gibbons, Rush, & Immekus, 2009).

To answer the second research question ‘What is the relative importance of the general common factor of strategic competence and other specific domain factors in explaining the SCS tasks?’, bifactor-MGRM based composite loadings, or metaphorically, the average loadings of tasks in a strategy cluster for subscales on the general factor as well as their corresponding domain-specific factors (see DeMars, 2005) were computed using the method recommended by Reckase (Reckase, 2009). Before calibrating, potential emergence of LD was examined. This detection is important as severe violation of LD risks the inflation of parameter estimates and hence increases the probability of Type I errors. To detect item pairs showing severe LD, the LD  $\chi^2$  statistics (Chen & Thissen, 1997) were consulted. The LD  $\chi^2$  statistics are (approximately) standardized values computed by comparing the observed and expected frequencies in each of the two-way cross tabulations between responses to each item and each of the other items. A LD  $\chi^2$  statistic larger than 10.0 was considered to violate the LD assumption for the MIRT models (Cai, du Toit, et al., 2011) while a LD  $\chi^2$  statistic larger than 15.0 was regarded as severe violation of the LD assumption for the MGRM models<sup>4</sup>. However, as IRT models have a good reputation of robustness to LD, item pairs displaying a violation of the LD assumption were not immediately deleted. Instead, they were marked and their impact on item parameter estimations evaluated in further calibrating. In practice, if the discrimination parameters related were inflated to an unreasonable extent, i.e., larger than the rule of thumb criterion of 3.0, then the item would be removed. Otherwise, it would be retained for further analyses.

LD detection was performed concurrently with the initial item selection process. An item was considered to be inappropriate for bifactor-MGRM modeling if it had a negative discrimination estimate on the intended primary factor and/or the domain factor or it measured other abilities apart from the intended ones (the so-called LD phenomenon) (Mark Reckase, personal communication, August 29, 2012). Cautious steps were taken to identify and delete

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<sup>4</sup> At the time of analyzing the data, LD indices for detecting MGRM was still not well established. The absolute cutoff point of 15 was set up after personal communication with Dr Li Cai, the author of the IRTPRO2.1.

problematic items. First, the discrimination estimates on the primary factor were checked and items found problematic were removed. Second, the discrimination estimates on the domain factors were examined and items with zero or negative discrimination estimates were constrained on the domain factor for further analyses.

As a final step, the composite loadings on the general factor and on their corresponding domain-specific factors were computed, using the methods recommended by Reckase (2009). The computation involved three steps: 1) obtaining N (N=the number of domain factors) sets of two-by-j (j=the number of items within each domain factor) discrimination matrices for each scale; 2) transforming each of the N matrices to a two-by-two matrix; and 3) deriving the eigenvectors that could be used as the weighting ratios (composite loadings) for the general common factor and for the domain-specific factor.

## 4. Results

### 4.1 Descriptive and reliability statistics

The descriptive and reliability statistics are shown in Table 1. Item means ranged from 3.59 (SD = 1.10) for Scanning and skimming to find topics or main ideas to 2.86 (SD = 1.36) for Making notes during the reading. The values of skewness ranged from -.80 to -.40 and those of kurtosis ranged from -.33 to .45, all within the range of + 2 that suggests approximate normal distribution (Bachman, 2004). Regarding reliability estimates, the internal consistency estimates for the six subscales ranged from .66 for Memory to .86 for Comprehending and that for the overall scale was .95. In addition, no individual items within any of the six subscales produced alpha higher than its corresponding subscale reliability estimate. In all, results of preliminary analysis based on the classic test theory show that all of the 38 items were consistently tapped into the common factor as well as their corresponding domain factors.

Table 1: Strategies and Descriptive and Reliability Estimates

Item	Mean	SD	Skew	Kurt	Alpha	Item	Mean	SD	Skew	Kurt	Alpha
SC1	3.16	1.32	-0.75	0.25	0.79	SC20	2.87	1.29	-0.45	-0.17	0.84
SC2	2.88	1.25	-0.51	0.05	0.77	SC21	3.01	1.3	-0.49	-0.1	0.84
SC3	2.92	1.26	-0.49	-0.04	0.78	SC22	3.08	1.22	-0.45	-0.1	0.84
SC4	3.28	1.19	-0.55	0.1	0.81	SC23	3.32	1.15	-0.52	0.07	0.84

<b>SC5</b>	3.04	1.27	-0.5	-0.08	0.79	SC24	3.23	1.15	-0.5	0.15	0.85	
	Subtotal				0.82	SC25	3.25	1.14	-0.53	0.17	0.84	
<b>SC6</b>	3.57	1.21	-0.8	0.38	0.76	SC26	2.94	1.21	-0.4	0.02	0.85	
<b>SC7</b>	3.28	1.21	-0.62	0.14	0.73		Subtotal				0.86	
<b>SC8</b>	3.44	1.19	-0.71	0.22	0.72	SC27	3.18	1.15	-0.49	0.07	0.52	
<b>SC9</b>	3.52	1.11	-0.63	0.37	0.74	SC28	3.37	1.13	-0.64	0.32	0.55	
<b>SC10</b>	3.36	1.15	-0.63	0.33	0.76	SC29	2.86	1.36	-0.42	-0.33	0.62	
	Subtotal				0.78		Subtotal				0.66	
<b>SC11</b>	3.34	1.22	-0.49	-0.19	0.76	SC30	3.16	1.21	-0.64	0.25	0.81	
<b>SC12</b>	3.2	1.21	-0.44	-0.22	0.72	SC31	3.05	1.22	-0.54	0.18	0.82	
<b>SC13</b>	3.16	1.19	-0.46	0.02	0.71	SC32	2.97	1.24	-0.58	0.16	0.82	
<b>SC14</b>	3.09	1.2	-0.48	-0.01	0.71	SC33	2.95	1.27	-0.4	-0.22	0.81	
<b>SC15</b>	3.56	1.22	-0.75	0.26	0.77	SC34	3.21	1.2	-0.49	0.03	0.81	
	Subtotal				0.78	SC35	3.49	1.16	-0.61	0.09	0.82	
<b>SC16</b>	3.58	1.1	-0.58	0.38	0.85	SC36	3.27	1.22	-0.61	0.05	0.83	
<b>SC17</b>	3.22	1.08	-0.47	0.45	0.84	SC37	2.97	1.2	-0.45	0.09	0.81	
<b>SC18</b>	3.17	1.07	-0.44	0.43	0.85	SC38	3.3	1.14	-0.46	0.15	0.82	
<b>SC19</b>	3	1.24	-0.46	0.02	0.85		Subtotal				0.83	
											Total	0.95

## 4.2 Dimensionality assessment

Table 2 summarizes the results of the dimensionality assessment. As shown, a unidimensional GRM estimation produced a -2 times loglikelihood (with freely estimated parameter) of 156218.98 (228). Adding the factors of planning, monitoring, evaluating, comprehending, memory and retrieving successively produced reduced -2LLs (with degrees of freedom) of 516.88 (df=5), 679.54 (df=5), 287.54 (df=5), 438.55(df=11), 70.77 (df=3), 161.08 (df=9), all significant at the .00 level. This indicates that the assumption of the predetermined seven-dimensional model of strategic competence could not be rejected.

Table 2: Bifactor-MGRM Results of Dimensionality Assessment for the SCS (N=1491)

Factors*	-2LL	fp	$\Delta G^2$	$\Delta df$	p
G	156225.27	228	--	--	--
G+f1	155708.39	233	516.88	5	.000
G+f1+f2	155028.85	238	679.54	5	.000
G+f1+f2+f3	154741.31	243	287.54	5	.000
G+f1+f2+f3+f4	154302.76	254	438.55	11	.000
G+f1+f2+f3+f4+f5	154231.99	257	70.77	3	.000
G+f1+f2+f3+f4+f5+f6	154070.91	266	161.08	9	.000

\*Note: G= the general strategic competence factor, f1=the planning factor, f2=the monitoring factor, f3=the evaluating factor, f4=the comprehending factor, f5=the memory factor, f6=the retrieving factor.

### 4.3 Local dependence (LD)

Before the SCS was calibrated and scored, potential LDs between items had been examined by performing the bifactor-MGRM with six domain factors (i.e., planning, monitoring, evaluating, comprehending, memory and retrieving) on the 38-item SCS tasks using the BAEM estimation method. This gave two LD statistics larger than 20.0. They were 24.4 (by SC10 and SC11) and 21.4 (by SC8 and SC14). The impact of dependent item pairs upon discrimination estimation relevant to these four items was inspected. According to the IRTPRO results, the discrimination estimates were 1.69 (by SC8), 1.49 (by SC10), 1.37 by (SC11) and 2.18 (by SC14) on the general factor and 2.31 (by SC8 on the planning domain factor), 0.62 (by SC10 on the monitoring domain factor), 0.08 (by SC11 on the evaluating domain factor), and 1.90 (by SC14 on the evaluating domain factor). Among them, the estimates relating to SC8 (2.18 on the domain factor and 1.73 on the general factor) and SC14 (2.09 on the general factor and 1.71 on the domain factor) were suspected of inflating each other's estimate. Nevertheless, given all estimates ranged from 1.71 to 2.18, the potential harm of estimate inflation was considered minimum, and therefore no modification was performed due to the violence of LD before further calibrating (Li Cai, Personal communication, June, 9, 2012).

### 4.4 Bifactor-MGRM calibrating

A bifactor-MGRM model accounting for one general factor of strategic competence and six individual domain factors, i.e., planning, monitoring, evaluating, comprehending, retrieving and memory based on Phakiti (2006, 2008a, 2008b) was applied using the MH-RM on the 38-item SCS and the discrimination estimates evaluated. The first trial produced two negative discrimination estimates on the domain factor of retrieving ( $a=-0.38$  by item SC35 and  $a=-.25$  by SC36). These two items were regarded as poor indicators for retrieving, thereby their loadings on this domain factor constrained. A second trial with this modified model was performed and no negative loadings were produced. The discrimination, threshold estimates and standardized errors for these statistics, as well as the derived  $MDISC_{i's}$  (or  $A_{i's}$ ) and  $MDIFF_{i's}$  (or  $B_{i's}$ ) are shown in Table 3.

For the differentiating power on the general factor of strategic competence, 28 of the 38 items had high discrimination values that ranged from 1.37 (by SC25) to 2.13 by (SC14) and all

other 10 items were moderately discriminating (with  $a_i$ s ranging from 1.05 by SC19 to 1.33 by SC23). This indicates that all strategic competence functioned as efficient indicators of the primary trait of strategic competence.

For the five discrimination estimations on the domain factor of planning, the discriminating power varied. There were two items showing high discriminating power: SC1 ( $a_i = 1.70$ ) and SC2 ( $a_i = 1.88$ ); one item showing moderate discriminating: SC3 ( $a_i = 0.94$ ); and two items showing low discriminating: SC4 ( $a_i = 0.21$ ) and SC5 ( $a_i = 0.59$ ). For the five items measuring the monitoring domain, two items had high discrimination estimates as high as 2.23 (by SC8) and 1.41 (by SC9); one item had a moderate discrimination of 1.04 (by SC7); and two items of SC6 and SC10 produced low discrimination estimates of .59 and .61, respectively. For the evaluating domain factor, the only high discrimination estimate of 1.75 was produced by SC14. Another item SC13 produced a moderate estimate of 1.36. All other three items produced low discrimination estimates. The  $a_i$ s were 0.08, 0.38 and 0.43 by SC11, SC12 and SC15, respectively. Among them, the discrimination produced by SC11 was trivial and almost ignorable.

For the eleven discrimination estimates on the comprehending domain factor, six items were moderately discriminating (with  $a_i$ s ranging from 0.66 by SC23 to 1.12 by SC20) and the other five items were lowly discriminating (with  $a_i$ s ranging from 0.52 by SC16 to 0.61 by SC25). For the second domain factor of memory, two of the three items were moderately discriminating (the  $a_i$ s were 1.07 and 0.99 for SC27 and SC28, respectively) and one lowly discriminating (the  $a_i$  for SC29 was 0.42). For the seven calibrated items on the domain factor of retrieving, only two items were moderately discriminating (the  $a_i$ s were 0.99 and 1.24 by SC31 and SC32); all other unconstrained items were low in discriminating students' retrieving (with  $a_i$ s ranging from 0.24 by SC34 to 0.57 by SC33).

The overall discrimination power of the items is shown in the continued part of Table 4. After the discriminating power on the primary factor and the domain factors was balanced, there were 33 out of the total 38 items showing high discriminating power, with  $A_i$ s ranging from 1.36 (by SC16) to 2.36 (by SC1). All other four items were moderately discriminating (the lowest  $A_i$

was 1.25 by SC36). In terms of  $\mathbf{MDISC}_{i,\xi}$ , it could be concluded that all SCS items were discriminating the composite trait of strategic competence well.

The derived  $\mathbf{MDIFF}_{i,s}$  for the bifactor-MGRM model are shown in the last five columns of the continued part of Table 3. As the SCS is a six-point-Likert scale, there were five thresholds and hence five composite thresholds. As shown, all items produced negative  $\mathbf{B}_{i,s}$  for the first three thresholds, indicating that all SCS items were easy for students. In other words, most students rated their strategic competence represented higher than the score of 3.0 in contrast with the highest possible point of 5.0. In addition, almost all items except for SC6 and SC15 produced positive  $\mathbf{B}_{i,s}$  for the third and fourth thresholds, indicating that these two thresholds were relatively challenging to students. Note that there were six items produced  $\mathbf{B}_{i,s}$ s equal or larger than 2.0: SC18 ( $\mathbf{B}_i = 2.18$ ), SC20 ( $\mathbf{B}_{i,s} = 2.00$ ), SC24 ( $\mathbf{B}_{i,s} = 2.01$ ), SC26 ( $\mathbf{B}_{i,s} = 2.16$ ), SC29 ( $\mathbf{B}_{i,s} = 2.10$ ), and SC37 ( $\mathbf{B}_{i,s} = 2.15$ ), indicating that students rated their strategic competence relatively lower on the compared with their ratings on other items.

These results suggest that the 38-item SCS tasks, by placing constraints on SC35 and SC36, could be sufficient indicators of strategic competence and that the bifactor-MGRM model could be established as a valid structure to score these strategic items.

Table 3: Seven-dimensional Bifactor-MGRM Solution for the SCS (N=1491): Slopes, Thresholds,  $\mathbf{MDISC}_{i,s}$ , and  $\mathbf{MDIFF}_{i,s}$

Domain	Item	$\alpha_2$	s.e.	$\alpha_1$	s.e.	$\alpha_{12}$	s.e.	$\alpha_{13}$	s.e.	$\alpha_{14}$	s.e.
Planning	SC1	1.64	0.09	1.70	0.14	4.18	0.18	3.29	0.15	1.86	0.11
	SC2	2.10	0.13	1.88	0.21	4.67	0.40	3.39	0.31	1.14	0.14
	SC3	1.77	0.08	0.94	0.08	3.83	0.14	2.75	0.11	0.88	0.07
	SC4	1.81	0.08	0.21	0.07	4.68	0.19	3.36	0.13	1.55	0.08
	SC5	1.63	0.07	0.59	0.07	3.84	0.14	2.56	0.10	1.15	0.07
Monitoring	SC6	1.44	0.07	0.59	0.07	4.68	0.20	3.31	0.13	2.10	0.09
	SC7	1.43	0.07	1.04	0.08	4.66	0.19	3.17	0.12	1.73	0.08
	SC8	1.72	0.00	2.23	0.00	6.64	0.28	4.61	0.18	2.77	0.12
	SC9	1.39	0.08	1.41	0.09	5.62	0.26	4.12	0.15	2.42	0.10
	SC10	1.53	0.07	0.61	0.07	4.72	0.20	3.39	0.13	1.77	0.08
Evaluating	SC11	1.39	0.07	0.05	0.07	4.53	0.20	2.88	0.11	1.37	0.07
	SC12	1.78	0.08	0.36	0.08	4.90	0.20	3.00	0.11	1.33	0.07
	SC13	2.05	0.10	1.36	0.12	5.48	0.24	3.73	0.16	1.63	0.09
	SC14	2.13	0.06	1.75	0.00	5.91	0.07	3.95	0.08	1.70	0.08
	SC15	1.19	0.06	0.39	0.08	4.25	0.18	3.01	0.11	1.82	0.08

Comprehending	SC16	1.26	0.07	0.52	0.07	4.92	0.24	3.74	0.15	2.22	0.09
	SC17	1.55	0.07	0.83	0.07	4.91	0.22	3.67	0.14	1.65	0.08
	SC18	1.21	0.06	0.58	0.08	4.44	0.19	3.20	0.12	1.41	0.07
	SC19	1.05	0.06	1.03	0.09	3.58	0.14	2.58	0.10	0.96	0.07
	SC20	1.19	0.07	1.12	0.10	3.39	0.13	2.24	0.09	0.82	0.07
	SC21	1.42	0.07	0.93	0.08	3.60	0.14	2.61	0.11	1.00	0.07
	SC22	1.41	0.07	0.96	0.08	4.29	0.18	2.70	0.11	1.15	0.07
	SC23	1.33	0.07	0.66	0.08	4.91	0.23	3.10	0.12	1.62	0.08
	SC24	1.11	0.06	0.59	0.07	4.24	0.19	2.86	0.11	1.34	0.07
	SC25	1.37	0.07	0.61	0.07	4.65	0.20	3.02	0.11	1.50	0.07
SC26	1.32	0.06	0.56	0.07	3.71	0.14	2.49	0.10	0.85	0.06	
Memory	SC27	1.65	0.00	1.07	0.00	5.20	0.31	3.40	0.18	1.57	0.09
	SC28	1.49	0.08	0.99	0.17	5.16	0.24	3.51	0.14	1.94	0.09
	SC29	1.27	0.06	0.42	0.10	2.90	0.11	2.03	0.08	0.69	0.06
Retrieving	SC30	1.72	0.07	0.50	0.09	4.16	0.16	2.95	0.11	1.49	0.08
	SC31	1.49	0.07	0.99	0.11	3.96	0.15	2.96	0.11	1.23	0.08
	SC32	1.45	0.10	1.24	0.17	3.82	0.15	2.82	0.13	1.19	0.09
	SC33	1.60	0.07	0.57	0.13	3.81	0.16	2.55	0.11	0.81	0.07
	SC34	1.58	0.07	0.24	0.08	4.33	0.18	2.98	0.11	1.34	0.07
	SC35	1.42	0.07	0.00	0.00	4.99	0.24	3.26	0.12	1.84	0.08
	SC36	1.25	0.06	0.00	0.00	4.00	0.17	2.66	0.10	1.38	0.07
	SC37	1.41	0.07	0.47	0.08	3.77	0.15	2.44	0.10	1.02	0.07
	SC38	1.52	0.07	0.30	0.08	4.71	0.20	3.34	0.12	1.63	0.07

Table 3 (Continued): Seven-dimensional Bifactor-MGRM Solution for the SCS (N=1491): Slopes, Thresholds, **MDISC<sub>is</sub>**, and **MDIFF<sub>is</sub>**

Domain	Item	$d_{1i}$	s.e	$d_{2i}$	s.e	$A_i$	$B_{1i}$	$B_{2i}$	$B_{3i}$	$B_{4i}$	$B_{5i}$
Planning	SC1	-0.93	0.09	-3.28	0.13	2.36	-1.75	-1.38	-0.78	0.39	1.38
	SC2	-2.04	0.17	-4.76	0.35	2.82	-1.69	-1.22	-0.41	0.74	1.72
	SC3	-1.44	0.08	-3.74	0.13	2.00	-1.94	-1.39	-0.45	0.73	1.90
	SC4	-0.54	0.07	-2.75	0.10	1.82	-2.58	-1.85	-0.86	0.30	1.52
	SC5	-1.04	0.07	-3.02	0.11	1.73	-2.24	-1.49	-0.67	0.61	1.76
Monitoring	SC6	0.17	0.06	-1.75	0.08	1.56	-3.00	-2.12	-1.34	-0.11	1.12
	SC7	-0.47	0.07	-2.66	0.10	1.77	-2.64	-1.79	-0.98	0.27	1.50
	SC8	-0.01	0.08	-3.14	0.13	2.82	-2.32	-1.61	-0.97	0.00	1.10
	SC9	-0.03	0.07	-2.30	0.09	1.98	-2.93	-2.15	-1.26	0.02	1.20
	SC10	-0.34	0.06	-2.55	0.09	1.65	-2.92	-2.10	-1.10	0.21	1.58
Evaluating	SC11	-0.40	0.06	-2.08	0.08	1.39	-3.30	-2.10	-1.00	0.29	1.52
	SC12	-0.73	0.07	-2.84	0.10	1.82	-2.74	-1.68	-0.74	0.41	1.59
	SC13	-1.05	0.08	-3.58	0.15	2.46	-2.26	-1.54	-0.67	0.43	1.48

	SC14	-1.30	0.09	-4.32	0.12	2.76	-2.04	-1.37	-0.59	0.45	1.49
	SC15	0.07	0.06	-1.50	0.07	1.25	-3.44	-2.43	-1.47	-0.06	1.21
<b>Comprehending</b>	SC16	-0.12	0.06	-1.74	0.08	1.36	-3.63	-2.76	-1.64	0.09	1.28
	SC17	-0.89	0.08	-3.18	0.13	1.76	-2.74	-2.05	-0.92	0.50	1.78
	SC18	-0.91	0.06	-2.97	0.11	1.34	-3.27	-2.35	-1.04	0.67	2.18
	SC19	-1.10	0.07	-2.93	0.11	1.47	-2.42	-1.75	-0.65	0.74	1.98
	SC20	-1.41	0.08	-3.33	0.12	1.63	-2.04	-1.35	-0.49	0.85	2.00
	SC21	-1.08	0.07	-3.02	0.11	1.70	-2.08	-1.51	-0.58	0.62	1.74
	SC22	-1.00	0.07	-3.06	0.11	1.71	-2.51	-1.58	-0.67	0.59	1.79
	SC23	-0.47	0.06	-2.47	0.09	1.48	-3.30	-2.08	-1.09	0.32	1.66
	SC24	-0.63	0.06	-2.51	0.10	1.26	-3.40	-2.29	-1.07	0.50	2.01
	SC25	-0.61	0.06	-2.77	0.10	1.50	-3.08	-2.00	-0.99	0.40	1.84
	SC26	-1.29	0.07	-3.15	0.11	1.43	-2.55	-1.71	-0.58	0.89	2.16
<b>Memory</b>	SC27	-0.84	0.08	-3.32	0.14	1.97	-2.59	-1.69	-0.78	0.42	1.65
	SC28	-0.30	0.07	-2.73	0.11	1.79	-2.89	-1.97	-1.09	0.17	1.53
	SC29	-1.14	0.07	-2.78	0.10	1.34	-2.19	-1.53	-0.52	0.86	2.10
<b>Retrieving</b>	SC30	-0.78	0.07	-3.16	0.11	1.79	-2.31	-1.64	-0.83	0.43	1.76
	SC31	-1.13	0.08	-3.27	0.12	1.79	-2.22	-1.66	-0.69	0.63	1.83
	SC32	-1.32	0.08	-3.64	0.14	1.91	-2.01	-1.48	-0.63	0.69	1.91
	SC33	-1.18	0.10	-3.21	0.15	1.70	-2.24	-1.50	-0.48	0.69	1.89
	SC34	-0.73	0.06	-2.64	0.10	1.60	-2.71	-1.87	-0.84	0.46	1.65
	SC35	-0.06	0.06	-1.95	0.08	1.42	-3.54	-2.31	-1.30	0.04	1.38
	SC36	-0.38	0.06	-2.29	0.09	1.25	-3.23	-2.15	-1.11	0.31	1.85
	SC37	-1.28	0.07	-3.15	0.12	1.49	-2.57	-1.66	-0.69	0.87	2.15
	SC38	-0.63	0.06	-2.53	0.09	1.55	-3.00	-2.12	-1.04	0.40	1.61

#### 4.5 Computing composite loadings

As there were six subscales in the SCS, six composite scores were computed using IRTPRO item parameter estimates to represent each of the six domain factors of planning, monitoring, evaluating, comprehending, memory, and retrieving. For the planning items, the original discrimination matrix produced by the five calibrated items could be transformed to the

following matrix:  $\begin{bmatrix} 16.68 & 9.94 \\ 9.94 & 7.79 \end{bmatrix}$ . The two eigenvalues of this matrix were extracted out as 23.12

and -1.35, respectively. The larger value of 22.90 corresponded to the vector of  $\begin{bmatrix} .84 \\ .54 \end{bmatrix}$ .

Therefore, the scalar on the top was the weight for the general factor (GF) and the one on the

bottom was for the domain factor of planning (PLAN). Hence, the composite score representing the five planning items could be obtained as:

$$\text{Composite}_{\text{PLAN}} = .84 * \text{Score}_{\text{GF}} + .54 * \text{Score}_{\text{PLAN}}$$

For the monitoring items, the original discrimination matrix produced by the five calibrated items could be transformed to the following matrix:  $\begin{bmatrix} 11.49 & 8.86 \\ 8.86 & 8.56 \end{bmatrix}$ . The two eigenvalues of this matrix were extracted out as 19.01 and 1.04, respectively. The larger value of 19.01 corresponded to the vector of  $\begin{bmatrix} .76 \\ .65 \end{bmatrix}$ . Therefore, the scalar on the top was the weight for the primary factor (GF) and the one on the bottom was for the domain factor of monitoring (MONI). Hence, the composite score representing the five monitoring items could be obtained as:

$$\text{Composite}_{\text{MONI}} = .76 * \text{Score}_{\text{GF}} + .65 * \text{Score}_{\text{MONI}}$$

For the evaluating items, the original discrimination matrix produced by the five calibrated items could be transformed to the following matrix:  $\begin{bmatrix} 15.62 & 7.71 \\ 7.71 & 5.06 \end{bmatrix}$ . The two eigenvalues of this matrix were extracted out as 19.68 and -1.00, respectively. The larger value of 19.01 corresponded to the vector of  $\begin{bmatrix} .89 \\ .47 \end{bmatrix}$ . Therefore, the scalar on the top was the weight for the primary factor (GF) and the one on the bottom was for the domain factor of evaluating (EVAL). Hence, the composite score representing the five evaluating items could be obtained as:

$$\text{Composite}_{\text{EVAL}} = .89 * \text{Score}_{\text{GF}} + .47 * \text{Score}_{\text{EVAL}}$$

For the comprehending (COMP) domain items, the original discrimination matrix produced by the eleven calibrated items could be transformed to the following matrix:  $\begin{bmatrix} 18.85 & 10.88 \\ 10.88 & 6.91 \end{bmatrix}$ . The two eigenvalues of this matrix were extracted out as 25.29 and -0.47, respectively. The larger value of 23.12 corresponded to the vector of  $\begin{bmatrix} .86 \\ .51 \end{bmatrix}$ . Therefore, the scalar on the top was the weight for the primary factor (GF) and the one on the bottom was for the

domain factor of comprehending (COMP). Hence, the composite score representing the eleven calibrated items in comprehending domain could be obtained as:

$$\text{Composite}_{\text{COMP}} = .86 * \text{Score}_{\text{GF}} + .51 * \text{Score}_{\text{COMP}}$$

For the memory items, the original discrimination matrix produced by the three calibrated items could be transformed to the following matrix:  $\begin{bmatrix} 6.68 & 3.81 \\ 3.81 & 2.29 \end{bmatrix}$ . The two eigenvalues of this matrix were extracted out as 8.88 and -0.09, respectively. The larger value of 8.88 corresponded to the vector of  $\begin{bmatrix} .87 \\ .50 \end{bmatrix}$ . Therefore, the scalar on the top was the weight for the primary factor (GF) and the one on the bottom was for the domain factor of memory (MEMO). Hence, the composite score representing the three memory items could be obtained as:

$$\text{Composite}_{\text{MEMO}} = .87 * \text{Score}_{\text{GF}} + .50 * \text{Score}_{\text{MEMO}}$$

For the retrieving items, the original discrimination matrix produced by the three calibrated items could be transformed to the following matrix:  $\begin{bmatrix} 20.58 & 6.67 \\ 6.67 & 3.51 \end{bmatrix}$ . The two eigenvalues of this matrix were extracted out as 22.90 and -1.21, respectively. The larger value of 22.90 corresponded to the vector of  $\begin{bmatrix} .95 \\ .33 \end{bmatrix}$ . Therefore, the scalar on the top was the weight for the primary factor (GF) and the one on the bottom was for the domain factor of retrieving (RETR). Hence, the composite score representing the three memory items could be obtained as:

$$\text{Composite}_{\text{RETR}} = .95 * \text{Score}_{\text{GF}} + .33 * \text{Score}_{\text{RETR}}$$

## 5. Discussion

In addition to providing a brief view of the evolution of strategic competence in language ability, this paper validated a scale measuring strategic competence during ESP reading test performance. Conventional definitions of strategic competence in general and ESP testing used to refer to metacognitive strategies. In this paper, most recent advances on strategy use in the field of second language acquisition and language testing were discussed and insights absorbed. In this example, a 38-item strategic competence scale was developed by adapting previous scales in strategy use study. Drawing on O'Malley and Chamot (1990), Purpura (1999) and Phakiti

(2006, 2008a, 2008b), the Strategic Competence Scale was designed to measure strategic competence as a construct that not only consisted of three specific metacognitive strategies, i.e., planning, monitoring, and evaluating, but also three cognitive strategies, i.e., comprehending, memory and retrieving.

To answer the first research question regarding the factorial structure of the Strategic Competence Scale that measured strategic competence, the study applied bifactor-MGRM model and deconstructed strategic competence as a function of an independent general factor representing the common feature of strategic competence tasks and six uncorrelated domain-specific factors representing planning, monitoring, evaluating, comprehending, memory and retrieving, respectively. The analytical results lent substantial evidence supporting that the Strategic Competence Scale measured a general common factor and six domain-specific factors in the context of ESP reading test. These results provided empirical evidence supporting Purpura's (1999) and Phakiti's (2006, 2008a, 2008b) conceptualization of cognitive strategies into strategic competence in the language testing literature. Given the targeted population and research design of the study, these results should function as strong evidence supporting this conceptualization of strategic competence in ESP ability set in reading.

The second research question investigated the relative importance of different factors in explaining the strategic competence measure tasks. With the question, one intended interest was to see whether the general factor could outperform domain-specific factors in explaining strategy tasks; another was to see whether cognitive strategy tasks outperformed metacognitive strategy tasks or metacognitive strategy tasks outperformed cognitive strategies in determining the general factor of strategic competence. These comparisons are important, as results would provide detailed information regarding the potential contribution of cognitive strategies in determining the construct of strategic competence, an issue that had not caught enough attention of previous studies (e.g., Phakiti, 2008a, 2008b).

Predictably, the general factor of strategic competence played a dominant role in determining students' responses to each type of strategies as against the effect contributed by their corresponding domain-specific factor. Looking closer into the composite loadings on the general factor by different subscale (or domain-specific) tasks, the largest composite loading was produced by retrieving tasks, followed by tasks addressing domain-specific factors of evaluating, memory, comprehending, planning, and monitoring. Along this list, all composite loadings by

domain-specific tasks addressing cognitive strategies ranked top four. These findings not only evidenced the plausibility of including the cognitive strategies in the conceptualization of strategic competence, but also proved that they might even play a more important role than metacognitive strategies do in determining the application level of strategic competence that was previously assumed as the sole ingredients of strategic competence.

Equally important, all of the 38 items except for two constrained retrieving items (SC35 and SC36) loaded significantly on their corresponding domain-specific factors that they were designed to cover. The relative importance of the influences of these domain-specific factors on their corresponding tasks follows an order reverse to the one for that of the general factor. From large to small, they were monitoring, planning, comprehending, memory, evaluating, and retrieving. The message conveyed here is that when a cluster of strategy tasks tapped more into about the general factor, it would display fewer features belonging to the domain-specific factor; on the contrary, when a cluster of strategy tasks tapped less into about the general factor, they would display more feature belonging to the domain-specific factor. This perception is quite different from the interpretation based on conventional factor analysis that treated ingredients unaccounted by the common factor as noises.

## **6. Conclusion**

To conclude, the current study was concerned with the evolution of the concept of strategic competence and highlighted the view of strategic competence that extended from metacognitive strategies to include cognitive strategies. It then designed and validated a scale for assessing strategic competence in ESP reading test context. Results of bifactor-MGRM showed that the strategic competence measured a general common factor and six domain specific factors, i.e., planning, monitoring, evaluating, comprehending, memory, and retrieving and that those cognitive strategies (i.e., comprehending, memory and retrieving) seemed to play a more important role in determining the general factor than metacognitive strategies did. It is hoped that the results could provide a tentative list for assessing strategic competence in ESP reading context. It is also expected that the demonstration of applying bifactor-MRGM could encourage greater use of this advanced method for validation study in ESP research. Nevertheless, future studies might further examine the relative importance of different strategy types to ESP reading

test performance and how they work in concert with each other to enhance ESP reading test performance.

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## Appendix

### The Strategic Competence Scale for ESP Reading

Metacognitive Strategies		
Planning	SC1	阅读之前，对如何完成阅读做初步计划 Planning what to do before starting to complete the reading
	SC2	阅读过程中，不断检查阅读的计划或目标 Setting the goal for reading before starting to read carefully
	SC3	阅读过程中，一旦发现初步阅读计划无效，知道如何处理 Knowing what to do if intended plans did not work efficiently while completing the reading test
	SC4	阅读之前，对阅读的目的进行明确 Setting the goals before starting to read
	SC5	阅读之前，安排阅读进行的几个重要步骤 Considering essential steps needed to complete the test
Monitoring	SC6	细读之前，快速浏览文章和问题，初步了解任务量 Before starting to read carefully, flipping through the texts and questions to have a general understanding of the workload
	SC7	阅读过程中，知道还有多少任务没完成 Being aware of how much of the reading and test tasks remained to be done while taking the test
	SC8	阅读过程中，注意力开小差时自己会有意识 Being aware when losing concentration while working on the test
	SC9	产生担心、紧张、或不太想完成阅读时，自己会有意识 Being aware when feeling worried, tense or unmotivated to complete the test
	SC10	阅读困难时，知道导致困难产生的部分在文中什么位置 Being aware of the confusion the location when confusion occurred
Evaluating	SC11	阅读困难时，知道困难是因生词还是概念本身的迷惑性 When comprehension suffers, being able to tell whether it was due to an unknown term interfering with meaning or an concept was confusing
	SC12	阅读过程中，知道哪里应该快读，哪里应该细读 Knowing when to read or complete the test more quickly or carefully
	SC13	阅读过程中，对理解的正确性不断进行检查 Double-checking reading comprehension or performance
	SC14	阅读过程中，对任务完成的进度不断进行检查 Checking progress when moving along with the test tasks
	SC15	对理解或回答进行检查，一旦发现错误立即进行纠正 Immediately correcting misunderstanding or performance mistakes wherever found
Cognitive strategies		
Comprehending	SC16	快速阅读或略读寻找文章主题或主旨意思 Finding topics and main ideas by scanning and skimming
	SC17	理解文中观点之间的关系 Understanding the relationships between ideas in the text
	SC18	寻找句子之间的关系 Reading to see what all or most sentences were in common
	SC19	对下文即将读到的内容进行预测 Predicting what is going to happen next while reading.
	SC20	对预测的正确性进行检测(Dis)Confirming a prediction of the main idea
	SC21	对作者意图进行分析 Analyzing what the author meant or tried to say in the text
	SC22	对文章暗含的意思进行推测 Interpreting hidden ideas/meanings in texts
	SC23	对文章大意进行概括 Summarizing the main information in the text
	SC24	排除部分生词对理解的干扰 Comprehending the content without looking up every word
	SC25	运用上下文猜测生词词意 Identifying or guessing meanings of unknown words

		using context clues
	SC26	运用词根猜测生词词意 Guessing meanings of unknown words using root words
Memory	SC27	通过反复阅读理解难点 Rereading texts or tasks several times when feeling not understanding them
	SC28	借助中文思维或翻译成中文帮助理解 Translating text or reading tasks into my first language
	SC29	阅读过程中做简短笔记帮助理解 Making notes during the reading
	SC30	运用与文章信息相关的知识帮助理解 Relating the information from the reading or tasks to prior knowledge or experience
Retrieving	SC31	运用文章信息相关的知识预测下文内容 Using background knowledge to predict what was going to happen next while I was reading the text
	SC32	在脑中形成某些与文章信息相关的图形帮助理解 Forming pictures or diagrams relating to information provided in the text
	SC33	使用英语语法知识帮助理解文章或问答题 Applying learned grammar rules while reading or completing tasks
	SC34	知道文中哪些信息重要哪些不重要 Knowing which information is more or less important.
	SC35	回答问题前仔细审题 Trying to understand questions adequately before attempting to find the answers
	SC36	碰到较难的题时，知道该在上面花多长时间 Spending more time on difficult questions
	SC37	运用多种思维方式回答问题 Using multiple thinking strategies to help answer the test questions
	SC38	运用与文章信息相关的知识帮助回答问题 Selecting relevant information to help understand texts and answer the questions



**‘This paper thinks...’/‘I argue...’: English and Chinese Author Identities in  
Linguistics Conference Abstracts**

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**Abstract**

This study investigates author identity represented by both implicit and explicit self-references in English and Chinese conference abstracts (CAs). A quantitative analysis is conducted to find out

the distribution of different authorial roles realized by the deictic noun phrases (*this paper/study/researcher/author*) and the first person singular and plural pronouns (*we* and *I*) in the subject position. Then, a qualitative analysis is conducted to explore reasons behind the distinctive features found in the use of the linguistic devices, by referring to different social and cultural backgrounds, discourse communities, writing conventions as well as the genre and discipline. The results show that the English CA writers present themselves more frequently and in more explicit ways, showing stronger authorial power from a more individual perspective while the Chinese CA writers tend to project author roles in more impersonal or indirect ways, showing weaker authorial power from a more collective perspective. By analyzing author identity in English and Chinese CAs, this study aims to extend the current contrastive study on academic discourse.

**Keywords:** author identity, English and Chinese conference abstracts, linguistics conference abstracts

## 1. Introduction

In recent years, following the modified notion of academic discourse as interpersonal or interactive rather than “purely objective, impersonal and informational, designed to disguise the author and deal directly with facts” (Hyland & Tse, 2005, p. 123), growing research has seen academic discourse as a forum or platform, where the author interacts with other scholars and the audience, takes a position, presents his/her voice or identity (Hyland, 2005; Hyland & Tse, 2012; Flottum, 2009). Thus, the argumentative nature of academic writing calls for a visible author, who clearly indicates position in relation to one’s own and others’ findings (Hyland, 2002b; Dahl, 2009). Such author presence or representation in text or discourse is often referred to as author identity (Hyland, 2002a, b). Attention has especially been given to how authors represent themselves through different roles assumed in text and their linguistic realizations. Previous research has demonstrated that one of the typical linguistic resources used to present the author in discourse is first person, which obviously constitutes the most direct and explicit author identity (Ivanic, 1998; Tang & John, 1999; Hyland, 2001). It is shown that first person “is a powerful means by which writers express an identity by asserting their claim to speak as an

authority, and this is a key element of successful academic writing” (Hyland, 2002b, pp. 1093-1094).

So far, most of the studies have placed great emphasis on first person pronouns, the explicit forms of author identity (Ivanic, 1998; Kuo, 1999; Tang & John, 1999; Hyland, 2002a,b; Mur Duenas, 2007; Sheldon, 2009; see Section 2 for a detailed review). However, more recent research shows that there are other types of linguistic devices indicating author presence, but in implicit ways, such as *this paper* and *this study* (Bondi, 2009; Flottum, 2009). These are linguistic realizations of implicit author presence, referring to the author indirectly through either the text/research or the writer/researcher (Bondi, 2009). Flottum (2009) used the term “implicit presence of self” (p. 117) for such uses. For example, expressions like “this paper investigates ...” or “the writer looks at the following instances of ...” are used to present the author as *a researcher* or *guide* to readers. This is especially the case when different languages or disciplines are taken into consideration, for there may exist much variation (Flottum, 2009). Bondi (2009) explored in detail the use of such implicit forms as *this paper/article/study* for author representation in Italian and English historical articles. Dahl (2009) in the study on author identity in English RA abstracts of economics and linguistics found frequent uses of the inanimate noun *paper* or *article* combined with verbs like *examine* and *present* for authorial roles in nearly all the abstracts without first person pronouns. These studies point to the need for a comprehensive investigation into both explicit and implicit forms of author presence (Flottum, 2009). By focusing on English and Chinese conference abstracts (CAs), we intend to look at the ways in which writers in linguistics use these devices to establish their identities across cultures.

Previous comparative studies have investigated the effects of cultural and disciplinary factors on the uses of micro linguistic features like personal pronouns (Vassileva, 1998, 2000; Hyland, 2002a, b; Martinez, 2005; Flottum, 2009; Dahl, 2009; Mur Duenas, 2007; Sheldon, 2009; Lores-Sanz, 2009), focusing on the roles or functions of the pronouns in the construction of author identity in different disciplines or cultures/languages, for example, first person pronouns used in the research articles (RAs) or RA abstracts between English and several European languages (French, Norwegian, German, etc.) in the fields of economics, linguistics and medicine (cf, the KIAP project, [www.uib.no/kiap](http://www.uib.no/kiap); Flottum, 2009; Dahl, 2009); in English, German, French, Russian and Bulgarian RAs in linguistics (Vassileva, 1998, 2000); and in English and Spanish RAs or RA abstracts of various fields (Martinez, 2005; Mur Duenas, 2007;

Sheldon, 2009; Lores-Sanz, 2009). These studies have demonstrated “the use of *I* as critical to meaning and credibility, helping to establish the commitment of writers to their words and setting up a relationship with their readers” (Hyland, 2002b, p. 1093). However, there has been almost no such research into author identity in CAs.

Studies on the genre of CAs have so far concentrated on establishing the macro textual structure of this genre in different disciplines (cf. Halleck and Connor, 2006). For example, Halleck and Connor (2006), in their study on rhetorical moves in TESOL conference proposals, reviewed six studies on CAs in the fields of rhetoric and linguistics, all devoted to the textual pattern and rhetorical moves. One most recent CA study (Cutting, 2012) examined vague language in the abstracts for two linguistics conferences in Britain to discover if the language chosen reflected the level of completeness of the abstract. Yet, it does not specifically analyze the use of first person pronouns. Therefore, it is our contention that there is still a need to extend present comparative studies on author identity to other genres and to those between English and non-European languages like Chinese so as to enhance people’s understanding of both NNEs and NES writers’ construction of authorial identity.

The purpose of this paper is to examine author identity as it is expressed through (a) explicit self-reference (Kuo, 1999; Tang and John, 1999; Hyland, 2002a), i.e., first person pronouns (*I/we*); and (b) implicit self-reference (Flottum, 2009), i.e., deictic noun phrases (*this paper/research* and *the writer/researcher*) (Bondi, 2009) used in English and Chinese CAs submitted to two international linguistics conferences, and then to further explore reasons behind the similarities and differences. To achieve the goals, it intends to answer the following two questions:

- 1) How is author identity expressed by academic writers from different socio-cultural backgrounds (China and English-speaking countries) in terms of explicit and implicit author self-reference?
- 2) What are the reasons behind their respective features or writing practices?

## **2. Author identity in academic written discourse**

To date, author identity has been extensively studied by many researchers or scholars, mainly concerned with types of author identity manifested by first person pronouns and their rhetorical

functions (Ivanic, 1998; Tang and John, 1999; Kuo, 1999; Hyland, 2002a, b; Mur Duenas, 2007; Sheldon, 2009; Flottum, 2009; Dahl, 2009). Ivanic (1998) identified three different types of author identity in writing, i.e., the autobiographical self, the discursive self and the self as author. Tang and John (1999) later expanded the typology to five authorial roles: representative, guide, architect, recounter, opinion-holder and originator. Other studies, based on the rhetorical functions in the use of first person pronouns, have established some more categories. For example, Kuo (1999) identified six types of author roles in his study of personal pronouns in RAs, which are: proposing a theory or approach, stating a goal or purpose, showing results or findings, showing commitment or contribution to research, comparing approaches or viewpoints and expressing a wish or expectation. Focusing on the clear discourse functions accompanying the first person pronouns, Hyland (2002b) in a comparative study on first person pronouns used in project reports (PR) by final year Hong Kong undergraduates and in RAs from different fields identified five types of authorial roles: stating a goal/purpose, explaining a procedure, stating results/claim, expressing self-benefits, elaborating an argument.

More recently, in-depth studies on authorial roles played by a specific first person pronoun in single language or cross-linguistic studies have been conducted. Mur Duenas (2007) in a comparative study on the rhetorical functions of the exclusive first person plural subject pronoun “we” in English Business Management research articles by American and Spanish scholars added three more functions to Hyland’s classification, which are: stating a hypothesis, an expectation or a wish; assessing the limitations of their research; assessing the strength of their research. From a more pragmatic-rhetorical perspective, Flottum (2009) in his study of the self- and other-dimensions of academic voices in English RAs of economics, linguistics and medicine established four author roles: writer, researcher, arguer and evaluator. Dahl (2009), based on Flottum’s (2009) study, further investigated author identity in 80 English and Norwegian RA abstracts of economics and linguistics abstracts, focusing on three author roles: researcher, writer and arguer, and found uses of researcher as the dominant authorial role in economics but arguer in linguistics. Finally, from the postmodern view of author identity, Sheldon (2009) explored first person pronouns in the Spanish and English RAs of linguistics and language teaching, incorporating into the analysis the “reflexive role” of first person pronouns, which is perceived to be the most powerful because it is concerned with the writer’s actual experiences in the research process. A typology of six authorial roles was created on the basis of

Tang and John's (1999): conveyor of general knowledge, guide or navigator, conductor of research, evaluator of previous claims, originator of claims, and the reflexive role. They are then examined further in a continuum of authorial power, from the least powerful role, conveyor, to the most powerful, the reflexive role.

The above review shows that despite more refined and complete categorization of authorial roles in the studies of author identity, the analysis of implicit author self-reference is still lacking, especially the comparative one between English and Chinese. Also, the academic genre analyzed is still limited to RAs or RA abstracts. Thus, the present study attempts to fill the gap in the field.

### **3. Method**

#### **3.1 Data collection**

Altogether 60 English CAs were selected from the Conference Program (in the PDF format) of the 11<sup>th</sup> International Cognitive Linguistic Conference (ICLC), held at Xi'an International Studies University from 11 to 17 July, 2011. A total of 368 abstracts were accepted by the reviewing committee for the conference, but these were filtered for the abstracts written by English-L1 authors. Such screening was to ensure that the data can represent as much as possible the authenticity of English CAs. 60 Chinese CAs were also collected from the PDF Conference Program of the 14<sup>th</sup> International Conference on Contemporary Linguistics in China (ICCLC), held at the same university from 11 to 13 May, 2012. Compared with the ICLC2011, the ICCLC2012 is much smaller in scale and more domestic in nature, with almost all the CAs written in Chinese. There were 164 abstracts accepted for the conference. Likewise, abstracts written in English or by non-native-Chinese speakers from universities outside China were excluded.

While examining the CAs, we noticed some striking differences between the two sets of CAs. One of these is the length. The English CAs appeared more or less the same in length, about 500 words, while the Chinese CAs varied greatly in length, from 200 to 800 words. The specific word limit requirements in the submission guidelines posted on the two conference websites are 500 and 300 words, respectively. Also, unlike Sheldon's analysis (2009), the present study included only single-authored abstracts, though there are both single and co- or

multi-authored CAs in our data. It is assumed that such restriction may lead to more interesting results, especially in the present cross-linguistic study. Finally, CAs that met the above requirements were randomly selected to form the two small corpora used in the study, the English corpus (ICLC2011) containing 24,385 words and the Chinese (ICCLC2012) 44, 286 words (Chinese characters).

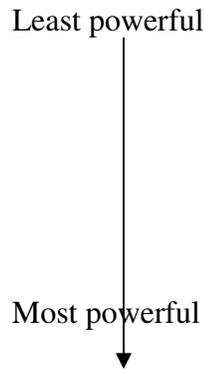
### 3.2 Data Analysis

We employed Sheldon's (2009) framework of analysis, but modified it by adding the implicit authorial role (cf. Bondi, 2009; Flottum, 2009) to the typology, indicating the least authorial power, as illustrated in Fig. 1 below. Sheldon's model was selected because unlike previous studies, it also reveals clearly the strong or weak authorial power accompanying each role. This allows a much fuller view of author identity in academic texts, given the cross-cultural nature of this study.

For the explicit authorial roles, we focused on the first person subject pronouns in both languages, including singular forms *I/我* (*wo*) and plural forms *we/我们* (*women*), which can be inclusive or exclusive, because a subject pronoun conveys "a stronger authorial voice" (Mur Duenas, 2007, p. 150). The identification of the authorial roles depends on types of verb processes as described in transitivity of functional grammar (Halliday, 1994) together with the co-text where the pronoun occurs. The combination of the two renders a more precise identification of different authorial roles. For example, the conductor role, manifested by verbs like *work, interview, collect, select*, etc. indicating material processes, often occurs in the context describing the research process.

The same type of analysis could be applied to the deictic noun phrases representing implicit authorial roles. However, for this study, we are more interested in the general characteristics of implicit roles rather than the specific types. Besides, they are not the commonly used or typical means of constructing authorial roles in English (Flottum, 2009), though we believe that the identification of these roles is essential to the interpretation of author identity as a whole. The implicit linguistic devices analyzed in our study include *this research/study/paper* and *the researcher/writer* in English and the Chinese counterparts 本研究/本文 and 研究者/笔者. Used as epistemic subjects, they play an important role in constructing the worlds and uncovering ideologies in academic texts (MacDonald, 1994).

1. Implicit role
2. Conveyer of general knowledge
3. Guide or navigator
4. Conductor of research
5. Evaluator of previous claims
6. Originator of claims
7. Reflexive role



(Adapted from Sheldon, 2009, p. 254)

Fig. 1: Classification of Author Identities

The actual analysis comprises both quantitative and qualitative analyses. First, an electronic word search was performed to examine and classify all the instances of both implicit and explicit author representation based on the criteria and categories mentioned above. Then, all the identified items were counted for the frequency and distribution of author roles in the two corpora. Following this basic quantitative analysis was the qualitative analysis intended to give an interpretation of the differences and similarities found in author representation.

In the following analysis, the first-person pronouns and deictic noun phrases appear in italics, with each Chinese example accompanied by a literal English translation (in brackets) for the sake of direct comparison between the two languages. The page number in the parenthesis at the end of each excerpt indicates the page of the conference program where the extract was taken.

### 3.2.1 Implicit authorial roles

This type of roles is often realized by placing deictic noun phrases (the paper/research/author) in the subject position followed by the verb processes, like material (*study, collect*), mental processes of perception (*observe, note*), etc. (Halliday, 1994). Used as agents of the investigation or discourse participants, the phrases actually refer to the author, allowing him/her to justify the research and meet expectations of the discourse community (Sheldon, 2009). However, by hiding behind the research or text, the author represents the least powerful role. The examples below illustrate such use.

Ch. *本研究*将从历时的角度探讨这一问题，集中如下三个方面：(p. 69)

[*This study*, from the diachronic perspective, will explore the issue, focusing on the following three aspects:]  
Eng. *This paper* will examine some well-known and lesser-known examples of natural grammatical patterns. (p. 157)

### 3.2.2 Explicit authorial roles

#### *Conveyor of general knowledge*

This role mainly concerns providing general information or conveying a common understanding to readers. Serving to demonstrate accepted knowledge, it also shows much weaker authorial power (Sheldon, 2009).

- Ch. 在话语交流中有一种我们非常熟悉的现象，就是一些话语常常传递一些额外的信息。(p.56)  
[In discourse communication, there exists a phenomenon that *we* are all very familiar with, that is, extra information often conveyed by some utterances.]  
Eng. *We* first invented language, and then language changed us. (p. 49)

#### *Guide or navigator*

The main function of this role is to guide readers through the facets of text by providing overt signals of textual information or structure (Sheldon, 2009). It is often realized through verbs showing mental processes of perception, e.g., *observe, see and look*, etc. (Halliday, 1994). The examples below show that the CA writers in both languages are conscious of giving readers a clear guidance of the aspects of the text.

- Ch. 根据我们搜集到语料来看，“就是”既有连词也有关联副词词性。(p.39)  
[We can see from the data collected that “jiushi” can be used as both a conjunction and a conjunctive adverb.]  
Eng. In this second part, *I* will look at the use of these verbal structures in severely deaf children. (p. 44).

#### *Conductor of research*

This mainly serves to describe research procedures or methodology used, including data collection, instruments, the framework of analysis, etc. The role is mostly manifested by verbs of material processes (Halliday, 1994): *collect, interview, analyze*, etc., often used in the past tense.

- Ch. 我们首先根据海内外已有的研究和相关量表编制筛选初表。(p. 5)  
[First, *we* designed a preliminary selection table based on the previous studies and relevant parameters in China and overseas.]

Eng. *I will use bilingual art magazines, in particular, sections on written reports and reviews of exhibitions and installation arts.* (p. 21)

*Evaluator of previous claims*

The evaluator role, showing agreement, disagreement or interest in a position, issue or topic, is associated with explicit cognitive verbs of the mental process (Halliday, 1994), such as *think, agree, believe, assume, etc.*

Ch. *我们认为可能不然。我们基本赞同这一分析方法。* (p. 58)

[However, *we don't think so. We basically agree with this analytical method.*]

Eng. *I would like to emphasize that there is much need for an analytical framework of applied cognitive typology.* (p. 8)

*Originator of claims*

By claiming authority and showing originality of the ideas, authors announce their presence in the distinctive contribution and commitment to a position, which explicitly projects a much powerful role, the second most powerful in Sheldon's (2009). The examples below illustrate how writers in both languages use the pronoun to act as the originators or arguers of their claims.

Ch. *我们提出内容名词小句与关系名词的论元实现相一致。* (p. 58)

[*We argue that the content noun clause is the same as the argument of the relative pronouns.*]

Eng. *In this paper, I will argue that there is one important argument for a supplementary blending analysis: ....* (p. 25)

*Reflexive role*

The reflexive "I" was adopted in Sheldon's (2009) analysis to show how writers position their research by drawing attention to their experiences or involvement in the research process, usually reflected in the narrative accounts. This role "allows authors to create a powerful textual self" (Starfield and Ravelli, 2006, qtd. in Sheldon, 2009, p. 256). It is used with verbs such as *feel* (mental processes), *say* (verbal processes) and *be* (relational processes) (Sheldon, 2009).

Ch. *而在教学实践中，我们感到主观性和客观性任务，小组合作式和个人式任务需要相互搭配。* (p. 73)

[In actual teaching, *we felt that subjective or objective tasks and group cooperation or individual work must complement one another.*]

In this example, the writer explored the task-based learning, and here she is telling the readers what she realized while carrying out the study in her teaching.

## 4. Results and discussion

### 4.1 Results

The computer word search produced a total number of author roles in each set of data, as presented in Table 1. Given different lengths of the two corpora, the normalization of the identified items per 1000 is needed to ensure accurate comparison (Biber, Conrad, & Reppen, 1998).

Table 1: Frequency and Distribution of Author Roles in the Two Sub-corpora

Author Roles	English (24,385)		Chinese (44, 286)	
	Sub-total words	per 1000	Sub-total	per 1000 words
<b>Implicit roles</b>	58	2.38	160	3.62
<b>Explicit roles</b>	96	3.93	75	1.69
<b>Total</b>	154	6.31	235	5.31

The normalized frequency of the total use of implicit and explicit forms of author identity shows more instances of author roles in the English CAs (6.31) than in the Chinese (5.31), with much more explicit authorial roles in the former (3.93 to 1.69) but more implicit ones (3.62 to 2.38) in the latter.

To find out specific realizations of implicit author roles, we further analyzed the two corpora in terms of the three types of deictic expressions: *this paper/article*, *this study/research*, and *the researcher/writer*. Table 2 below shows the raw counts of the implicit author roles.

Table 2: Distribution of Implicit Author Roles in the English and Chinese CAs

Implicit Author Roles	English CAs (58 instances)		Chinese CAs (160 instances)	
	No.	%	No.	%
This paper/article <i>Benwen/wenzhang</i>	30	52%	139	87%
This study/research <i>gaiyanjiu/diaocha</i>	28	48%	13	0.8%
The writer/researcher <i>bizhe/zuozhe</i>	--		8	0.5%
<b>Total</b>	58	100	160	100

The table shows clearly the more dominant uses of “this paper/article” in Chinese (87%) than in English (52%) but much fewer uses of “the writer/researcher” (*bizhe/yanjiuzhe*) in

Chinese (0.5%) and even the absence in English. In contrast, the use of “this study/research” is much higher in English (48%) than in Chinese (0.8).

Then, the distribution of explicit authorial roles realized by the first person subject pronouns in the data is summarized in Table 3. Altogether there are 96 occurrences of the pronouns in English and 75 in Chinese. The most striking difference lies in the form of the first person pronouns used. Whereas most of the English CAs (74%) use the singular form, almost all the Chinese single-authored CAs (99%) employ the plural form, an interesting result worth more discussion.

Table 3: Distribution of Explicit Author Roles in the English and Chinese CAs

Explicit	English			Chinese	
	we %	I %	Total %	我们 % we (women)	我 % I (wo)
Conveyor	3 2%		3 3%	7 9%	
Guide/navigator	3 12%	14 20%	17 18%	9 12%	
Conductor	5 20%	17 24%	22 23%	17 23%	1 1%
Evaluator	11 44%	19 27%	30 31%	21 28%	
Originator	3 12%	21 30%	24 25%	14 19%	
Reflexive		--		6 8%	
Total	25 26%	71 74%	96 100	74 99%	75 100

## 4.2 Discussion

From the findings in Table 1, we can see that both explicit and implicit author roles are adopted in the two sets of CAs, but the Chinese prefer the impersonal or implicit means to a greater extent while the English tend to display more explicit author presence. Atkinson (1999) described such difference as “object-centered” rhetoric in Chinese writing and “author-centered” rhetoric in English writing (qtd. in Wang, 2009, p. 178). Also, some scholars (Hyland, 2002b; McCool, 2009) accounted for this phenomenon in terms of collectivism and individualism in the two cultures. That is, explicit author representation in the form of first person pronouns reflects a kind of stance valued in an individualist culture, but such strong writer identity may be in conflict with the beliefs and values in a collectivistic culture (Hyland, 2002b). In cultures with strong individual identities and personal opinions, writers tend to use more direct means like the personal pronoun “I” more frequently, “giving language a unique power” (McCool, 2009, p.32). In contrast, in a collective culture that values humility and modesty, writers prefer to hide behind the text, expressing their opinion, position and attitude in a more implied or indirect manner so as to avoid conflict and to moderate “potential problems between people” (McCool, 2009, p. 53).

However, given the relatively larger amount of occurrences of implicit author roles in Chinese, we think that, if first person pronouns are regarded as “a powerful way of projecting a strong author identity” (Hyland, 2002a, p. 354) in English, then the use of the discourse object or the text itself to represent the author can be endowed with a strong rhetorical role in other cultures, like Chinese, too.

#### 4.2.1 The implicit author representation

Table 2 reflects how implicit authorial roles are represented in English and Chinese. We can see that, though both Chinese and English CA writers adopt the implicit or impersonal means of author presence, the former are overwhelmingly more implicit than the latter, as shown in the type and the number of the deictic noun phrases used. Specifically, to appear less intrusive, Chinese CAs mainly use *this paper/article* whereas there are much more uses of *this study/research* in English. Despite different epistemic subjects (MacDonald, 1994) used, this indicates a somewhat formulaic nature of the references to the paper or to its typical procedure or study in academic writing (Bondi, 2009), especially when the noun clusters are used with verbs like *examine, investigate, analyze, develop, focus, study*, etc., as illustrated in the examples below:

Ch. 本文考察了汉语中动构式的几个结构。(p. 35)

[*This paper* examined some typical verb constructions in Chinese]

Eng. *This study* will explore lexical networks through word association tests in Chinese L1 and L2. (p. 98)

Such uses reflect the typical feature of scientific language discussed in previous studies (Dahl, 2009). We assume that both Chinese and English CA writers are inclined to stating their research in more impersonal terms, hiding their research or acting role to a greater extent (Mur Duenas, 2007).

However, careful examination of the context reveals great variations in the roles these formulaic phrases play in the two sets of corpora. That is, in English their use is much restricted, mainly for the roles of guide/navigator and conductor, which “commit the writer to little and carry only a very weak identity” (Hyland, 2002a, p. 354) whereas in Chinese they tend to represent a much wider range of roles. Even more interesting are the uses for key argumentative functions in Chinese, such as the roles of originator and evaluator, usually realized by first

person pronouns in English to emphasize the writer's contribution, as can be seen from the following expressions:

- Ch. 本文认为 [*This paper* thinks/argues ....]  
本文基本同意 [*This paper* basically agrees ....]  
本文提出 [*This paper* proposes that ....]  
本文指出 [*This paper* points out ...]  
作者论证 [*The author* demonstrates ...]  
笔者认为 [*The writer* thinks ...]  
笔者分析了 [*The writer* analyzed ...]
- Eng. In this paper, *I* argue ...  
In this paper, *I* propose/suggest ....  
In this paper, *I* will demonstrate/show ....  
In this paper, *I* hypothesize ....

We can see that English CA writers are clearly taking a stand as arguer or evaluator. In the field of linguistics, it is necessary to create research findings through argumentation in the text, which requires clear signaling of author position (Dahl, 2009). In this sense, English CA writers are typical representatives of such a pattern of argumentation. The Chinese CA writers, on the other hand, tend to present their voice through text or impersonally, instead of presenting and justifying claims through direct reference to themselves. To some extent, this does not mean there is little argumentation. It just means the authors are more cautious as regards personal involvement in this form of direct commitment.

Such writing practices show the influence of the underlying socio-cultural contexts in China (Wang, 2009; Taylor and Chen, 1991). The clear distinction between personal writing and public writing in Chinese history may prevent writers from expressing or projecting their own voices, which reflects a broader need to maintain social harmony and connectedness (Wang, 2009; McCool, 2009). Thus, the use of implicit self-reference in Chinese can avoid more intrusive and even interpersonally perilous author roles manifested by a personal subject (Hyland, 2004).

#### **4.2.2 Explicit author identity**

##### **Use of first-person pronouns: *I* and *We***

The results of manifestation of explicit authorial roles through first person are summarized in Table 3. On the whole, 99% of the Chinese CA writers are visible as authors through the use of

*we* whereas the English are predominantly represented through *I* (74%). The striking difference could be explained in terms of different conventional and traditional views on author self representation in the two cultures (Atkinson, 2004). Author identity in English academic writing means the construction of individualism ideology and knowledge claim, leading to clear author presence but much weaker group solidarity (Hyland, 2002b, p. 1110). On the contrary, author presence in Chinese public writing is usually reduced to a minimum in order to achieve expected group solidarity and social harmony (Wang, 2008). Moreover, Chinese culture seems to prefer positive politeness strategies, highlighting in-group and involvement relations, which may avoid the use of self-reference emphasizing strong authorial power whereas the English-speaking cultures seem to generally prefer negative politeness strategies, which could prompt the frequent use of first person singular pronouns (McCool, 2009; Hyland, 2002b). Accordingly, authorial power in the two sets of CAs is presented from two different perspectives: collective or communal in Chinese and individual in English.

Finally, the choice between the singular and plural forms may also be related to different language systems and writing conventions (Mur Duenas, 2007). That is, the frequent use of “I” in the English CAs, as in RAs and abstracts, can be traced to the trend of development in academic discourse in the past few decades, when ‘I’ has been used more widely instead of royal *we*’s in academic writing of several fields (Hyland, 2001). In contrast, in Chinese writing, preference to the first person singular is considered informal and subjective (Chang & Swales, 1999). In this sense, the Chinese CA writers tend to follow more formal, traditional writing.

### **Representation of explicit author roles**

Below we will take a closer look at the explicit author roles used, from the most dominant to the least frequent.

#### *Evaluator*

Both English and Chinese CA writers are predominantly evaluators, 31% and 28%, respectively. The high frequency shows that CA writers, like those of RAs and RA abstracts, are more inclined to asserting their views (Sheldon, 2009). Especially, in English CAs the occurrence of the plural form “we” used for this role is much higher (44%) than for other roles, which is corresponding to Tang and John’s (1999) finding that evaluation in English usually occurs in the

first person plural form. This can occur when it comes to the “high-risk function” of the role (Hyland, 2002b, p. 1103), where the writer is certain of his/her assertions, but prefers to select rhetorical strategies like “we” for projecting authority and engaging with readers. Such use may indicate “how writers can simultaneously reduce their personal intrusion and yet emphasize the importance that should be given to their unique procedural choices or view” (Hyland, 2001, p. 217).

This is especially the case for linguistics in the soft disciplines, where clearly recognized interpretations are hard to obtain, leading to “more explicit authorial involvement” (Hyland, 2002b, p. 1098). CAs are actually very rhetorical, though they are sometimes considered to be merely a neutral descriptive “summary” of the longer paper (Kaplan et al., 1994).

Finally, closely related to the manifestation of this role are evaluative resources used, showing the key features of these texts (Stotesbury, 2003), for writers have to clearly demonstrate that they have something valuable to say to gain the interest of the reader. Thus, when making evaluations, both groups choose to use hedges such as *could*/可能(*keneng*) , *basically*/基本(*jiben*) , *will*/将(*jiang*), etc. to moderate the responsibility of the writer and anticipate possible objections (Hyland, 2004). By mitigating the strength of their claims, they may easily gain support from the colleagues.

#### *Originator*

The second most dominant authorial role in English is originator (25%), which is the third in Chinese (19%). That is, more Chinese CA writers assume the conductor role (24%) because it conveys “a low degree of personal exposure” (Hyland, 2002b, p. 1101). The result shows that English CA writers are more likely to present themselves as originators than the Chinese. By assuming a unique role in the construction of a convincing interpretation, English CA writers seek to establish “their personal authority based on confidence and command of their arguments” (Hyland, 2002b, p. 1104). On one hand, this can be attributed to the ideology in English academic writing, such as stance-taking, positioning of oneself, writer responsibility and ownership of one’s ideas and text, as discussed by Hyland (2002b). On the other, it reflects features of the specific discourse community. Western scholars in general are persuasive and self-promotional, as Yakhontova (2002) states, they “experience ever-increasing demands in promoting their research during the process of struggling for publishing opportunities, academic positions, or additional findings” (p. 229). Pressures like this are reflected in strong claims for

originality, which better suit the readers' expectations and offer an easy access to their main points. For example:

Eng. In this paper, *I* will argue that such intriguing and so far the neglected present tense occurrences are compatible with Langacker's present tense analysis. (p. 30)

However, the Chinese writers from a culture valuing the concept of "face" tend to avoid it in order to minimize the threat to their own face (McCool, 2009), because making strong commitments or taking the responsibility for the truth of the claims made is "the most self-assertive, and consequently potentially the most face-threatening" (Hyland, 2002b, p. 1103). Thus, in writing they choose to hide or blur authorial presence through more impersonal devices like "this paper" or the plural form "we" to downplay their unique personal perspective in interpretation, protecting themselves from their claims.

#### *Conductor*

English and Chinese CAs have nearly the same occurrences of this role, 23% and 24% respectively, which suggests that CA writers in the two languages are familiar with "disciplinary practices," and try to enhance their authority "by validating their framework" (Sheldon, 2009, p. 258). Besides, the type of academic conventions followed by the discourse community in China may contribute to the result. In the Chinese educational system the concept of teaching academic writing or teaching discipline specific writing is not widely known (Hinds, 1990), so the lack of academic writing conventions in Chinese may prompt the Chinese academic writers to follow those in English. Especially in linguistics, most teachers and researchers have received a university education, from which they acquired English academic language norms (cf. Mauranen, 2009). This seems to be an interesting case of transfer from L2 to L1, an area that deserves more investigation.

#### *Guide or Navigator*

In both CAs, this role ranks only the fourth, 18% in English and 12% in Chinese, though more frequent than the conveyor and reflexive roles. Its uses are closely linked to the feature of the CA genre, that is, incompleteness. At the point of submission, the research in most of the CAs might not be completed, as observed by Cutting (2012). We speculate that this could limit the contents of research or textual aspects provided in our CAs, thus leading to its relatively fewer

occurrences. Meanwhile, the result may also indicate that CA writers of both languages are aware of their relationship with readers and tend to signpost readers through the text. Previous research has shown that Chinese writing pays less attention to the structuring or signaling of information (Hinds, 1990; Hinkel, 1999), but this study shows that like English writers, they also make explicit the mapping of the text in academic writing, an indication of audience awareness. However, used largely for planning or organizing of the text, it is regarded as “a fairly low risk writer role” (Hyland, 2002b, p. 1100).

### *Conveyor*

Though not the most frequently used role in both CAs, its use is much higher in Chinese (9%) than in English (3%). This confirms the finding of previous studies that Chinese writers may often aim to inform readers of established opinions rather than join in a conversation or argument with writers and readers to negotiate opinions in some way (Wang, 2009). However, our study suggests that other factors may also contribute to its use. The use of “we” in CAs clearly treats readers as participants. Different from RAs and RA abstracts, CAs are meant to be presented at the conference to share with readers. So, this role allows writers to share their knowledge with readers and attract an audience to the paper presentation (Cutting, 2012). Sheldon (2009) also described its use as “a springboard” (p. 257) to direct readers to the following ideas or arguments. In this regard, use of the plural form “we” for this role shows a sense of cooperation between readers and the writer, without much stronger authorial power.

### *Reflexive Role*

Different from Sheldon’s (2009) finding in the study of English RAs, there is no occurrence of this role in English CAs. We assume that its use has just emerged in English academic texts like RAs (Sheldon, 2009), and thus has not spread to other academic genres (e.g., CAs). However, what is worth mentioning here is its occurrence in the Chinese CAs (8%), a quite surprising finding, given the most powerful authorial role it represents (Sheldon, 2009) and the general tendency of the Chinese CAs towards much weaker authorial power, as indicated earlier in this study. The result may stem from the lengthiness of the Chinese CAs. Following the strict word constraints, most of the English CAs do not have an extended narration or reflection of the

research process, which is the main function of this role (Sheldon, 2009). However, the Chinese CAs are much longer, thus allowing more space for the recount of the author's experience of acting either as a researcher or as a participant in the research process. So, its use in Chinese may not imply a much stronger or powerful authorial role, as discussed by Sheldon (2009).

## **5. Conclusion**

Major findings from the study show striking differences as well as some common features in English and Chinese CA writers' representation of authorial roles. They are summarized briefly as follows to answer our research questions: First, when it comes to author identity expressed in the two languages, English CA writers predominantly take on explicit authorial roles, showing much stronger authorial power while Chinese CA writers overwhelmingly appear in implicit authorial roles, reflecting much weaker authorial power. Then, for implicit authorial roles, writers of both groups use the typical deictic noun phrases to represent themselves, but the uses in Chinese are much higher than in English, with the striking difference in originator and evaluator roles between the two languages. And in terms of explicit roles, almost all Chinese CA writers use plural forms "we" to represent themselves while the English predominantly choose the singular form "I" for author presence, showing two different perspectives: collective and individual. Finally, regardless of the forms of first person pronouns used, both English and Chinese CA writers make explicit their presence first and foremost as evaluators, followed by conductors and guides/navigators. However, the former assume originator roles to a greater extent whereas the latter display much more conveyor roles, again indicating stronger and weaker authorial power, respectively.

To explain their respective features or different writing practices, we have to take into account different socio-cultural factors, discourse communities, writing conventions or traditions as well as the discipline, language and genre, as discussed in our study as well as in previous cross-cultural or cross-linguistic studies (Connor, 2004; Hyland, 2002a, b, 2004; Yakhontova, 2002; Mur Duenas, 2007; Sheldon, 2009; Lores-Sanz, 2009; Wang, 2009). All this provides further evidence for the influence of complex cultural factors on academic texts. Thus, we may argue along with other scholars (Hyland, 2002b; Mur Duenas, 2007; Sheldon, 2009; Wang, 2009) that it is the cultural differences that contribute to the striking differences in author representation manifested in English and Chinese CAs.

Finally, while making a worthwhile attempt in the contrastive study of CAs in the two languages, this study also points out directions to future research in this area. We propose that to better understand the differences of Chinese and English rhetorical strategies in academic writing, future studies should pay attention to “the complexity and dynamic nature of the genre” (Wang, 2009, p.185), and employ a more integrated approach, including the ethnographic studies for various contextual factors and discourse or genre analysis for typical textual features.

### **Acknowledgements**

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**The Use of Reporting Verbs in Mechanical Engineering Articles:  
A Cross-generic Study**

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**Abstract**

This study presents an analysis of the use of reporting verbs (RVs) across the three related part-genres in the opening phase of empirical research articles. This phase has two main patterns: (1) a traditional single Introduction section and (2) an Introduction and a following Literature Review section. Based on a collection of recent research articles selected from the top-ranking journals in mechanical engineering, the current study has found that there is much denser use of RVs in the Introduction in pattern 1 than in the other two part-genres in pattern 2. In terms of denotation, Research Acts RVs are the most frequently used category in all three part-genres, in terms of evaluation, Writer Non-factive and Author Neutral are the predominant RVs, in contrast to Writer Counter-factive and Author Critical RVs, which are hardly used. Significant proportional differences exist in the use of the other categories of RVs. The observed variations in the use of RVs across the three part-genres are mainly associated with their content elements, functional foci, disciplinary tradition and epistemological value. The findings enhance our understanding of language use in reporting literature in engineering discourse and have important pedagogical implications.

**Keywords:** reporting verbs; research articles; advanced EAP; research writing

## **1. Introduction**

### **1.1 Background**

The importance of citation in introductions to research articles (RAs) was highlighted over 30 years ago when Swales (1981) presented his groundbreaking work on the rhetorical structure and language use of this crucial section. Reporting verbs (RVs), among various citation elements, such as reporting adjuncts, reporting nouns and reporting clauses, are perhaps the most prominent reporting device and one of the clearest signals of attribution and the presence of evaluation (Hyland, 1999, 2002; Thomas & Hawes, 1994; Thompson, 1994; Thompson & Ye, 1991). As the focus of the present research, RVs are defined as verbs that are used to report (and evaluate) previous studies in any sentence that can be regarded as an actual citation (Lang, 2004).

In the ESP literature, RVs have been investigated from diverse perspectives: the use of tense (Lackstrom, Selinker, & Trimble, 1972, 1973; Malcolm, 1987; Oster, 1981; Salager-Meyer, 1992), the interaction between tense and voice (Hanania & Akhtar, 1985; Hawes & Thomas, 1997; Shaw, 1992), their roles in signaling evaluation (Hyland, 1999, 2000, 2002; Thompson, 1994; Thompson & Ye, 1991), the semantics of RVs and their discursal function (Thomas & Hawes, 1994), and variations in the use of RVs across disciplines (Hyland, 1999, 2000, 2002; Thompson, 2001) and across different groups of writers (Neff, et al., 2003). However, a close analysis of these studies reveals that the use of RVs has frequently been examined within the entire RA (e.g., Clugston, 2008; Hyland, 1999, 2002) and rarely in its part-genres. Indeed, in this regard, more than a decade ago, Hyland (1999) pointed to the need for more research into variations in the use of RVs in subgenres, such as introductions and literature reviews. In view of this, the present study makes an innovative attempt to examine and compare the use of RVs across the three related part-genres with partly similar content elements and communicative functions in the introductory phase of empirical RAs. The detailed accounts of the three part-genres (i.e., a single Introduction (I<sub>1</sub>) section before the Method section, and the Introduction (I<sub>2</sub>) and a following Literature Review (L) section) and the justifications for focusing on the use of RVs in them are provided in the following.

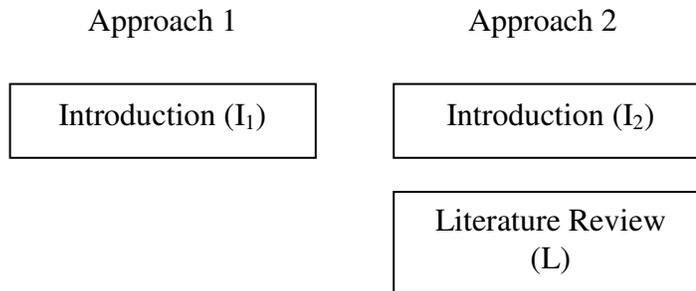
## 1.2 The introductory phase of empirical RAs

Traditionally, the independent Introduction (I) section of empirical RAs structured in the canonical Introduction-Method-Results-Discussion (IMRD) pattern has been a major location for introducing and reporting prior scholarship (Swales, 1981, 1990) and thus a context for the use of RVs (Hyland, 1990, 2002). Nevertheless, in the opening phase of RAs, authors increasingly use a separate L section (with varied section headings and content foci) between I and the Method section. This has been alluded to in a very limited number of previous studies (e.g., Belcher & Braine, 1995; Kwan, Chan & Lam, 2012; Swales, 2004; Yang & Allison, 2004) and further demonstrated in a recent large-scale macro-structural analysis of 780 RAs from 39 disciplines in the sciences, social sciences, engineering and humanities (Lin & Evans, 2012). This analysis revealed that the “standard” IMRD framework is actually not the most frequently-used structural pattern in empirical RAs. Instead, “Introduction-Literature Review-Method-Results and Discussion-Conclusion” (I-L-M-[RD]-C) is the most common one. This analysis also revealed four other commonly-used structural patterns (i.e., IM[RD]C, IMRDC, ILMRDC and ILMRD) and the IMRD pattern only ranks the fourth most frequently used one.

All the newly-identified patterns revealed in Lin and Evans (2012) indicate the importance of the RA sections not represented in the conventional IMRD framework, e.g., L and the Conclusion section. The L section, as one part-genre that has long been overlooked in the introductory phase, is used in just over half (51.7%) of all empirical RAs analyzed. Therefore, L is an important yet underinvestigated part-genre both in terms of its structure and language use. It should also be pointed out that, with regard to its content, this stand-alone section between I and the Method section is traditionally regarded as an elaborate integrated review of previous studies. However, sometimes it can also go beyond the scope of the conventional literature review section by providing background information on contextual, methodological or other issues to prepare the readers for the research to be presented (Lin & Evans, 2012). Therefore, the traditional term “Literature Review” is unable to fully capture and represent the propositional content of this section. Nevertheless, this term is still adopted in the present study as it remains the most familiar one to ESP practitioners. While acknowledging that “L” is not an entirely satisfactory term, the author found that in the data compiled for the current study, all the sections between I and the Method section are indeed traditional reviews of literature in view of their thematic content and information flows. Therefore, there seems to be a sound basis for the

analysis of the use of RVs in the two sections—I and L—for they both report and refer to the prior scholarship in my data, though to a different extent.

The above-mentioned analysis of empirical RA macro-structures (Lin & Evans, 2012) suggests that there are two main approaches to organizing the introductory phase before the Method section (see Fig. 1). In Approach 1, there is only a single Introduction ( $I_1$ ) section in the opening phase of the articles before the Method section. In Approach 2, the structural form of the introductory phase is “ $I_2+L$ ”, which suggests that there are two major sections before the Method: the L section and its preceding Introduction ( $I_2$ ) section with its distinct communicative purpose. It is noted that  $I_2$  may be somewhat different from the traditional stand-alone Introduction ( $I_1$ ) section (without an accompanying L section) in the IMRD model: in some cases,  $I_2$  is a brief, prologue-style introduction that simply identifies the research issue, the research aim and the outline of the RA, but makes no attempt to “create a research space” along Swalesian lines (Lin & Evans, 2012); in contrast, creating the research space is the major communicative purpose of the traditional Introduction section (Swales, 1981, 1990, 2004). In many cases,  $I_2$  might often lightly “refer to” the gaps in the previous literature in a general sense while leaving more relevant details to the subsequent L section that usually recreates the research space for the study (Lin & Evans, 2012). Nonetheless, almost no systematic detailed analysis has thus far been conducted of the similarities and differences in the two types of Introduction sections (viz.,  $I_1$  and  $I_2$ ) in terms of their language use and rhetorical structures. To what extent the two types of introductions may differ from each other linguistically and structurally because of the use of a subsequent L section is thus still unknown.



**Note:** I<sub>1</sub> refers to the single independent Introduction section before the Method of an empirical RA. I<sub>2</sub> denotes the Introduction section with a following Literature Review section while L represents the section(s) between the Introduction and the Method sections.

Fig. 1: Two main approaches to structuring the introductory phase

Since the Introduction section conventionally has an obligatory step “reviewing items of previous research” according to Swales’s (1990) classic “Create-a-Research-Space” (CaRS) model and the literature review elements often occur and recur throughout it (Samraj, 2002; Swales, 2004), the Introduction and Literature Review sections appear to have some similarities in terms of their microstructures and content elements. In view of this, I<sub>2</sub> and L, like the traditional Introduction section (I<sub>1</sub>), are also possible locations for reviewing and evaluating previous research and thus major contexts for using RVs. The variations in the use of RVs across them are consequently an intriguing yet unexplored research topic.

The present study aims to bridge the above-mentioned gaps by comparing the use of RVs in the three associated part-genres (namely I<sub>1</sub>, I<sub>2</sub> and L) of empirical RAs in the field of mechanical engineering in terms of their categories, frequencies, ranges and functions. Possible reasons for the similarities and differences revealed in terms of the use of RVs in the three genre parts are also for the first time provided as an important reference for future studies. Although this study only focuses on the field of mechanical engineering, the findings illuminate our understanding of disciplinary research writing and the role of RVs in the three part-genres.

### **1.3 Theoretical framework: categorization of RVs**

Referencing is widely acknowledged as a social-rhetorical activity driven by the ultimate purpose of claiming membership of the particular discourse community and gaining recognition from other members for the new claim or contribution the writer has made (Harwood, 2004;

Martinez, 2008). In view of this, the present study has conducted both semantic and functional analyses of RVs by adopting a slightly modified version of Hyland's (1999) classification framework of RVs.

Hyland's (1999) taxonomy of RVs was developed based on Thompson and Ye's (1991) and Thomas and Hawes's (1994) frameworks for categorizing RVs. Thompson and Ye (1991) offered the first systematic classification of RVs in terms of their denotation and evaluative potential after their close readings of around 100 introductions of RAs from a number of disciplines (e.g., applied linguistics, geology, public administration, veterinary science and engineering). They also proposed the useful distinction of the source of evaluation between the reported author and the reporting writer. This pair of concepts, "the reported author" and "the reporting writer", is employed in the present study. Regarding their denotation, RVs are classified into three groups according to the process involved: Research Acts verbs (which are primarily concerned with experimental actions or procedures, e.g., "observe", "discover", "notice", "show", "analyze", "calculate", "assay", "explore", "plot", and "recover"), Cognition Acts verbs (which represent mental activities of researchers, e.g., "believe", "conceptualize", "suspect", "assume", and "view") and Discourse Acts verbs (which are concerned with the verbal expression of research or cognitive activities, e.g., "ascribe", "discuss", "hypothesis", "report", and "state"). The three categories are similar to those of Thomas and Hawes (1994) (i.e., Experimental Activities RVs, Cognition Activities RVs and Discourse Activities RVs) and are also adopted in this study (see Fig. 2). However, RVs can not only refer to the different types of activities, but also the state (existence, development, etc.) of phenomena, theories or other issues in citations (e.g., "involve", "appear", "occur", and "remain"). This has not been pointed out by previous studies and the following sentence selected from one journal article Introduction section in the field of applied linguistics illustrates the use of this newly-identified category of RV:

(1) For instance, Dyson's (2009), Jansen's (2008), and Sakai's (2008) studies on PT all **involved** 45- to 60-min interviews with learners. (AL1)

Apparently, in this sentence, unlike Research Acts RVs, Cognition Acts RVs and Discourse Acts RVs which indicate how or in which manner the activities were undertaken, the RV "involve" functions to describe the kind of method the three previous studies shared. This

new denotative category is termed “Stative RVs” and is added to our analytical framework (see Fig. 2).

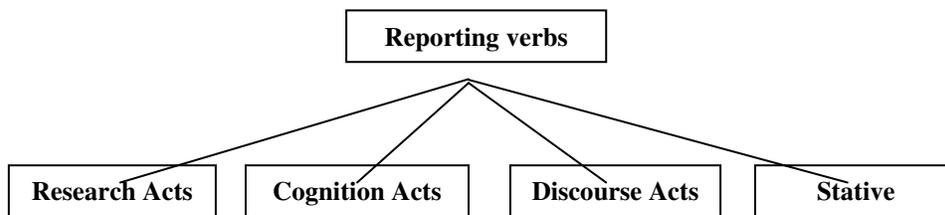


Fig. 2: Categorization of RVs in terms of denotation

As for the categories of evaluation, Thompson and Ye (1991: 372) provided a three-layer approach to show the important features of evaluation in RVs. The three approaches are termed Author’s stance, Writer’s stance and Writer’s interpretation. Regarding Author’s stance, there are three subcategories, namely, “Author Positive RVs”, “Author Negative RVs”, and “Author Neutral RVs”; from the perspective of Writer’s stance, RVs can be classified as “Writer Factive RVs”, “Writer Counter-factive RVs”, and “Writer Non-factive RVs”; under Writer’s interpretation, four main options are presented: “Author’s Discourse Interpretation RVs”, “Author’s Behavior Interpretation RVs”, “Status Interpretation RVs” and “Non-interpretation RVs”. Thompson and Ye’s scheme was critiqued by Hyland (2002) as there are altogether as many as ten subcategories with possible overlaps between them, constituting a rather complicated system that could not easily be applied to the real analysis of RVs. Thompson and Ye themselves also admitted the complexity of their classification, which may be difficult to apply. As aforementioned, some subcategories are somewhat overlapping. For example, “Non-interpretation RVs”, which indicate that the writer presents the reported information/opinion as objective, are fairly similar to “Writer Non-factive RVs”. This is also the case with “Status Interpretation RVs” and “Writer Factive/Counter-factive RVs”.

Thomas and Hawes’s (1994) scheme also has its limitations. As Hyland (2002) pointed out, it could neither reveal explicitly the evaluative potential of different RVs, nor consistently maintain the distinction between the reported author and the reporting writer in identifying the source of the evaluation. To overcome these limitations, Hyland (1999) classified RVs from both the writers’ and the authors’ perspectives in terms of their evaluative functions (see Fig. 3) by

drawing on the previous classification schemes (e.g., Thompson & Ye, 1991; Thomas & Hawes, 1994) as well as his own observation of the data. As Hyland explained:

The writer may present the reported information as true (*acknowledge, point out, establish*), as false (*fail, overlook, exaggerate, ignore*) or non-factively, giving no clear signal. This option allows the writer to ascribe a view to the source author, reporting him or her as positive (*advocate, argue, hold, see*), neutral (*address, cite, comment, look at*), tentative (*allude to, believe, hypothesize, suggest*) or critical (*attack, condemn, object, refuse*). (1999: 350)

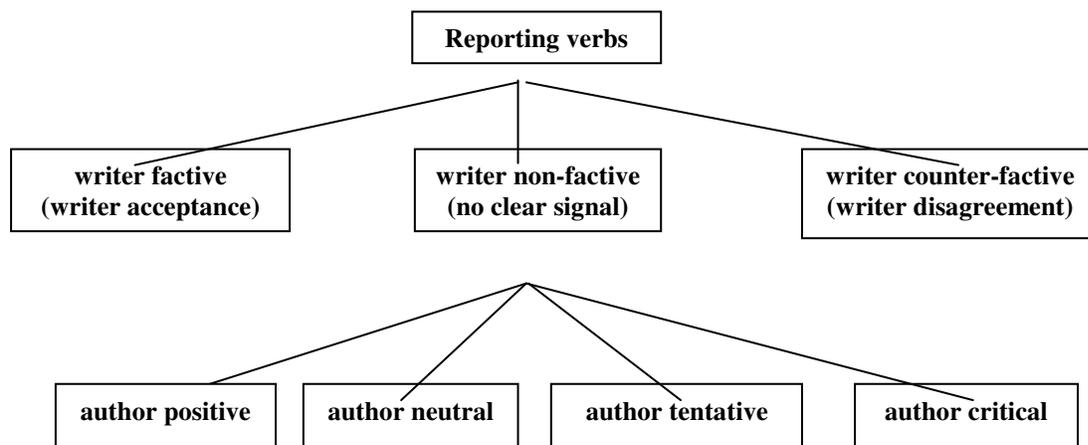


Fig. 3: Categorization of RVs in terms of evaluation

Given that Hyland’s classification framework of RVs appears to be more clear-cut, practical, and easier to apply, a slightly modified version of it will provide the basis for this study. In other words, Hyland’s taxonomy of RVs with a new category (“Stative RVs”) added in terms of their denotation is the analytical framework used in the present research (see both Fig. 2 and Fig. 3).

## 2. Research methods

### 2.1 The corpus

This study aims to examine and compare the use of RVs by mechanical engineering expert writers in the three associated part-genres in the opening phase of empirical RAs (i.e., I<sub>1</sub>, I<sub>2</sub> and L). For this purpose, the main approach adopted is textual analysis. Email inquiry and the face-

to-face interview were also employed in this study to elicit insiders' views on this topic, which help to illuminate findings from the textual analysis.

As the major focus of this study, the analysis of the distribution and the use of RVs across the three associated part-genres (viz.,  $I_1$ ,  $I_2$  and L) was based on a collection of 20 RAs (around 125,086 words) in mechanical engineering. The reason for focusing on the field of mechanical engineering is that there can be disciplinary variations in the use of RVs, even in the same part-genre, and mechanical engineering is one of the disciplines where experienced scholars often use an independent L section between the Introduction section and the Method section (Lin & Evans, 2012).

The RAs selected for this study are all the lead article of the first issue of 2007 published in 20 different high-impact, English-language journals (see Appendix). This sample of 20 RAs in mechanical engineering is a sub-corpus of the 5.6 million-word corpus of research articles (available online at <http://rcpce.engl.polyu.edu.hk/RACorpus/default.htm>) that consists of 780 RAs from 39 disciplines in the fields of engineering, sciences, social sciences and the humanities. All the source journals were selected on the basis of the recommendations of the disciplinary experts and the impact factors listed in the Journal Citation Report. In addition, special care was taken to select RAs written by different authors.

Among the 20 RAs, 13 of them were identified as of an empirical nature. Seven empirical RAs following the second approach to structuring the introductory phase have both the part-genres " $I_2$ " and "L" and the other six only have the independent  $I_1$  section before the Method. Accordingly, three corpora for the part-genres of empirical RAs— $I_1$ ,  $I_2$  and L—in mechanical engineering ( $MEI_1$ ,  $MEI_2$  and MEL) were compiled so that the examination and comparison of the use of RVs in terms of their denotation and evaluation across the three part-genres could be undertaken systematically.

## **2.2 Analysis of RVs**

After the compilation of the three part-genre corpora, the distribution and use of RVs in them were analyzed. The CLAWS part-of-speech tagger was firstly used to tag all texts in the three corpora and thus all lexical verbs with their concordance lines in the corpora were retrieved. Altogether 1076 lexical verbs were identified. The researcher then read carefully all identified lexical verbs and their concordance lines, and excluded those that are not RVs according to the

definition of RVs in this paper. Since the RV is not a discrete language element, its identification and the subsequent classification and analysis based on the above-mentioned analytical framework have to be undertaken in the discursive context where its reporting (and evaluative) function operates. Finally, 171 occurrences of RVs were identified in the three corpora. The frequencies, ranges, categories and functions of these RVs in the three part-genres were then analyzed and compared with reference to the concordance lines generated by WordSmith 5.0 (Scott, 2008).

It is worth noting that the analysis of a small proportion of RVs is far from straightforward (John, 2012). The few RVs that are difficult to analyze semantically and functionally have been noted by only a few scholars such as Hunston (1993), Thompson (2001), and Thompson and Tribble (2001). To overcome this problem, the researcher maximized all efforts to conduct a contextual analysis of RVs by referring to all possible linguistic clues and the discursive context where they are employed. For example, the RVs that are polysemic such as “observe” could possibly be grouped into different categories semantically and functionally in the light of the different cotext and context surrounding it. In all world-famous English language dictionaries (e.g., CCED and LDOCE), “observe” as a verb can mean either “make a remark on...” (Discourse Acts RVs) or “notice or perceive (something) and register it as being significant” (Research Acts RVs). The analysis of this RV thus entails studying the specific context where it is used. For example, in the following citation sentence selected from MEI<sub>2</sub>, “observe” is judged as a “Research Acts RV” as it denotes a special phenomenon a number of scholars have perceived in their studies:

(2) In particular, light-to-moderate wind combined with light-to-moderate rain has been **observed** to induce significant cable motion in cables of various cable-stayed bridges; this phenomenon is generally termed rain-wind induced vibration (Hikami 1986; Hikami and Shiraishi 1988; Matsumoto 1998; Main and Jones 1999).  
(MEI<sub>2</sub>5)

It is also observed from the data of the current study that there exists a small group of RVs that are often delexicalized in the discourse context such as “present”, “provide”, “offer”, “give” and “make”. The appropriate assignment of them into a particular category either in terms of their denotative meaning or evaluative functions requires the study of their cotexts, especially their noun collocates. The following extract taken from the data illustrates this:

(3) A detailed analysis of the horseshoe vortex characteristic **presented** by Muzzammil and Gangadharaiah (2003) was discussed by Unger und Hager (2005b). (MEI<sub>1</sub>2)

Clearly, we can find that the RV “present” in the above sentence is delexicalized and the noun phrase “a detailed analysis” paired up with it instead carries and delivers the essential part of the meaning. It is the denotative meaning conveyed by the noun phrase that justifies the classification of “present” as a Research Acts RV. However, the verb “present” in other lexical phrases such as “present a convincing argument” or “present a useful account” may need to be grouped into another type of RV (viz., Discourse Acts RVs) as it indicates the discursual activity the reported author has been engaged in. The analytical principles used here were also applied to the analysis of the other delexicalized RVs as abovementioned in the corpora.

It is worth noting that only very few RVs could not be neatly analyzed into a specific category either in terms of their denotation or evaluative stance in the present study. This certainly would not affect the general tendencies to be revealed in mechanical engineering expert writers' preferences in using different types of RVs in the three associated part-genres in the introductory phase of empirical RAs.

### **2.3 Face-to-face interviews and email inquiry**

To better understand the textual findings on the use of RVs in the three related part-genres, the researcher contacted three expert writers in the field of mechanical engineering for interviews and the other four for email inquiry. Two of them work in a major university in UK, three of them in Hong Kong and the other two in mainland China. All of them are non-native speakers. They all have a good publication record and have published at least three single authored or first-authored articles in top-ranking journals in this field in the past six years. Their views, experience, and perceptions about the use and choice of RVs in the three part-genres help to explain the findings from textual analysis in this study. They are also valuable for our more comprehensive understanding of the possible similarities and differences in mechanical engineering researchers' employment of different types of RVs across the three associated part-genres.

## **3. Findings and discussion**

This study investigates mechanical engineering writers’ use of RVs in the three partly similar RA part-genres, i.e., I<sub>1</sub>, I<sub>2</sub> and L. Findings related to the distribution of RVs and the writers’ preferences in using different categories of RVs in terms of denotation and evaluation across the three part-genres are respectively reported in the following two subsections.

### 3.1 Distribution of RVs in the three part-genres

For an overall understanding of the mechanical engineering writers’ use of RVs in the three associated part-genres, we should firstly examine their distribution in the three corpora (i.e., MEI<sub>1</sub>, MEI<sub>2</sub> and MEL) (see Table 1). As noted above, altogether 171 RV tokens and 70 RV types were identified. Just over half (56.1%) of the RVs (e.g., “apply”, “prove”, “derive” and “see”) in the corpora occurred only once, which was not surprising, as in Hyland’s (1999) study, nearly half of the RVs examined also appeared only once. This may be because, on the one hand, academics should pay close attention to lexical diversity in their research writing in order to make it rhetorically more engaging and convincing (Laufer & Nation, 1995; Wolfe-Quintero, Inagaki & Hae-Young, 1998); on the other hand, they have the essential need to choose different RVs with various evaluative functions to (explicitly or implicitly) indicate their stance towards the reported information or to attribute the evaluative stance to the reported author (Thompson & Ye, 1991; Thomas & Hawes, 1994; Hyland, 1999, 2000, 2002; Mansourizadeh & Ahmad, 2011). As a consequence, in this study, RVs that were used more than once are regarded as the “frequently-used” RVs (Table 1).

Table 1: Distribution of RVs in MEI<sub>1</sub>, MEI<sub>2</sub> and MEL corpora

Part-genres	Frequencies of RVs	Standardized frequencies of RVs (per 1000 words)	Frequently-used RVs (occurrences ≥ 2)
Introduction (I <sub>1</sub> )	118	17.4	<i>find, present, investigate, propose, measure, use, observe, report, carry out, explore, assume, study, analyze, adopt, conduct, detect, describe, demonstrate, develop, employ, extend, indicate, perform</i>
Introduction (I <sub>2</sub> )	19	7.0	<i>observe, propose, demonstrate, consider</i>
Literature Review (L)	34	7.2	<i>find, show, study, conduct, develop, introduce</i>

Table 1 shows that RVs are much more densely used in  $I_1$  than in the other two part-genres. After the frequencies of RVs in the three part-genres were standardized, it was found that the density of RVs in  $I_2$  and L is quite similar. The findings are surprising as it was intuitively assumed that L is usually much more elaborate than the other two part-genres, thus possibly offering writers more opportunities to use RVs to review and evaluate the prior scholarship in detail. As pointed out by Hart (1998), Ridley (2008), Feak and Swales (2009) and many other EAP professionals, L is commonly a substantial section with multiple communicative functions; for instance, L provides essential connections between the intended study and the existing body of literature, presents critical background details and rationales for the research to be conducted, and expounds theoretical, methodological and empirical underpinnings; L can also demonstrate the writers' full command of the current state of knowledge about the research topic and their in-depth understanding of research problems.

Nonetheless, L might not be an established part-genre like the traditional Introduction section (Jesson & Lacey, 2006; Lin & Evans, 2012), particularly in this field, a point generally endorsed by the mechanical engineering specialists I consulted (via email or in face-to-face interviews). Another insightful view they contributed is: perhaps due to the less discursive nature of the discipline (Hyland, 1999, 2000, 2002; Thompson, 2001; Thompson & Tribble, 2001) as well as the stringent length requirement of all submissions by the journals, mechanical engineering scholars generally attach more importance to the findings or conclusions from previous studies rather than the specific research details or the individual authors who undertook the studies. Therefore, expert writers in this field tend to make greater use of non-integral citations to indicate sources within the brackets and to establish links among them (Petric, 2007; Harwood, 2009; Mansourizadeh & Ahmad, 2011) rather than integral citations and their associated RVs. As such, the strategic use and skillful choices of RVs by seasoned engineering scholars is closely linked to the different roles played by varied citation forms<sup>1</sup> and the diverse rhetorical functions performed by citations (Petric, 2007; Harwood, 2009; Mansourizadeh & Ahmad, 2011; Petric & Harwood, 2013).

As for the differences in the amounts of RVs distributed in the two types of the Introduction section (viz.  $I_1$  and  $I_2$ ), they could largely be attributed to the distinct communicative purposes of the two genre parts: the traditional Introduction section without a

subsequent L is conventionally regarded as an important article section to “create a research space”, for which “reviewing items of previous research” is an obligatory step (Swales, 1990); in contrast, as pointed out by Lin and Evans (2012), I<sub>2</sub>, the Introduction section preceding the elaborate L, more frequently plays a role of introducing the general research area, setting the scene for the study and identifying the research issue. Consequently, the use of RVs (especially for reporting specific items of research) is understandably far more sparing in I<sub>2</sub> than in I<sub>1</sub>. As such, whether there is an L section could greatly change the communicative functional foci and the propositional content of the Introduction section.

With regard to the “frequently-used” RVs, Table 1 reveals that more Research Acts RVs are employed in I<sub>1</sub> and L than in I<sub>2</sub>, e.g., “find”, “conduct”, “develop”, “investigate”, “study”, “measure”, and “explore”. This cross-generic difference can also be accounted for by their distinct nature, communicative functions and content elements involved. As mentioned above, I<sub>2</sub> frequently functions as a brief orientation to (or sometimes appears as a fairly general prologue-style introduction of) the research while leaving most of the detailed background, findings of the individual studies and related information to its following L section (Lin & Evans, 2012). Different from this, a large proportion of the focused “gap-creating” L and I<sub>1</sub> sections usually need to devote considerable space to the detailed review of individual previous studies, where there are greater chances to use Research Acts RVs to report either their research procedures or findings. More details related to the different categories of RVs used in the three part-genres regarding to their denotative meaning and evaluative functions are provided in the next subsection.

### **3.2 Different types of RVs used in the three part-genres**

Table 2 and Table 3 respectively show the distribution of different types of RVs in MEI<sub>1</sub>, MEI<sub>2</sub> and MEL in terms of their denotation and evaluative potentials. A careful examination of Table 2 reveals a common tendency—Research Acts RVs uniformly being the most frequently used category in the three part-genres (despite the number of the “frequently-used” Research Acts RVs used in I<sub>2</sub> being the smallest as aforementioned), reflecting the epistemology and the particular nature of the engineering field. This is consistent with the findings of Hyland’s (1999) research into disciplinary variations in the use of RVs, i.e., the academic professionals in soft disciplines, such as marketing, sociology and philosophy (which are often more discursive),

tended to use more Discourse Acts RVs in contrast to the far more frequent employment of Research Acts RVs in most of the engineering and sciences fields. Similarly, other studies such as Thompson (2001) also maintained that a discipline grounding its research programme in experimental research in an empiricist paradigm will use Research Acts RVs predominantly, whereas a more discursive discipline dealing mainly with interpretations will use more Discourse Acts RVs.

Table 2 The use of different types of RVs in MEI<sub>1</sub>, MEI<sub>2</sub> and MEL in terms of their denotation (%)

<b>Corpora</b>	<b><i>Research Acts</i></b>	<b><i>Discourse Acts</i></b>	<b><i>Cognition Acts</i></b>	<b><i>Stative</i></b>
<b>MEI<sub>1</sub></b>	73.7	19.5	6.8	0.0
<b>MEI<sub>2</sub></b>	57.9	21.1	15.8	5.3
<b>MEL</b>	70.6	17.6	11.8	0.0

However, in addition to Research Acts verbs, mechanical engineering writers still used a considerable number of Discourse Acts verbs in all the three part-genres, while in I<sub>2</sub>, they employed a significantly higher percentage of Cognition Acts RVs. A careful reading of the concordance lines where these Cognition Acts RVs were employed reveals that the expert writers' preferences for them in I<sub>2</sub> corresponds to one major focus of this section on the general landscaping of the research area. The seasoned mechanical engineering writers often favor employing Cognition Acts RVs at the very beginning of I<sub>2</sub> to depict the research landscape by reporting either the established knowledge base in this area or the perceptions generally agreed by a considerable number of researchers. This also frequently paves the way for the statement of the significance of the research issue. For instance, "consider" and "see" in the following two sentences selected from MEI<sub>2</sub> are used to suggest the common views of the entire disciplinary discourse community or at least of a good number of these researchers (Thomas & Hawes, 1994), which is an important element in constituting the general landscape of the research area.

(4) It is commonly **considered** that vibration emits squeal [3]. (MEI<sub>2</sub>1)

The modal coupling generally involves an eigen value analysis of friction system motion. However, it is **seen** that such an eigen value analysis can not define clearly physical phenomena causing squeal [9–13]. (MEI<sub>2</sub>7)

In contrast, the relatively smaller number of Cognition Acts RVs used in I<sub>1</sub> and L mostly refer to the specific mental research actions of the individual researchers for their own studies, such as “predict”, “assume”, “estimate”, and “postulate”, being generally used in the middle of the sections. Therefore, they are quite different from those employed in I<sub>2</sub> both in terms of their roles and positions in the sections.

As for Stative RVs, a category that has largely been overlooked by previous researchers such as Thompson and Ye (1991), Thomas and Hawes (1994), Hyland (1999, 2002), Thompson (2001) and Lang (2004), there is only one occurrence in the corpora (“appear” (1)). Although this category is in a small minority in the present corpora, it would be interesting to reexamine it by using larger corpora from a wider range of the disciplines. Noticeably, the Stative RVs often indicate the writers’ non-factive stance and the authors’ neutral attitude towards the reported proposition.

In terms of the evaluative potential of RVs from the writer’s perspective, the predominant use of Writer Non-factive RVs is the most prominent feature in all three part-genres (see Table 3). In MEI<sub>1</sub>, as many as 97 (more than 80%) out of the 118 RVs were used to indicate no explicit evaluative attitudes of the writers. This is generally consistent with Hyland’s (1999, 2002) observation that research writers in all disciplines in his study preferred to attribute an attitude to the reported author rather than show their own stance directly.

Table 3: The use of different types of RVs in MEI<sub>1</sub>, MEI<sub>2</sub> and MEL in terms of their evaluative potential (%)

<b>Corpora</b>	<b><i>Writer Factive</i></b>	<b><i>Writer Non-factive</i></b>	<b><i>Writer Counter-factive</i></b>	<b><i>Author Positive</i></b>	<b><i>Author Neutral</i></b>	<b><i>Author Tentative</i></b>	<b><i>Author Critical</i></b>
<b>MEI<sub>1</sub></b>	17.8	82.2	0.0	27.0	64.4	8.6	0.0
<b>MEI<sub>2</sub></b>	31.6	68.4	0.0	38.8	45.4	15.8	0.0
<b>MEL</b>	32.4	64.7	2.9	32.4	58.8	8.8	0.0

Unlike some humanities disciplines, such as philosophy, where the inferences from scholars’ arguments are the focus of the research (Hyland, 1999), mechanical engineering lays emphasis on factual information or findings obtained from research activities, and thus Writers’

Counter-factive RVs are rarely found in the present corpora. There is indeed only one Counter-factive RV “neglect” used in L:

- (5) With small sag, the inclination, the static deflection due to gravity, and the flexural rigidity may be **neglected** in the previous research since they are second order effects.  
(MEL3)

Some expert writers’ rare use of Writers’ Counter-factive RVs indeed also conforms to their strong adherence to the politeness principle in academic writing and their unwillingness to threaten the face of the other researchers within the same disciplinary community. This view is generally agreed by all subject specialists I consulted and especially emphasized by the three interview participants in this study. Another interesting perception shared by them all is: researchers who are doing a pioneering study or exploring a new area without much existing literature in this field do not even have the need to create the space for their own research by using the Writers’ Counter-factive RVs to point out the limitations in the previous studies.

Table 3 also shows that around a third of RVs in MEI<sub>2</sub> and MEL and nearly 20% of RVs in MEI<sub>1</sub> suggest the reporting writers’ agreement with the reported content. By using the Writers’ Factive RVs, the writers show their appreciation and recognition of the contributions of the previous studies. This highlights the accumulative nature of knowledge construction and scientific inquiry in the engineering field (Hyland, 1999, 2000, 2002). Two example sentences are provided below:

- (6) For an attached discrete linear viscous damper, it has been **demonstrated** (Kovacs, 1982; Sulekh, 1990; Pacheco et al., 1993; Krenk, 2000) that an optimal damper size exists for a given cable configuration. (MEI<sub>2</sub> 4)

The manipulation of dried red-blood cells and various protozoa has been **demonstrated** in Kim, Pisano and Muller (1992). (MEI<sub>1</sub> 6)

The quintessential feature of engineering discourse and research writing—“impersonality”—is also reflected in the absence of Author Critical RVs and the dominant use of Author Neutral RVs in all the three corpora. However, there are still some noticeable proportional differences in mechanical engineering writers’ use of the three major types of RVs in the three part-genres from the authors’ perspective (viz., Author Positive RVs, Author Tentative RVs and Author Neutral RVs). For instance, it is interesting that the writers employ many more Author Tentative RVs (15.8%) and Author Positive RVs (38.8%) in the introductions

with a subsequent L section whereas Author Neutral RVs are more frequently used in both I<sub>1</sub> and L. This presumably demonstrates the fact that academics in the science and engineering fields more frequently report the findings and details of the individual previous studies (as one major content element of I<sub>1</sub> and L as aforementioned) objectively on account of the nature of the scientific inquiry. However, in generalizing findings or commenting on the general developmental tendencies in the area (as the perceived key content elements involved in I<sub>2</sub>), the writers either tend to show their recognition positively in order to establish the significance of the topic or display their caution. Therefore, they use proportionally more Author Tentative RVs and Author Positive RVs. In this sense, experienced writers' strategic deployment of some characteristic linguistic signals such as RVs examined here, as repeatedly stated, conforms to the core communicative purpose and propositional content of the particular part-genre (or genre) where they are used. Further research is suggested into the detailed moves and steps of the three part-genres to ascertain the specific interrelationship between their microstructures and communicative functional foci and this particular prominent language feature shared by them.

#### **4. Conclusion**

As a response to Hyland's (1999) call for more research into variations in the use of citation elements in subgenres, this article has presented a comparative analysis of the incidence, categories, ranges and functions of RVs across the three related part-genres in the opening phase of mechanical engineering empirical RAs. The three part-genres—I<sub>1</sub>, I<sub>2</sub> and L—share partly analogous content elements, i.e., reporting (and evaluating) previous literature, and thus are major locations in an article for using RVs.

Findings related to the generic variations in the use of RVs show that, generally speaking, there are more RVs used in I<sub>1</sub> than in L and I<sub>2</sub> in empirical mechanical engineering RAs. In terms of denotation, there is a general tendency that all the three part-genres employ a substantial number of Research Acts RVs due to the strong disciplinary tradition and the nature of the knowledge structure in this area (Clugston, 2008; Hyland, 1999; Thompson, 2001). Cognition Acts RVs, which “seem to correlate with reports of consensus views generally held by many in the scientific community” (Thomas & Hawes, 1994: 147) are favored by expert writers in I<sub>2</sub>. In terms of evaluation, the Writer Non-factive RVs, which do not show the writers' criticisms of the previous research, are employed far more frequently in all the three part-genres. This is partly

due to the politeness principle in academic discourse and partly due to the nature of their research and the epistemology of this engineering discipline. However, academics strongly favor Author Positive RVs and Author Tentative RVs (altogether 54.6%) in composing  $I_2$ , while they more obviously prefer using Author Neutral RVs in both  $I_1$  (64.4%) and L (58.8%). This tendency is presumably related to the different communicative functional foci and major content elements involved in them. Despite this difference, Author Neutral RVs is still the most frequently used category in all the three part-genres, whereas no Author Critical RVs were used, which may characterize the engineering discourse and particular disciplinary research writing.

The study indicates the existence of significant variations in the use of RVs in the three associated part-genres in the introductory phase of the empirical RAs, which evidently have strong links with, *inter alia*, their communicative purposes and distinct content foci. As for some aforementioned similarities in the writers' use of different types of RVs in the three genre parts (e.g., the prevalent use of Research Acts RVs, Writer Non-factive RVs and Author Neutral RVs), they principally reflect the epistemological value of the discipline (Hyland, 1999, 2000, 2002; Thompson, 2001; Thompson and Tribble, 2001) and the impersonal feature of the research genre writing (Hood, 2010).

The present study illuminates our understanding of language use in reporting literature in engineering academic discourse. This has useful implications for EAP teaching in that teachers can raise their student writers' awareness of these observed commonalities and differences in using different amounts and categories of RVs with their diverse evaluative functions in the three part-genres. Purposeful employment of language resources in referring to previous scholarship not only helps with the writers' (quasi-) obligatory task of making appropriate academic attribution and situating the research work in the larger domain of relevant inquiry, but is more associated with the effective realization of the communicative focus of the particular part-genre through indicating the writers' stance towards the reported proposition to various degrees of explicitness.

However, it should be noted that a considerable number of accounts of the above-mentioned similarities and differences in the use of RVs across the three genre parts are assumptions. Only a handful of disciplinary professionals have been invited to contribute their perceptions and more insiders' views should be elicited in future research to complement and verify the current findings. In addition, this study is limited in the generalizability of its findings

because of the modest size of the corpora analyzed. However, it is an important and innovative attempt to compare the featured language use across the three associated part-genres with some overlapping content elements and partly similar communicative purposes. Finally, more research should also be conducted into other aspects (e.g., the moves and steps) of the three associated part-genres to generate more innovative insights into and perhaps other useful accounts for the characteristic distinctions in the use of RVs in them.

#### Note

1. For more details on the classic pair of citation forms—integral and non-integral citations, see Swales (1990); for information on subtypes of the two citation forms, see Thompson (2001) and Thompson and Tribble (2001).

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## **Appendix A list of mechanical engineering journals for corpus compilation**

Progress in Energy and Combustion Science  
Aerosol Science and Technology  
International Journal of Plasticity  
Journal of Microelectromechanical Systems  
International Journal of Heat and Mass Transfer  
The International Journal of Heat and Fluid Flow  
Journal of Mechanical Design  
Journal of Engineering Materials and Technology  
International Journal of Impact Engineering  
International Journal of Machine Tools & Manufacture  
Mechanical Systems and Signal Processing  
Wear  
Tribology International  
Experiments in Fluids  
Drying Technology  
Probabilistic Engineering Mechanics  
Journal of Hydraulic Engineering  
International Journal of Thermal Sciences  
Transactions on Mechatronics  
Journal of Engineering Mechanics



## **English for (Very) Specific Business Purposes: A Pedagogical Framework**

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### **Biodata**

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### **Abstract**

Over the last decade there have been a number of studies into English for Specific Business Purposes (ESBP) drawing on genre based theories, on discourse analysis and on corpus linguistic approaches (Paltridge, 2009; Bhatia, 2009; Flowerdew & Wan, 2010). However, dealing with the practical questions of how, and in what circumstances, this research can be applied to workplace communications syllabus planning, implementation and evaluation remains unanswered due to a lack of research at the applied level of training and education . This has presented a problem for the English for Specific Business Purposes (ESBP) syllabus writer in making informed decisions about training design in the workplace sector. There are a plethora of ‘ESBP courses’ ranging, for example, from a 100-hour program for ‘English for Business’ developed for bank employees and aimed at reaching an internationally determined language proficiency benchmark level (e.g. Business English Certificate–Cambridge ESOL) to a highly tailored short support course ‘English for Collections agents at Bank A’, aimed at enhancing business quality performance in a specific call centre worksite. These courses are vastly different. The overarching label of ‘ESBP courses’ in the workplace context needs to be reframed in a way to ensure the different

categories of ESBP courses are first identified. Once this is achieved, systematic approaches to planning, implementation and evaluation can be recommended to ensure well-targeted offerings in the workplace.

This article will describe an ESBP syllabus planning framework which emerged from my doctoral studies entitled “Language Training Design and Evaluation Processes in Hong Kong Workplaces” (2002). This syllabus framework has been useful in determining what differentiates the many ESBP courses from each other and how to categorise them. I propose a typology, based on the empirical study of over a hundred ESPB courses in Hong Kong workplaces, that has a horizontal continuum from ‘generic ESBP’ to a ‘tailored and highly focused ESBP’ and a vertical continuum from ‘education’ (meaning long- term language proficiency development) to ‘training’ (meaning short-term language performance development). As the axes intersect, four distinct course types emerged. The ESBP course types from my study were then plotted onto the framework and the implications for course planning and evaluation, drawing on applied linguistic, educational and business management theories, were then suggested. This article will conclude with a discussion on further areas of research that are required to test the efficacy of this model.

## **1. The problem**

When a large Hong Kong utilities company requested an ‘English for Telephoning Skills Course’ for its telephonists, the human resource (HR) manager specified that she wanted something of a generic and ‘off the shelf’ nature as she did not want to spend time and money developing a bespoke programme. She reported quality assurance issues in politeness and efficiency on the phones. No needs analysis was carried out by the provider, and a well-known and commercially produced ‘English for Telephoning Skills’ coursebook, aimed at developing improved politeness when interacting with native speaker callers, was selected. The ‘English for Telephoning Skills Course’ was a failure and provided little impact for the company. During this course, it transpired that the Cantonese-speaking telephonists, whose English appeared to range from an intermediate to an advanced level, routinely had to answer their calls in English mostly to non-native English speaking expatriates, and to Filipino and Indonesian domestic helper callers, all ringing to complain about the households’ utility services, to query the bills and to report emergencies. The telephonists complained that they had particular difficulty in

understanding non-native English speaking expatriates living in Hong Kong, as well as the non-native English speaking domestic helper workforce. Interestingly, they found native-speaker customers from the UK and USA generally easier to understand, and reported no difficulty in serving these customers except for when they got angry.

On reflection, this ‘English for Telephoning Skills Course’ would have ideally provided intensive listening skills practice to selected and frequent native and non-native speaker callers (for example, the telephonists reported Japanese, Scottish, Filipina and Korean speakers) whose accents were difficult to understand, strategies training for employing “accommodation” strategies when talking to callers whose English was poor, and soft skills training in defusing anger expressed by frustrated customers. There was clearly a mismatch between what the HR training department assumed the problem to be and what the telephonists were experiencing.

This article is about providing a framework that may assist in avoiding such mismatches in stakeholder expectations when sourcing, planning, delivering and evaluating ESBP courses for the Hong Kong workforce. The study proposes a way of approaching the highly complex task of providing well-targeted ESBP workplace English communication courses, thus providing practitioners with an empirically derived framework for investigating, developing and evaluating their own ESBP assignments.

## **2. Background**

The data for this article comes from ten years of experience when working at the Centre for Professional and Business English Centre (CPBE) at The Hong Kong Polytechnic University culminating in a doctoral thesis formally investigating ESBP curriculum planning and evaluation practices in Hong Kong workplaces. CPBE is a self-financed centre which relies on income from workplace training and consultancies. These include government organisations such as the Hospital Authority, the Hong Kong Monetary Authority and the Independent Commission Against Corruption, Hong Kong (ICAC), as well as multinational companies such as JP Morgan and DHL and retail outlets such as Marks and Spencer. This centre also conducted courses for the public in Business English and was accredited by Cambridge ESOL to offer the Business English Certificate at three levels.

All the courses at CPBE could be called ‘ESBP’ courses, but some seemed to be much more specific than others, requiring very different syllabus planning and evaluation approaches.

Data collected from about 100 Hong Kong workplaces provide the basis for the suggested syllabus planning and evaluation typology that has proved useful in planning well-targeted workplace English for specific business communication courses.

First I will briefly review the literature on ESP, with particular reference to English for Business, and then I will summarise the doctoral study focusing on the syllabus framework that emerged from the data. The framework which suggests four distinct types of ESBP course types and brief case study examples, provided by Hong Kong HR managers, will be used to exemplify each of these. The article will finish with a final discussion on how this ESBP syllabus framework may support systematic approaches in the future and will suggest further areas of research.

### **3. The ESP and ESBP literature**

The literature describing and justifying new definitions for ESP has been on-going for a number of decades (Strevens, 1978; Hutchinson & Waters, 1987; Robinson, 1991; Swales, 1991, 2004; Dudley-Evans & St. John, 1998; Hyland, 2002; Basturkmen, 2006; Belcher, 2004, 2009; Nation & Macalister, 2010; Paltridge, 2009; Flowerdew & Wan, 2010). Learner-centred motivation and face validity as reasons for specific English teaching (see, for example, Hutchinson & Waters, 1987) have moved to much more theoretically grounded studies that show that texts generated in different and specific situations reflect different and specific genres and texts (see, for example, Belcher, 2009). Much research has been carried out in recent years into the English for Specific Purposes (ESP) genres and discourses of workplace and professional spoken and written texts, showing high levels of specificity in the way certain texts are organized and in the ways certain lexico-grammatical features are further reflected and patterned in the workplace texts under investigation (see, for example, Idema, 1994; Bhatia, 2008; Flowerdew & Wan, 2010; Forey & Lockwood, 2007; Hood, 2010). These are highly informative studies, yet educational theory has not yet illuminated how, in practice, syllabus planning, implementation and evaluation processes can be enacted. This article, it is hoped, will contribute to building this theory.

When we talk about English for Business in the Hong Kong workplace, we may be asked to provide English language proficiency development in a business context, or we may be asked to develop some kind of communication performance course that is specifically required for work, for example, writing accounting audit reports. The course requests are numerous, not all

requiring the same kind of approach. Some may require drawing on already published materials; others will require starting from scratch in a needs analysis; some may be developed for pre - employment purposes; some may be required for quality support on the floor. For example, whilst a small number of generic ESBP publications exists for call centre training (see, for example, Lockwood, *et al.*, 2010), their use is generally confined to pre-employment training. On the floor, it is quite a different story as recent research in ESBP in the call centre industry shows. Call centre exchanges in different industries and accounts are radically different according to their purposes, content and customers (Forey & Lockwood, 2007; Lockwood, 2008, 2010; Forey & Lam, 2013) and this has huge implications for different kinds of course planning and evaluation processes.

Applied and theoretical linguistic research into ESBP remains fragmented and limited (see, for example, Bargiela-Chiappini, *et al.*, 2007) when compared to other branches of ESP, such as English for academic purposes (EAP). This is unfortunate as global business communication, where it is estimated there are more non-English language speakers using English as a lingua franca than native speakers (Graddol, 2006; Nickerson, 2005), has unleashed a huge demand for highly specific business English communication solutions. To provide impact, ESPB curriculum and assessment requires researched and evidence-based tools and processes.

Business English is a materials-led movement rather than a research-led movement. Without research, Business English will be hampered. (St. John, 1996: 15)

and

Business English is an area of ESP that is relatively poorly researched. Rigorous linguistic analysis is fragmented and is more frequently based on written forms of language such as correspondence, annual reports and articles in business journals. Some kinds of analyses have been carried out with respect to the language of meetings and discussions, but there is still little to support course developers beyond their first-hand experience in the field. (Ellis & Johnson, 1994: 8)

In order to become more focused, ESBP applied linguistic perhaps need to take an interdisciplinary approach. Over two decades ago, White (1988) found the theoretical approaches to language curriculum design lacking:

My own experience as well as that of many others working in the field of language curriculum, confirms the importance of looking beyond the traditional concerns of the syllabus designer whose main influences are derived from applied linguistics. Although applied linguistics provides a basis for approach, design and procedure takes us right out of applied linguistics and straight into innovation management. This is because decisions about language curriculum rapidly cease to be decisions about ideas and become actions, which affect people. On such matters, applied linguistics is silent. (White 1988: 45)

The danger of an over-reliance on the discipline of applied linguistics in developing a clear way forward for ESBP syllabus development is further elaborated by two Hong Kong based ESP researchers:

ESP business practitioners need to reconceptualise their task as language teachers and gain access to the discourse communities of business people, training professionals and other ESP practitioners...This understanding must include: the values of the community e.g. returns on investment and value for money; operational details and relationships within the community. In dealing with training managers, ESP practitioners must appreciate the training paradigm, specifically the concepts of accountability, corporate orientation and human resource management, budgetary realities, training objectives, professionalism in training, as well as expectations of training managers in terms of course design. (Boswood & Marriott, 1994: 16)

Here there is a clear call for an interdisciplinary approach in ESP syllabus design, whether that be across subject disciplines in the case of EAP or across industry and job task types in the case of ESBP.

For the purposes of this study, I drew on the business management and training literature (Hamblin, 1974; Goldstein, 1980, 1993; Kirkpatrick, 1994; Brinkerhoff, 1998). In terms of conducting training needs analysis, they suggest that all levels within the workplace and all stakeholder interests need to be systematically canvassed before the syllabus design is commenced.

It is notable that in the last decade, beyond workplace and professional genre and text analyses and corpus studies, there appears to be little in the educational training materials illuminating principled approaches for the ESBP practitioner. It is hoped that this study will contribute to enhanced practice in workplace English communications training.

#### **4. The study**

My doctoral study (2002) comprised two stages: first the distribution of a survey questionnaire to CPBE clients (HR managers) probing details of recent English communication courses conducted at their workplaces. 150 questionnaires were sent out to workplaces representing a range of industry types and employing above 100 workers, and there was a 58% response rate. This was followed by seven in-depth case study interviews with HR managers and trainers from a range of respondent workplaces.

The data provided by the companies explaining the purposes, content and length of over a hundred courses soon resulted in patterns of different types of workplace English communication courses emerging. On the one hand there appeared to be some workplace English communication courses that were more generic in nature. Other courses, on the other hand, appeared to be highly specific, requiring them to be 'tailor-made'. The generic courses seemed to aim at improving the general English language proficiency of the participants in a business context. Examples of such courses taken from the data were 'Oral English Language Programmes at Elementary and Intermediate levels' (for a wine importer) and 'Business Writing Development' (for a Hong Kong government office). Specific or 'tailor-made' courses aimed, on the other hand, to meet the specific job performance needs within the workplace. Examples of such courses taken from the data were 'Oral English for customer services-sales assistants' (for a UK retail chain) and 'Report writing for senior investigators' (ICAC). Such tailor-made courses seemed to require more intensive syllabus planning and evaluation if, for example, they were to have an impact on job performance change and improvement. For example, improved customer feedback was important for retail groups as there had been a number of customer complaints. The retail group needed the sales assistants to provide more accurate information about shop policies and procedures to customers, to provide more proactive assistance, to provide better information about their products and to build rapport with the customer as they completed the transaction. All these business requirements were to be embedded within the communications training and assessed at the end of the course.

There appeared, therefore, to be categories of courses aimed at developing longer term educational and proficiency gains as opposed to those that had quite specific training and language performance gains. To communicate this emerging ESBP syllabus concept visually, I created two axes, one denoting generality to specificity drawn horizontally; whilst the other

denoting short-term ‘training and performance gains’ to long-term ‘education and proficiency gains’ drawn vertically. This model yielded four basic course types on which I could plot the data about the Hong Kong courses (see figure 1), as shown below:

<b>Language performance training with business focus</b>	
<b>Short training packages with performance gain outcomes (TYPE 1)</b>  e.g. presentation skills; meeting skills(20 hours)	<b>Short tailor-made packages for individual workplace settings with performance gain outcomes (TYPE 2)</b>  e.g. telephoning skills (20 hours)for Hong Kong gas company; sales assistants courses for a UK retail outlet
<b>GENERIC</b>	<b>SPECIFIC</b>
<b>Teaching programs with proficiency gain outcomes (TYPE 3)</b>  e.g. Business English certificate programs (100 hours) offered at different CEFR levels	<b>Teaching programs specialized to an industry/professional association standards with proficiency outcomes (TYPE 4)</b>  e.g. Writing courses (75-100 hours) for accountants (Hong Kong Society of Accountants)
<b>Language proficiency teaching with education focus</b>	

Figure 1: Workplace ESP syllabus development

Each of these course types is now discussed separately. Type 1 courses fall into the generic/language performance driven quadrant of English for Business provision. From the data, these courses typically comprise short training modules delivered in one or two-day workshops to middle and senior managers who need quick skills development in such areas as presentation skills, meeting skills and report writing. In order to access such training, participants must already have a sufficient ‘base line’ English language proficiency level and materials are

normally commercially available for this kind of ESBP workplace English communications training. The amount of needs analysis required for Type 1 courses is minimal as the materials already exist in generic commercial packages. However the form of participant assessment and course evaluation would need to be decided by the workplace in relation to the precise reason for the participants undertaking the training and what the impact expectations may be.

**Type 2 courses** fall into the specific/language performance driven quadrant of business English provision. These also comprise short training courses (typically 15-30 hours duration) and reflect highly specific workplace needs. For example, the telephonists in the Hong Kong public utility company, already mentioned earlier in this article, required specific skills in understanding non-native expatriate callers, in defusing native speaker customer anger and in using ‘accommodation’ strategies with callers whose English was weak. As well, these same telephonists were expected to incorporate specific information on procedures and policies peculiar to this public utility company. Such tailor-made requests were found in this part of the study to target all levels of employees within workplaces from low-level unskilled workers to those in higher management levels. In terms of syllabus development, this Type 2 course, unlike Type 1, requires delicate needs analysis through the gathering and analysis of authentic spoken and/or written texts, tailor-made materials development and appropriate follow-up assessments and course evaluation. Given that typically these kinds of courses are business performance and quality driven, key evaluative data should be collected back in the workplace once participants have completed their courses to measure impact.

**Type 3 courses** comprise those generic/education driven courses aimed at the longer-term goal of English language proficiency development. All the workplaces surveyed, except one, said that they did not see it was the workplace’s responsibility to fund this kind of long-term course and that it should be the responsibility of either Hong Kong schools and universities or the employees themselves. The one workplace to offer this kind of generic/proficiency pathway was a large Hong Kong based bank. In this bank they had what they called a ‘career development’ stream of English courses and these were language proficiency based and long-term, and to be completed in the employee’s own time. As far as syllabus development is concerned, these courses are often qualifications-driven where participants are working towards a series of

internationally recognized exams at different levels (for example, the Business English Certificate). These courses, like Type 1 courses, do not need the same intensity in the needs analysis and materials development as Type 2 courses as commercially available courses already exist. Furthermore, the evaluation processes for Type 3 courses may stop at the point of the examination result or end-of -course test scores.

An interesting finding in this part of the study was that despite what HR personnel said about not funding generic ESBP language proficiency, rather than shorter term ESBP performance courses, many workplaces were found to be asking for these general kinds of courses, but did not want the cost and bother of a final examination. They also often expressed a preference for them to be as short as possible and frequently expressed a preference for the provider not to do any special needs analysis and materials development that would incur extra costs ( as noted in the earlier Hong Kong utility worksite example). The problem arises where the client may insist on a Type 1 course for cost reasons, where a Type 2 course would be much more effective. It could be surmised that the HR manager, and for that matter the ESBP trainer, do not fully appreciate that the purposes for training will require very different approaches. A well-conceived ESBP syllabus framework, such as the one that has emerged from this study, may provide for clearer explanation of the kinds and attendant benefits for each type of ESBP course. This would be useful for clients and providers alike when first meeting and negotiating the right kind of ESBP course.

**Type 4 courses** fall into the specific/language proficiency quadrant in the framework and are aimed at targeted groups within designated professions and industries. These are long-term proficiency-based courses, similar to Type 3, but specifically targeted. Typically these kinds of courses are offered as part of Continuing Professional Development (CPD) courses by many Hong Kong professional associations. One example of such a course is the ‘Writing course for Junior Accountants’ that has been developed collaboratively with the Hong Kong Society of Accountants and Hong Kong University. This course is run within one of the accounting houses surveyed as part of this study. Generally speaking, these run for professionals from different workplaces (but within the same industry) where they register for the public courses. In terms of syllabus development, at the planning stage, there was for example, in the case of the accounts’ course, a very lengthy needs analysis stage, which explored accountant-writing needs in a

number of accounting firms across Hong Kong (Forey & Nunan, 1998). This study was funded by the Hong Kong government in collaboration with the Hong Kong Society of Accountants. The research outcomes were then turned into course material and delivered on a regular basis as a 75-hour course in venues such as university language centres and the British Council.

## **5. Discussion**

These four ESBP course types have been empirically derived from a survey of Hong Kong workplaces that regularly conduct English communications courses. The data suggests a huge variety in the types of ESBP offerings and the requirements for planning, delivering and evaluating these four courses types are different. In terms of the study, the majority of the courses fell into type 1 and 2 courses, those are the language performance driven courses. I will now discuss each of these course types under the syllabus stages of planning and evaluating, as these were the two aspects focused on in the study.

### **5.1 Planning**

Needs analysis is important in all ESBP courses but requires different approaches and different levels of intensity depending on the type of course being offered. For example, Type 1 (generic language performance) courses and Type 3 (generic language proficiency) courses often have commercially prepared courses on offer as publishers are able to market their generic ESBP products to large numbers of candidates. Such courses include Business English Certificate courses (Type 3) offered through accredited Cambridge ESOL providers. These courses are long-term (100 hours) and contextualise proficiency development in broad business contexts. They are delivered with commercially developed English for Business coursebooks that are designed to reach a broad global market (see, for example, the Cambridge university press products). Type 3 courses will typically be assessed externally with an examination from one of the big testing organisations such as Educational Testing Services (ETS) or Cambridge ESOL. Type 1 courses, on the other hand, assume a threshold proficiency (perhaps of around B2 (i.e. competent speaker) according to the Common European Framework of Reference-CEFR) in order to access the short-term language performance training offered through 10-20 hours of presentation skills, for example. These courses can also be sourced ‘off-the shelf’ and therefore require minimal provider preparation beyond carefully checking the proficiency levels of the

target group to ensure the course is well-targeted. In summary, therefore, Type 1 and 3 courses, at the generic end of the ESBP continuum, are supported by commercial publishers and commercial testing organisations where their market reach is significant and the publishing and assessment organisations can make significant profits from generic products that have high face validity as ESBP products.

On the other side of the continuum, however, we have Type 2 (specific language performance) and Type 4 (specific language proficiency) which large testing entities and commercial publishers do not cater for because developing bespoke products for small markets is costly, and as the study showed, workplaces often do not want to pay such costs. In Type 2 courses, the needs analysis and subsequent materials development needs to be funded by the workplaces themselves. Professional Associations and Chambers of Commerce, as we have seen previously, typically fund Type 4 courses. The purposes for ESBP training and education in these Types 2 and 4 courses are generally sourced in order to impact quality performance in the workplace and the overall communication reputation of specific groups of professionals. For this reason, understanding the policies, processes and products of the worksite and engaging in close collaboration with the key stakeholders (for example, quality assurance personnel and supervisors and professional association personnel) is key to success when planning, delivering and evaluating these courses.

## **5.2 Evaluation**

Just as the syllabus planning processes can be differentiated across the four different types of courses, so can the evaluation processes. By evaluation, I mean to focus on course evaluation rather than candidate assessment which will be discussed later in this discussion section. In the study, I drew on both educational and business management literature in the area of course evaluation, finding Kirkpatrick's (1994) 'levels' of evaluation, a business training management model, to be most useful in informing this study by mapping the levels into the ESBP syllabus framework. These 5 levels of course evaluation are as follows:

- (i) **Level 1 the reaction level:** at this level of training evaluation, the participants are often asked to comment on various aspects of the training event itself such as the attributes of the trainer, the method of presentation, the quality of the venue and handouts. This is sometimes called in the industry, a 'happy sheet'.

- (ii) **Level 2 the learning level:** at this level of training evaluation, the participants are tested on the content of the course as evidence that knowledge, skills and, in the case of language learning, language proficiency have improved.
- (iii) **Level 3 the performance level:** at this level of training evaluation, the participants are assessed on how they are able to apply or transfer what they have learned on the course to their jobs.
- (iv) **Level 4 the results level:** at this level of training evaluation, the results of the training are related to general organizational improvement. Kirkpatrick (1994) suggests looking at areas such as staff turnover, absenteeism and morale of employees for evidence.
- (v) **Level 5 the return on investment (ROI):** at this level of training evaluation, an accounting formula is used to calculate if there has been any financial ‘payback’ on the training.

At the specific end of the ESP syllabus framework continuum (Types 2 and 4), all 5 levels of course evaluation are theoretically desirable. This is because the highly specific job performance requirements for the training need to demonstrate business impact and justify expenditure. In the study, many of the business stakeholders surveyed and interviewed were familiar with Kirkpatrick’s 5-level model of course evaluation and required outside providers to enact this level of detailed evaluation. Demonstrating business impact for the training funded is key, as reported below:

Job performance improvements demonstrate a ‘payback’ to the workplace. What most organisations want to see is the results of why they are paying for the course. It may be more difficult to measure such a work-related improvement than to simply demonstrate that participants have learned new knowledge in the classroom, but here the line managers and supervisors should be able to come up with some suitable kind of measurement criteria.

(HR Manager of a Hong Kong Bank, Chinese woman, mid-40s)

However, at the generic end of the continuum, it was found that the traditional educational process of end-of-course surveys in university settings was used; for example, the administration of student feedback questionnaires and end-of-course achievement testing was common (equivalent to Kirkpatrick’s levels 1 and 2 only). As mentioned earlier, large well-known testing organisations cater for the generic end of the continuum with suites of business English tests at different levels. The purpose of these appeared to be for the study to relate to employment screening and job promotion.

In the next section, I will briefly describe some of the ‘mismatch’ problems that emerged in the study that are attributed to poor understanding of what is meant by ESBP courses and their attendant requirements.

### **5.3 ‘Mismatch’ problems**

The ESBP syllabus framework that has emerged in this study is speculated to have the potential to provide planning, implementation and evaluation tools and sets of processes for successful delivery and impact. Without this level of syllabus conceptualisation, problematic course plans were developed as described in this study.

At the time of this study, the Hong Kong government had launched a major initiative for supporting workplace English language communication development. This was in response to repeated complaints by Hong Kong professional associations and ‘captains of industry’ alike that the levels of English language competence had fallen and this was jeopardising Hong Kong’s competitive edge in the region. In February 2000, the government therefore provided HKD50 million to a fund called the *Hong Kong Workplace English Campaign* to support workplaces in developing suitable English communication enhancement courses for their workforce. Five years later, very little of the money had been spent, the reason being that the government would only support ESBP courses that demonstrated proficiency gain through benchmarked certificates awarded by a small groups of internationally recognised business English examination providers (for example, the large examination bodies such as Cambridge ESOL; Education testing Services (ETS) and the London Chamber of Commerce). As shown in this study, workplaces generally did not support this type of long-term language proficiency course (Type 3) as they were expensive, especially with the examination cost; but more importantly, such courses were not tailored to the language performance needs of the workplace (Type 2). In summary, the WEC-supported courses and examinations were not designed to show an impact in the workplace so Hong Kong workplaces did not use the funds.

However, it was not only the Hong Kong government that poorly conceived its subsidized WEC offerings. The other kinds of common mismatch were evident within the workplaces themselves where HR managers who were found in the study to be responsible for sourcing suitable courses often had few criteria upon which to base their requests and decisions,

apart from cost. For example, one case study reported that a large Hong Kong accounting firm wanted to source a short 15-hour training course for middle management accountants to write audit reports. The provider discovered, however, in the pre-course assessment of the target group that only 20% of the participants had a threshold writing proficiency level good enough to benefit from such short training. In other words, a Type 2 (specific/language performance) course was requested where a Type 4 (specific language proficiency) was in fact needed by the majority of the intended participants because of poor English language writing skills. This situation is common and requires careful and informed negotiation within the workplace as cost is involved.

Finally, providers of ESBP, whether they be university centres such as CPBE and the British Council or indeed the large number of small private English communications providers present in Hong Kong, have generally lacked a conceptual and empirically derived syllabus framework for planning, implementation and evaluation of their offerings. One ESBP trainer interviewed for this study complained about the problems that a lack of ESBP syllabus planning framework and principled approach often cause. This trainer reported a situation where her boss, the provider manager, wrote a Type 1 course proposal (off-the-shelf and cheap to deliver), where a Type 2 course was required (tailored and thus more expensive). She felt she had been set up for failure.

Early on, a very generic business English writing proposal was written by my boss (the ELT provider who 'negotiated' the training) without having done any needs analysis. When the training was allocated to me, I had to try and do some needs analysis in a very short period of time. This, combined with the certainty expressed by the HR manager and the Manager of the Corporate Finance Section that the communication problems related to 'poor grammar', laid the groundwork for a disaster. I tried to deliver a course on advanced grammar to the group, when they would have benefited in my view, from one-to-one tutorials each focusing on text, tone and style ... and building relationships with their colleagues in head office in New York through email writing.

(ESBP British trainer, female, mid-30's)

In summary, therefore, funding for ESBP may be better spent at the government, corporate and provider levels with ESBP syllabus frameworks and principled processes that ensure training and assessment is well-targeted.

## 6. Implications and further research

This empirically derived ESBP planning and evaluation framework still remains speculative as no further formal study has been carried out yet to test its efficacy. It would be of interest to carry out further research that tests the framework, not only from the planning and evaluation perspectives, but also from materials development, delivery mode and assessment perspectives; this would further enrich the proposed framework. This final part of the article highlights areas that warrant further investigation.

Let us consider how current research, as outlined in the literature review, may be systematically applied to course materials development. For example, in a recent article (Lockwood, 2012), the author reports on a study of how genre-based and discourse analyses research outcomes in the call centre industry in outsourced worksites in India and the Philippines have supported the development of informed materials for Type 2 and Type 4 training courses. This particular workplace, where second language speakers are employed in different industries and are dealing with different native-speaker customers, requires extremely high levels of English communication performance.. Training and measuring for high quality spoken communication skills in this rapidly developing outsourced call centre industry has required research-based training and assessment solutions. Without applied linguistic research and without ESBP models for good practice, reaching quality targets in this industry is constantly frustrated (see, for example, Lockwood & Hamp-Lyons, 2009; Forey & Lam, 2013.)

The nature of language assessment for specific purposes has, in recent years, become a focus of research attention, much of it relating to spoken performance assessment. This research has been triggered by workplace and professional dissatisfaction with generic ESBP proficiency assessment products that fail, in both a formative and summative sense, to report on improvements in quality in the workplace. For example, generic assessment products have been unsuccessfully promoted into workplaces without success (Lockwood 2010). This is because they are not designed for the highly specific purposes now required by many global workplaces. Spoken performance language assessment research (Douglas, 2001, 2005; Elder, *et al.*, 2011; Fulcher, *et al.*, 2010) is currently focused on how “indigenous criteria” (Douglas, 2001:171), meaning workplace and professional products, processes and values, can effectively be mapped into language assessment tools and processes to derive tailored communication performance measures that favourably impact the workplace. It was found, for example, that immigrant health

professionals in Australia, despite passing the specifically developed Occupational English Test (OET) by the University of Melbourne Language Testing and Research Centre, were not performing well on the job. Elder, *et al.* (2011) have reported close collaboration with health professionals, where their criteria of successful communication performance are incorporated into the assessment tools and processes. They argue that this approach will ultimately yield a more valid tool for screening second language speaker doctors and nurses. Similar studies in spoken performance assessment for pilots, air traffic controllers, telephonists, shop assistants and computer engineers are also under way (Elder, Pill, Woodward-Kron, McNamara, Mania, Webb and McColl, 2011; Fulcher, Davidson and Kemp, 2011.). These studies are particularly important in being able to assess English communication in Type 2 and Type 4 courses within the ESBP framework.

One final implication of this study for both research and ‘best practice’ is, of course, the training of the ESBP trainers providing these very challenging workplace and professional communication courses. They require the multiple roles of consultant, planner, implementer, deliverer, evaluator and assessor and this requires training and support (Lockwood, forthcoming). This was anticipated by Nunan (1988) who says:

The ELT workplace trainer as curriculum designer has the added responsibility of becoming familiar with the contextual terrain of the workplace and extrapolating what is relevant to the design, implementation and evaluation of ELT workplace courses that are commissioned. While teachers are prepared to accept responsibility for curriculum development, and to see themselves as prime agents in the curriculum process, they can face great difficulty if the added burden of their redefined role is not recognized. (Nunan, 1988: 180)

Interesting longitudinal case study research could be carried out on individual ESBP trainers who choose this career path as well as to investigate the content of training the ELT workplace trainer courses.

ESBP has become very specific indeed. The demand for English in the global business world is huge and this has implications for syllabus development not only in workplaces, but also within the secondary, vocational and tertiary sectors. Already English for general academic purposes (EGAP) and English for specific academic studies (ESAP) have been differentiated to describe academic literacy skills development from discipline-specific academic writing (see for example Hood, 2012); whether there is further delicacy in this area would make interesting research.

It is important to ensure that pedagogical approaches and training frameworks for ESBP are derived in a systematic and practical way to assist teachers and trainers in this important field of work, and, it is hoped that this study may contribute to this endeavor.

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## **Speech Acts Annotation for Business Meetings**

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### **Abstract**

With the advancement of information and communication technology, the study of speech acts is not only restricted to language philosophers but includes researchers who are interested in the study of speech acts in conversational corpora (Archer, Culpeper, & Davies, 2008; Cheng, 2009; Cheng & Tsui, 2009; Cheng & Warren, 2005, 2006; Jucker, 2009; Seto, 2009, 2010). Other researchers have attempted to develop software that can automatically identify speech acts from corpus data, resulting in annotated corpora in specific domains for different tasks (Allen and Core 1997; Bunt, 2009, 2011; Carletta et al., 1997; Dhillon et al, 2004; Geertzen, Petukhova, & Bunt, 2007; Stiles, 1992; Stolcke et al., 2000; Weisser, 2003). In this paper I present an attempt to annotate speech acts in business meetings in the business sub-corpus of the Hong Kong Corpus of Spoken English (Prosodic) (HKCSE (Prosodic)) with the aid of a computer-mediated program SpeechActConc designed by Chris Greaves for the analysis of the annotated corpus data. SpeechActConc is capable of automatically identifying annotated speech acts in a corpus, displaying information about each speech act and concordancing speech acts, listed by frequency and sorted by co-occurring or co-selected speech acts to the right and left of the centred speech acts. It can also automatically find 2, 3, or 4 speech act co-occurrences (Cheng, Greaves, &

Warren, 2005, 2006; Cheng, Greaves, Sinclair, & Warren, 2009). I will analyze the speech acts in the annotated corpus to explore the use and patterns of speech acts in business meetings in Hong Kong to find out the relative frequencies of occurrence of different speech acts in business meetings, to explore the predictable sequencing patterns of speech acts, to identify the characteristic lexical-grammatical patterns or linguistic realizations of different speech acts, and to put forward some possible implications for ESP teaching.

**Keywords:** business meeting, corpus linguistics, pragmatics, speech acts, spoken discourse

## 1. Introduction

Speech act theory, first proposed by a number of philosophers of language involved in analytical philosophy in the 1960s, focuses not on language form but on what language does (Petrey, 1990). Among these philosophers, John L. Austin and John R. Searle are the two most prominent advocates in the ordinary language school (Smith, 2003). Austin's *How to do thing with words* (1962; second edition, 1975) and Searle's *Speech acts: An essay in the philosophy of language* (1969) are two significant books for the study and the development of speech act theory (Burkhardt, 1990; Fotion, 2000). In response to their contemporary discussion on language, known as logical positivism, Austin (1975[1962]) and Searle (1969) argue that language, other than making statements or assertions to describe different states of affairs, performs many functions such as questions, exclamations, and commands. They also argue that most utterances in language cannot only be categorized as either true or false (Saeed, 1997), which is referred to a truth-conditional analysis of sentence meaning as proposed in logical positivism (Levinson, 1983). In truth-conditional analysis, a sentence is regarded as meaningful if and only if it can, in principle at least, be verified and tested for its truth and falsify (Levinson, 1983). In other words, if a sentence is not verifiable, it is meaningless.

In the process of identifying and depicting different functions performed by language, Austin (1975[1962]) and Searle (1969) propose different yet related classification systems of speech acts. Austin's classification is a lexical classification of illocutionary verbs, resulting in five categories of speech act, namely 'verdictives', 'exercitives', 'commissives', 'expositives', and 'behabitives' (Austin, 1975, pp. 151-164). Modified from Austin's five categories seven years later, Searle's (1969, 1979a) classification is also a lexical classification of illocutionary

acts or illocutionary points with slightly different categories, namely ‘assertives’, ‘directives’, ‘commissives’, ‘expressives’, and ‘declarations’ (Allan, 1998).

Since then, a number of research studies on different aspects of speech act theory have been conducted, for instance, Verschueren (1980) studies speech acts and the relationship between speech act verbs and performative verbs. Eemeren & Grootendorst (1984) investigate the possibility of resolving disputes over different expressed or verbalized opinions using speech act theory. Geis (1995) proposes that an empirically and theoretically significant speech act theory needs to be embedded within a general theory of conversational competence that can explain how people do things with words in naturally occurring conversation. Henderson and Brown (1997) explain that the basic emphasis of speech act theory is on what an utterer means by his or her utterance, which refers to illocutionary force, rather than what an utterance means in a language.

With the advancement of information and communication technology (ICT), the study of speech acts is no longer restricted to language philosophers, as linguists (Stenström, 1994; Tsui, 1994; Eggins & Slade, 1997) have become interested in the study of speech acts based on conversational corpora. The technological advancement, with a variety of unprecedented tools, have allowed linguists to scrutinize speech acts in the corpora collected from authentic conversation in different contexts for different purposes, such as the investigation of the use of corpus data in enhancing the authenticity of language teaching (Cheng, 2009; Cheng & Tsui, 2009; Cheng & Warren, 2005, 2006; Jucker, 2009; Seto, 2009, 2011). Most importantly, with the help of technology, it has been possible for corpus linguistic researchers to identify and propose different classifications for speech acts. Some scholars have attempted to make use of the technological advancement to develop software that can automatically identify speech acts from the corpus data (Stiles, 1992; Allen & Core, 1997; Carletta et al., 1997; Stolcke et al., 2000; Leech & Weisser, 2003; Rayson, n.d.).

The goal of this paper is to describe and analyze the use and patterns of speech acts in business meetings from the business sub-corpus in the Hong Kong Corpus of Spoken English (prosodic) (HKCSE (prosodic)). HKCSE (prosodic) contains four sub-corpora - academic, business, conversation, and public - of intercultural, naturally occurring spoken interactions between Hong Kong Chinese and native English speakers mainly from Britain, the United States of America, and Australia (Cheng et al., 2005, 2008). The business sub-corpus, compiled

between 1998 and 2002, contains a range of discourse types audio-recorded in various business- and professional-related contexts, including hotel and airport reception and information desks, meeting rooms in business organizations and the administrative offices in organisations in Hong Kong. (Cheng et al., 2005). In the business meetings, there are 10 recordings of around 210 minutes in duration totalling 37,000 words.

## **2. Literature review**

### **2.1 Corpus annotation**

Corpus annotation is understood as the practice or the procedure of identifying and adding interpretative and linguistic information to an electronic corpus of selected spoken and written language data (Leech, 1997, 2005). It is interpretative because annotation is a result of human understanding of the text; there can be no purely objective, mechanistic ways of deciding which label should be applied to a given linguistic phenomenon. It is also metalinguistic as the annotation offers additional information about the language of the text (Leech, 1997). Among different types of corpus annotation, prosodic annotation and pragmatic annotation are of particular relevance to this paper. The former adds information about prosodic features such as stress, intonation and pauses in a spoken dialogue while the latter denotes different kinds of speech act or dialogue act (Leech, 2005. See also Archer et al., 2008).

The annotation work of this present study belongs to the field of pragmatic annotation, which adds information about the speech acts as found in the utterances in the business meetings. The foundations of pragmatic annotation can be traced back to a variety of different approaches in philosophy, sociology, psychology, and linguistics. In the 1990s, with the advancement in information and communication technology, the annotation of spoken discourse has become more important in the design of dialogue systems or programs. These systems or programs allow a computer to interact with an individual to fulfill designated tasks such as flight planning and cooperative problem solving (Weisser, 2005). In order to create dialogue corpora for training or evaluating these systems, researchers from various disciplines began to get together to exchange their ideas and to establish best practice guidelines (Weisser, 2005). One of the most notable efforts in the area was the ‘founding’ of the Discourse Resource Initiative (DRI). The Multiparty Discourse Group at the DRI devised an annotation scheme called [DAMSL](#) (Dialog Act Markup in Several Layers) between 1996 and 1998 (Allen & Core, 1997). It attempted to recommend a

standardized annotation scheme for speech acts and dialogue transactions (Weisser, 2005). Other projects include the Edinburgh Map Task annotation scheme of Human Communication Research Centre Map Task Corpus (Carletta et al., 1997), the Dialogue Act Modeling for Automatic Tagging and Recognition of Conversational Speech (Stolcke et al., 2000), the Dialogue Act Markup in Several Layers (Allen & Core, 1997), Verbal Response Modes Annotated Utterances Corpus (Stiles, 1992), and the SPeech Act Annotated Corpus for Dialogue Systems (Leech & Weisser, 2003).

## **2.2 Annotation scheme**

The set of 69 speech acts used for the annotation of speech acts in this study is compiled with reference to a number of speech acts annotation studies, with Stenström's being the core reference (Stenström, 1994; Tsui, 1994; Stolcke et al., 2000; Leech & Weisser, 2003).

### *Stenström's categories of speech acts in casual conversation*

With reference to Sinclair and Coulthard's (1975) exchange structure, Stenström (1994) depicts spoken interaction in terms of five hierarchical levels, transaction, exchange, turn, move, and act. The last one, 'act', is the smallest interactive unit which signals what the speaker intends and wants to communicate (p. 30). In Stenström's (1994) classification of acts, there are three categories: 33 primary acts (pp. 39-40, 114-115), 7 secondary acts (p. 44), and 10 complementary acts (p. 46). A primary act is an act that can realize a move on its own (p. 38). Secondary acts are acts that accompany and sometimes replace the primary acts (p. 38). Complementary acts also accompany primary acts but rarely replace them (p. 39).

### *Tsui's speech acts in conversational utterances in English*

Tsui's (1991) model consists of three primary acts: Initiating Acts, Responding Acts, and Follow-up Acts. In Initiating Acts, there are four subclasses, namely 'requestive', 'elicitation', 'directive', and 'informative' (Tsui, 1991, p. 243).

In Responding Acts, there are three subclasses, namely "positive responding acts", "negative responding acts", and "temporization" (Tsui, 1994, pp.58-59). Positive responding acts can be understood as "preferred" responding utterances with less linguistic material and are given without any delay (Schegloff, Jefferson, & Sack, 1977, p. 362; as cited in Tsui, 1994, p.

58). Negative responding acts can be understood as “dispreferred” responding utterances with more linguistic material and are given with delay (Schegloff et al., 1977, p. 362; as quoted in Tsui, 1994, p. 58). Temporization is a “dispreferred” response used to postpone the decision making; it also contains linguistic features of delay such as fillers and particles (Tsui, 1994, p. 59).

In Follow-up Acts, there are three subclasses, namely “endorsement”, “concession”, and “acknowledgement” (Tsui, 1994, pp. 59-61, 200-211). Endorsements are follow-up responses to positive responding acts (1994, p. 59). Concessions, which aim at minimizing the face damage done, are follow-up responses to negative responding acts (1994, p. 60). Acknowledgements are follow-up responses to temporization, where the addressee has the obligation to get back to the speaker’s request later (1994, p.60).

#### *Stolcke et al.’s dialogue act modeling for automatic tagging and recognition of conversational speech*

Stolcke et al.’s (2000) Dialogue Act Modeling for Automatic Tagging and Recognition of Conversational Speech is an example of task-orientation annotation. Dialogue Act Modeling is a statistical approach for modelling dialogue acts in conversational speech, which refer to speech-act-like units such as statements, questions, backchannels, agreements, disagreements, and apologies. The model automatically detects and predicts dialogue acts based on lexical, collocational, and prosodic cues, as well as the discourse coherence of the dialogue act sequence.

In total, 42 dialogue act labels are found from a hand-labeled database of 1,155 conversations from the Switchboard corpus of spontaneous human-to-human telephone speech (Stolcke et al., 2000).

#### *Leech & Weisser’s A SPeech Act Annotated Corpus for Dialogue Systems (SPAAC)*

The SPAAC project (Leech & Weisser, 2003) focuses on annotating a range of telephone task-oriented dialogues between two individuals to produce a corpus of pragmatically annotated dialogues that may be used as training data for dialogue systems of telephone services on the one hand and developing a set of generic speech-act labels as well as determining other generic elements on the other. The analysis of data was done automatically as far as possible to process a large number of dialogues reliably and efficiently. The set of 41 categories of speech acts is

devised after experimentation. These speech-act categories aim at creating a generic (general) speech-act categorization scheme that can be applied to as many different kinds of task-oriented dialogue as possible (Leech & Weisser, 2003; Leech et al., n.d.).

### **2.3 Utterance segmentation**

Utterances are defined as ‘linguistically defined stretches of communicative behavior that have one or multiple communicative functions’ (Geertzen, Petukhova, & Bunt, 2007, p.1; cf. Bunt et al., 2010, p. 1). An adjective ‘minimal’ is later added before ‘sketches’ (Bunt, 2010b) to ensure that the particular communicative function assigned to the utterance is as accurately as possible.

Though debatable in discourse analysis, utterance segmentation, together with the determination of utterance boundaries, is often regarded as an essential first stage in preparing data for corpus analysis, which involves the division of a dialogue into meaningful segments or units for annotation (Archer et al., 2008, p. 632; Bunt, 2009; Geertzen et al., 2007, p.1). In the field of pragmatics, the tagging process is manual, as the segmentation and tagging are dependent on broader discursal characteristics of the transcribed corpus data (Archer et al., 2008, p. 635).

To segment transcribed speech into distinguishable utterances for further analysis, syntax, pragmatic function, prosody, and pauses are four factors taken into consideration (Dhillon, Bhaget, Carvey, & Shriberg, 2004, p. 8). In my speech act annotation, all of these four factors were considered in utterance boundaries, which are derived on a phrasal level (p. 8), from the unique functions as shown within the spoken discourse (p. 9), from the aural cues (p. 12) as proposed in Brazil’s (1997) discourse intonation choices, namely prominence, tone, key, termination, and from the appearance of a lengthy pause (p. 12).

### **2.4 Research questions**

The four research questions are:

- (1) What are the relative frequencies of occurrence of different speech acts in business meetings in Hong Kong?
- (2) Are there any predictable sequencing patterns of the speech acts?
- (3) What are the characteristic lexical-grammatical patterns of different speech acts?
- (4) What are the possible implications for ESP teaching?

### 3. Methodology

#### 3.1 Working speech act taxonomy

A working taxonomy of 69 speech acts for the speech act annotation was developed primarily with reference to the tag sets in Stenström (1994), Tsui (1994), Stolcke et al. (2000), and Leech & Weisser (2003). The 69-speech act working taxonomy is as follows (Table 1):

Table 1: The 69-speech act working taxonomy

Alert	Check	Express_possibility	Probe	Self-commendation
Answer to question: comply	Closer	Express_wish	Query	Self-denigration
Answer to question: disclaim	Clue	Filler	Question: confirmation	Smoother
Answer to question: evade	Confirm	Frame	Question: identification	Staller
Answer to question: imply	Correct	Greeting	Question: polarity	Starter
Answer to question: supply	Correct-self	Hedge	Raise_issue	Statement: inform
Answer to request: accept	Disagree	Instruction	React	Statement: opine
Answer to request: evade	Elicit-repeat	Invite	Rebound	Suggest
Answer to request: reject	Empathizer	Justify	Register	Thanks
Apology	Empathy	Metacomment	Reply to statement: acknowledge	Threat
Appealer	Emphasizer	Monitor	Reply to statement: agree	Unclassifiable
Appreciation	Engage	Offer	Reply to statement: object	Uptake
Booster	Evaluate	Precursor	Request: action	Warning
Call-off	Expand	Preface	Request: permission	

#### 3.2 SpeechActConc

SpeechActConc (Figure 1) is a programme written by Chris Greaves in 2010 and is specially designed for concordancing the annotated BPC. It is a program for concordancing speech acts, listed by frequency and sorted by co-occurring or co-selected speech acts to the right or left of the centred speech acts. It can also automatically find 2, 3, or 4 speech act co-occurrence even when they occur in different positions relative to one another (i.e. positional variation) and when one or more speech acts occur in between the other speech acts (i.e. constituency variation).

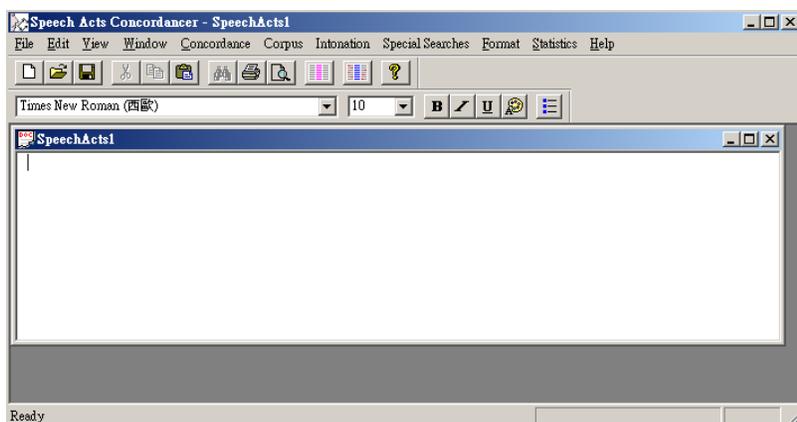


Figure 1: Screen shot of SpeechActConc

These functions are similar to ConcGram, another program written by Chris Greaves for concgramming and concordancing corpus texts, which can perform automated as well as user specified concgram searches to find 2, 3, 4 or 5-word patterns of all the word associations in a text, both grammatical and semantic, and patterns are listed by frequency of occurrence (Cheng, Greaves, & Warren, 2006). The notion of co-occurrence is related to concgramming (Cheng et al., 2006; Cheng, Greaves, Sinclair, & Warren, 2009). A concgram is made up of words which co-occur contiguously and/or non-contiguously. It includes all instances when one or more words are found between the co-occurring words (i.e. constituency variation), and if the co-occurring words are in different positions relative to one another (i.e. positional variation), e.g. ‘*play a role*’, ‘*play a key role*’, ‘*have a role to play*’ (Cheng et al., 2006)..

A basic search for a single speech act can be done in concordance search. After the speech act to search for in the corpus file has been entered, all of the instances of the searched SA are listed. A co-occurring SA search can be carried out by setting the preferences and entering the search words (2 to 4 words). The co-occurring speech acts are then sorted based on their position relative to the centered string.

#### 4. Discussion of findings

##### 4.1 Question 1: What are the relative frequencies of occurrence of different speech acts in business meetings in Hong Kong?

Out of 8,638 instances of speech acts found in the business meetings, there are 54 unique speech acts. They are listed in accordance with the descending frequency sort (Table 2). The top five

most frequent speech acts are 'statement: inform' (26.12%), 'filler' (19.51%), 'reply to statement: acknowledge' (8.52%), 'statement: opine' (7.72%), and 'unclassifiable' (5.35%).

Table 2: Frequency of unique speech acts in business meetings

number	speech act	frequency	percentage	number	speech act	frequency	percentage
1	Statement: inform	2239	25.92%	28	Thanks	39	0.45%
2	Filler	1686	19.51%	29	Empathizer	39	0.45%
3	Reply to statement: acknowledge	736	8.52%	30	Hedge	35	0.41%
4	Statement: opine	682	7.89%	31	Instruction	23	0.27%
5	unclassifiable	462	5.35%	32	Filler	22	0.25%
6	Expand	254	2.94%	33	Answer to question: supply	15	0.17%
7	Answer to question: comply	248	2.87%	34	Reply to statement: object	15	0.17%
8	Justify	237	2.74%	35	Emphasize	12	0.14%
9	Frame	218	2.52%	36	Query	12	0.14%
10	Uptake	179	2.07%	37	Staller	11	0.12%
11	Question: polarity	162	1.88%	38	Apology	10	0.12%
12	Preface	145	1.68%	39	Greeting	10	0.12%
13	Monitor	118	1.37%	40	Answer to question: disclaim	9	0.10%
14	Request: action	112	1.30%	41	Evaluate	9	0.10%
15	Question: identification	107	1.24%	42	Correct	5	0.06%
16	Question: confirmation	97	1.12%	43	Empathy	5	0.06%
17	Reply to statement: agree	79	0.91%	44	Disagree	5	0.06%
18	Suggest	74	0.86%	45	React	4	0.05%
19	Clue	73	0.84%	46	Request: permission	3	0.03%
20	Check	70	0.81%	47	Answer to request: evade	3	0.03%
21	Precursor	63	0.73%	48	Correct-self	2	0.02%
22	Answer to request: accept	55	0.64%	49	Invite	2	0.02%
23	Confirm	53	0.61%	50	Offer	1	0.01%
24	Alert	52	0.60%	51	Self-denigration	1	0.01%
25	Answer to question: imply	50	0.58%	52	Answer to question: evade	1	0.01%
26	Starter	48	0.56%	53	Smoother	1	0.01%
27	Appealer	46	0.53%	54	Engage	1	0.01%

In the business meetings, reporting objective or neutral information and expressing personal opinions are common practices, thus both ‘statement: inform’ (25.92%) and ‘statement: opine’ (7.89%) occur more frequently than other speech acts. With regard to reporting objective or neutral information in a hotel meeting, it can be a summary of the daily performance of various departments, as shown in Extract 1 (B022):

## Extract 1      B022

### B2:    male English

1.    B2:    <SA063 [statement: inform] and (.) we repeat the money  
         yesterday (.) >
2.           <SA063 [statement: inform] we did totally four hundred and  
         forty-one thousand
3.           dollars >
4.           <SA032 [filler] er >
5.           <SA063 [statement: inform] shortly behind budget >
6.           <SA063 [statement: inform] exceed the budget on the  
         beverage >
7.           <SA032 [filler] um >
8.           <SA063 [statement: inform] again a strong performance in  
         Todd's >
9.           <SA063 [statement: inform] thirty-five against budget  
         twenty eight (.) >
10.          <SA063 [statement: inform] good performance in Dickens >
11.          <SA063 [statement: inform] forty-two against budget  
         thirty-six >

Apart from lines 4 and 7, which are fillers, speaker B2 reports on the performance of the restaurants with the support of figures.

With regard to expressing personal opinions, it can be a suggestion for handling an issue from daily hotel operation. For example, as shown in Extract 2 (B016), a large amount of money has been found in a guest room, and the colleagues express their opinions about how the issue should be dealt with.

## Extract 2      B016

### b1, b3: male Hong Kong Chinese    a2:    female Hong Kong Chinese

1. b3:           <SA043 [preface] he is only a suspected may be could be  
         the another one >
2.           <SA064 [statement:opine] \* so we got to chase this  
         previous guest >
3. b1:           <SA064 [statement:opine] \*\* could be could be the >
4. b3:           <SA064 [statement:opine] we talk to this guy first and  
         then >
5.           <SA068 [unclassifiable] (inaudible) >
6. a2:           <SA064 [statement:opine] the other way we didn't tell him  
         anything just say the hotel  
         is looking for him >
7.           <SA064 [statement:opine] looking for him and \* ask him >
8. b1:           <SA064 [statement:opine] \*\* yeah for anything left >
9. b3:           <SA064 [statement:opine] \*\* whether he left something >
- 10.a2:          <SA064 [statement:opine] \*\* whether he left something >
11.           <SA032 [filler] yeah >
- 12.b1:          <SA064 [statement:opine] whether he left anything in the  
         hotel >

In lines 2 and 4, speaker b3 suggests looking for the guest and asking him about the money. In lines 6 and 10, speaker a2 suggests not telling the guest anything about the money. In lines 3, 8, and 12, speaker b1 suggests looking for the guest and asking him if he has left anything in the hotel.

The speech act of ‘statement: inform’ or ‘statement: opine’ is usually followed by ‘reply to statement: acknowledge’ (8.52%), which signals a minimal receipt of information, such as ‘okay’, ‘yeah’, ‘yes’, ‘uhuh’, ‘mhm’, ‘mm’, ‘right’, ‘sure’, or a combination of these markers, such as ‘okay yeah’, ‘mhm yeah’, ‘okay sure’. It is also possible for the listener to repeat what the speaker has just said as a signal of acknowledgement, as shown in Extract 3 (B017):

Extract 3      B017

b2:      male Hong Kong Chinese      a1 / a2: female Hong Kong Chinese

1.      b2:      <SA047 [question: identification] when is it >
2.      a2:      <SA002 [answer to question: comply] Sun \* day >
3.      a1:      <SA002 [answer to question: comply] \*\* Sunday >
4.      b2:      <SA053 [reply to statement: acknowledge] this Sunday >

After speaker b2 has raised a question about the date for a group check-in at a hotel in line 1, speaker a2 and speaker a1 answered it in lines 2 and 3. To reply to their answers, speaker b2 responds by repeating a2 and a1’s answers ‘Sunday’ in line 4, rather than using lexical items listed above.

The following is another example:

Extract 4      B060

a1 / a2: female Hong Kong Chinese

1.      a1:      <SA064 [statement: opine] my theory is female female gets bitten >
2.      a2:      <SA053 [reply to statement: acknowledge] female >
3.      a1:      <SA064 [statement: opine] females as opposed to male tend to get bitten by mos-mosquito mosquitoes >

In Extract 4 (B060), a1 was talking about her view on mosquito bites in line 1, and a2 responded to her views by repeating ‘female’ in line 2, instead of using such markers as ‘mhm’ or ‘okay’.

A filler is used to fill a silence in the discourse. Fillers like ‘er’, ‘okay’, ‘yeah’, ‘um’, ‘mhm’, ‘you know’ are very commonly used by speakers when they inform, opine, question, reply, or answer (19.51%) (Figure 2).

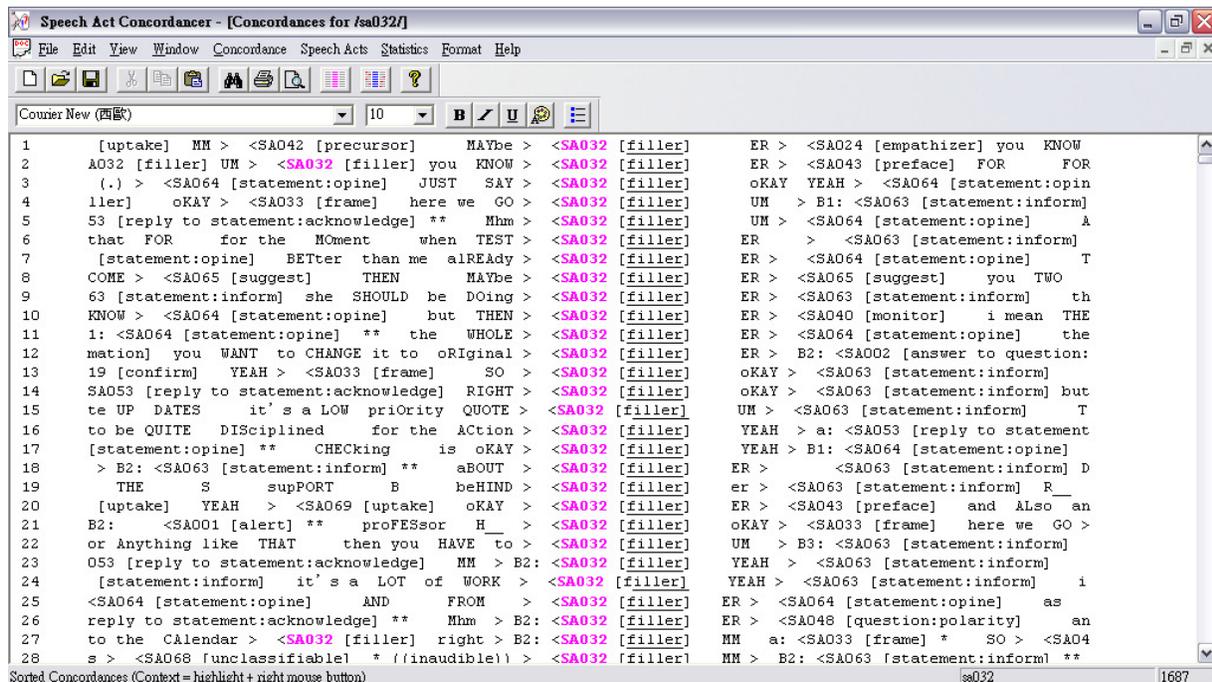


Figure 2: Examples of concordance lines for [filler]

## 4.2 Question 2: Are there any predictable sequencing patterns of speech acts?

The function of automated search for 2 co-occurring speech acts in *SpeechActConc* can show all the instances where a speech act occurs with another speech act, which is a helpful aid for the study of the sequencing patterns and co-selection patterns of speech acts in a conversation. Regarding sequencing patterns in conversation, the study of conversation analysis that primarily focuses on small-scale features or local management organization in conversation is relevant for the understanding of paired speech acts, in particular the closely-related notions of adjacency pairs and preference organization.

Adjacency pairs, originally referred to paired utterances such as question-answer, request-acceptance, apology-minimization, depicts an expectation of a relevant response from the second speaker to the first speaker in a conversation (Schegloff 1972; Sack, Schegloff, & Jefferson, 1978[1974]; Levinson 1983; Mey 2001). This notion leads on to preference organization, which divides the response into two categories – ‘preferred’ and ‘dispreferred’ in

which the former is structurally simpler than the latter (Schegloff 1972; Sack et al., 1978[1974]; Levinson 1983; Mey 2001). In conversational interchanges, not all potential second parts to the first part of an adjacency pair are of equal standing: there is a ranking operating over the alternatives such that there is at least one ‘preferred’ and one ‘dispreferred’ category of response (Levinson 1983, p. 307). The notion of preference is a structural notion that corresponds closely to the linguistic concept of ‘markedness’ (Levinson 1983, p. 307).

Preferred second pair parts are ‘unmarked’, occurring as structurally simpler turns, while dispreferred second pair parts are ‘marked’, occurring as structurally complex turns (Levinson 1983, p. 307). Marked behaviours are ‘dispreferred’ because they require more on the part of the users, usually resulting in a noticeable deviance from what is expected or accepted (Mey 2001, p. 152). In other words, not all second pair parts in an adjacency relationship are of equal structural complexity, with some simple such as acknowledgements or confirmations while others various degrees of structural build-up such as elaborate excuses or long explanations (Mey 2001, p. 151). In contrast to the simple and immediate nature of preferred second pair parts, dispreferred ones, such as rejections to requests, refusals of offers, disagreements after assessments, are delayed and contain additional complex components (Levinson 1983, p. 308). Correlations of the content and format in the first pair parts and the second pair parts of adjacency pairs are shown in Table 3 (Levinson 1983, p. 336):

Table 3: Content and format in the first and second pair parts of an adjacency pair

<b>First parts</b>	<b>Second parts</b>	
	<i>Preferred</i>	<i>Dispreferred</i>
Request	acceptance	Refusal
Offer / Invite	Acceptance	Refusal
Assessment	Agreement	Disagreement
Question	Expected answer	Unexpected answer or non-answer
Blame	Denial	Admission

To investigate if there are any predictable sequencing patterns of speech acts, a search for 2 co-occurring speech acts was carried out to show all the instances where a speech act occurs with another speech act. Out of a total of 8,666 co-occurring speech acts instances, the top ten, including positional variations of the same pair of speech acts, are as follows (Table 4):

Table 4: 2 co-occurring speech acts in business meeting

number	centred speech acts	co-occurring speech act	co-occurring instances	positional variation
<b>1</b>	<b>Statement: inform</b>	<b>Filler</b>	<b>1126</b>	
	<i>Filler</i>	<i>Statement: inform</i>	1101	*
<b>2</b>	<b>Statement: opine</b>	<b>Filler</b>	<b>223</b>	
	<i>Filler</i>	<i>Statement: opine</i>	215	*
<b>3</b>	<b>Statement: inform</b>	<b>Unclassifiable</b>	<b>208</b>	
	<i>Unclassifiable</i>	<i>Statement: inform</i>	204	*
<b>4</b>	<b>Reply to statement: acknowledge</b>	<b>Statement: inform</b>	<b>116</b>	
<b>5</b>	<b>Justify</b>	<b>Filler</b>	<b>114</b>	
	<i>Filler</i>	<i>Justify</i>	109	*
<b>6</b>	<b>Frame</b>	<b>Statement: inform</b>	<b>105</b>	
<b>7</b>	<b>Preface</b>	<b>Filler</b>	<b>105</b>	
	<i>Statement: inform</i>	<i>Frame</i>	105	*
	<i>Filler</i>	<i>Preface</i>	104	*
<b>8</b>	<b>Statement: inform</b>	<b>Reply to statement: acknowledge</b>	<b>86</b>	
<b>9</b>	<b>Unclassifiable</b>	<b>Filler</b>	<b>81</b>	
	<i>Filler</i>	<i>Unclassifiable</i>	80	*
<b>10</b>	<b>Expand</b>	<b>Filler</b>	<b>76</b>	
	<i>Filler</i>	<i>Expand</i>	76	*

If the same pair of speech acts with positional variation is excluded from the list, the top five most frequent speech acts are as follows: ‘Statement: inform’ and ‘filler’ with 1,126 instances, followed by ‘statement: opine’ and ‘filler’ with 223 instances, ‘statement: inform’ and ‘unclassifiable’ with 208 instances, ‘reply to statement: acknowledge’ and ‘statement: inform’ with 116 instances, and ‘justify’ and ‘filler’ with 114 instances.

As mentioned above, fillers are very commonly used by speakers when they inform, opine, question, reply, or answer, thus becoming one of the most frequently co-occurring speech acts. However, an adjacency pair with a preferred response is frequently found in the search for 2 co-occurring speech acts, which is ‘statement: inform’ and ‘reply to statement: acknowledge’, as shown in Extract 5 (B022):

Extract 5      B022

B3, B5: male English

1. B5: <SA063 [statement: inform] somebody just give her a courtesy call this morning >
2. B3: <SA053 [reply to statement: acknowledge] sure >

In a hotel meeting, after B5 has reported what has been done to a guest (line 1), B3 gives a preferred response of acknowledgement (line 2), which is simple and almost spontaneous.

### **4.3 Question 3: What are the characteristic lexical-grammatical patterns / linguistic realizations of different speech acts?**

It is found from the concordances that there is a variety of linguistic realizations of different speech acts. The lexical-grammatical patterns could be used as exemplars for English language learners. Take [thanks] as an example. Different expressions of thanking are found in meetings, which can be divided into four categories (Figure 3).

The base word or ‘node’ for the speech act of thanking is ‘thank you’ (lines 6 to 24) and ‘thanks’ (lines 30 to 32). Other than the ‘node’, an adverbial ‘very much’ could be placed after the ‘node’ in positions R1 and R2. The common expressions of such combinations are ‘thank you very much’ (lines 28 to 29) and ‘thanks very much’ (lines 34 to 35). A noun, usually the name of a person to whom or that of an organization to which the thanking message is directed, is added in position R1, as for ‘thank you M\_\_’ (line 25) and ‘thank you S\_\_’ in concordance line 26. Other than these formulaic expressions, there are expressions of thanking with a variety of word-classes, like ‘thank you so thank you especially the the banquet serving staff (line 27).

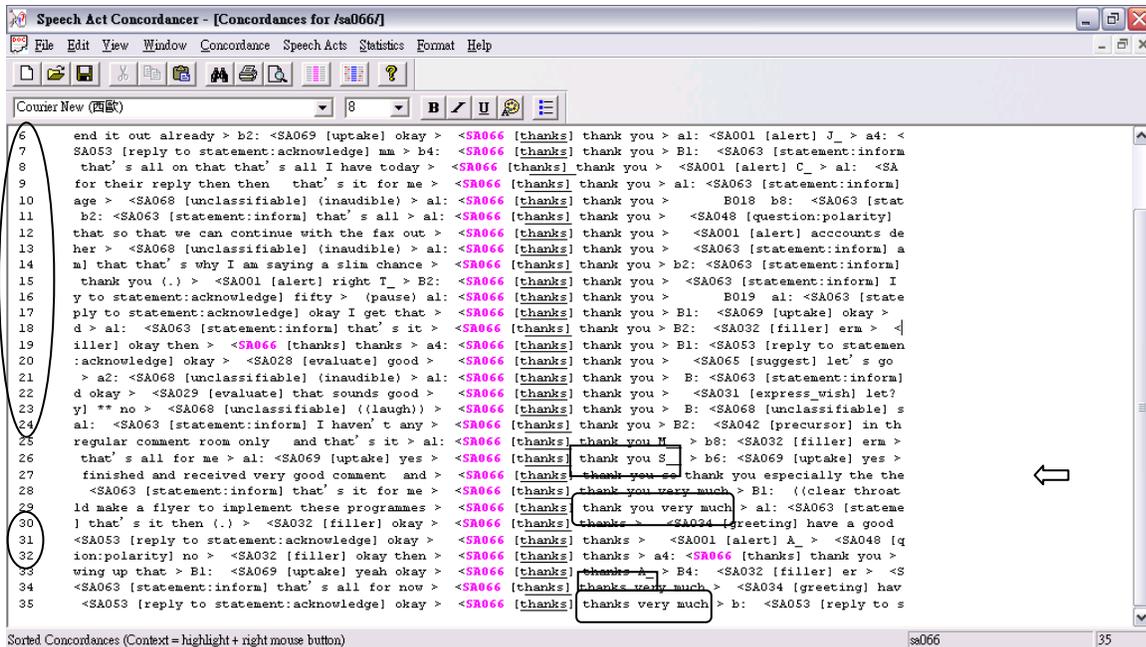


Figure 3: Concordances from [thanks] in business meetings

#### 4.4 Question 4: What are the possible implications for language teaching?

The above findings suggest that corpus evidence can contribute to ESP teaching in a number of important and productive areas, ranging from curriculum development to pedagogical practices. Teaching materials need to incorporate a more accurate and wider range of forms into their teaching material in order to better reflect the realities of actual language use, and so enhance learners' language awareness of the use of English in different contexts (Römer, 2009, 2011; Seto, 2009, 2011). The approaches of corpus-driven research and data-driven learning (Johns, 1991) are important for students to become language researchers through the application of corpus methods and strategies to investigate the linguistic features of naturally occurring English with reference to phraseology (Cheng, 2007).

This paper proposes a discourse-based approach to developing students' knowledge and ability in the appropriate use of the speech act in business meetings. Similar to the task-based learning approach, the discourse-based approach consists of three main stages, which are input exposure, students' production, and assessment (See, for example, Brown, 1994; Richards & Rogers, 2001; Ellis, 2003; Willis & Willis, 2007).

### *Input exposure*

The goal of the input exposure stage is to enhance students' awareness of the linguistic realizations of thanking in L2. Teachers' input to material writing and adaptation is crucial as their knowledge of the students in their classes allows them to judge and assess the appropriateness of the adapted and tailored material for their students. Frontline teachers and textbook writers could make use of corpus data to design tasks for students (Johns, 1991; Mindt, 1997; McCarthy, 1998; Meunier, 2002; Sinclair, 1991, 1997, 2001, 2004; Tognini-Bonelli, 1996, 2001; Tribble & Jones, 1990). These classroom activities can focus on the linguistic realizations of thanking in L2 with the use of corpus evidence.

Figure 4 shows some instances of *thank you very much* adapted from HKCSE (Cheng & Warren, 1999). These examples could be used as classroom activities in groups. After discussion, each group could share its findings with others to reflect on why they have sequenced the utterances. These tasks can be used to raise students' awareness of the linguistic features of the speech act of thanking in L2.

<b>Example 1</b>	<b>Example 2</b>	<b>Example 3</b>
b: may I have your signature once again please B: okay yeah b: alright here you go B: okay <b><i>thank you very much</i></b> b: no problem  (Source: Adapted from HKCSE [B001])	a: this is the lucky money for the Chinese New Year A: oh b: happy new year A: <b><i>thank you very much</i></b>  (Source: Adapted from HKCSE [B003])	b: did you took the min- from the mini-bar B: no b: just sign here sir B: okay b: <b><i>thank you very much</i></b>  (Source: Adapted from HKCSE [B006])

Figure 4: Examples of *thank you very much* in HKCSE

Teachers could extract examples from the corpus with specific genres when preparing learning materials so as to avoid the use of invented examples usually found in textbook material, such as *thanks a bunch* or *I can't thank you enough*, which are not very common realizations of the act of thanking (Aston, 1995; Eisenstein & Bodman, 1986; Herbert, 1986; Stenström, 1994). Other than emphasizing the linguistic realisations of the speech act of

thanking, textbook writers and frontline teachers can explicate others ways of expressing gratitude. While the use of modifiers or intensifiers is common to indicate the level of gratitude and formality, for example, *thank you very much* and *thanks so much*, the speech act of thanking can be complemented with another speech act, for example, *thank you for* [+the reason for thanking].

### *Student production*

After input exposure, a number of activities can be designed in the students' production stage. In this stage, students can pay more attention to the context of situation and the expressions learnt in the exposure stage to consolidate their socio-linguistic knowledge. Students could work in groups, make a list of linguistic realisations of thanking and check them against the corpus data. Then, students could prepare extracts of thanking and describe the linguistic realisations of thanking from the corpus data. They could then deduce from the communicative contexts in which the speech act is performed.

In another task, students can discuss and then select a situation from the corpus that expresses gratitude and perform through Readers' Theatre, which is originally a way for students to become excited and enthusiastic about reading when they are presented with the opportunity to participate in a performance (Trainin, G. & Andrezejczak, 2006). Through this activity, students have the opportunity to develop fluency and further enhance comprehension of what they are reading. The following, adapted from HKCSE could be a sample script for the role play (Figure 5):

b: Mister \_\_ is going to Japan Japan  
B: yeah  
b: **thank you for** your passport sir (.) er Mister \_\_ may I have er one hundred dollar for the airport tax please  
(pause)  
b: **thank you** (.) and Mister \_\_ do you have any check-in baggage  
B: no  
b: and you have a seat for you reserved is eighteen H it's aisle seat ok  
B: **thank you**

(Source: Adapted from HKCSE [B053])

Figure 5: Sample script for role play

More competent students could be asked to revise the scripts adapted from the corpus data and rewrite them to suit particular interactional contexts. For instance, teachers may ask students to develop the conversation further to achieve a particular outcome. Using the example in Figure 5, students could improvise how the conversation might go on after *thank you* uttered by B.

### *Assessment*

The goal of assessment is to check how efficiently students use the speech act of thanking for real-life communicative purposes (Cohen, 2004). The organisation and discussion activities presented above could be used in quizzes as continuous assessment (Figures 6 and 7).

<p><b>Speech act of thanking</b></p> <p>Identify the most appropriate (✓) and the least appropriate (✗) responses in the following situations:</p> <p>1. Your friend has bought you a drink from the school canteen. You would say:</p> <p>_____ thanks for buying me the drink. _____ thanks a bunch. _____ thanks. _____ many thanks.</p> <p>2. You are invited to give a talk in a company and would like to show gratitude for the invitation before the talk. You would say:</p> <p>_____ I thank you for inviting me to this talk. _____ thank you for inviting me to this talk _____ thank you ever so much for inviting me to this talk. _____ I can't thank you enough for inviting me to this talk</p>
--

Figure 6: Sample questions to test student's perception of speech act of thanking

### **Speech act of thanking**

Fill in the blank with an appropriate response of thanking.

1. You are in the classroom and your teacher has just given you back a quiz. What would you say?

\_\_\_\_\_

2. You asked your friend to buy you a book. You later knew that your friend had spent 5 hours looking for the book. When your friend gave you the book, what would you say?

\_\_\_\_\_

Figure 7: Sample questions to test student's production of speech act of thanking

The role-play activity presented could be audio-taped or video-recorded for self assessment or peer assessment. Teachers can also diagnose students' strengths and weaknesses, and particularly discuss possible inappropriate linguistic realizations of thanking after the role-play activity (Thomas, 1983; Sasaki, 1998). Teachers could assess the overall performance of the students with regard to the following factors on a scale of 1-5 (Cohen, 2004):

- Level of formality (given the age, status, and familiarity between the roles)
- Degree of politeness (given the importance of the event)
- Degree of directness (given the level of familiarity between the roles)
- Pragmalinguistic control (appropriateness of language structures used)
- Sociopragmatic control (appropriateness of speech act performed)
- Overall success of the speech act performance

## **5. Conclusion**

This paper first discusses the notions of speech acts and reviews the literature of the research-based methodological issues related to speech acts annotation. It then suggests the model of constructive alignment (Biggs, 1999) in the design, implementation and assessment of the learning and teaching of the pragmatic speech act. It also recommends the use of English language spoken corpora, such as the Hong Kong Corpus of Spoken English (Cheng & Warren, 1999), for real-life instances of particular speech acts for materials and tasks, and especially for

comparison with examples in the textbook literature, for example, functions of particular speech acts and linguistic patterns of their expressions.

The discourse-based approach is not merely restricted to interlanguage pragmatics; rather, it can be extended to different areas of language learning. Corpus data will continue to be important resources for materials writers, teachers and students for genuine English use in real-life situations. In order to better reflect the realities of actual language use, a wider range of both linguistic realizations and contextual functions of the speech act of thanking need to be incorporated into the instructional materials and tasks.

In ESP teaching, it is problematic to rely solely on the introspection or the intuition of teachers and textbook writers. More attention should be given to the daily use of language in the real world. Accordingly, corpus data would be a useful resource as it offers authentic material for not only learners but also teachers to more accurately understand the use of language in an ever-changing world.

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## **A Corpus-based Comparative Study of Semi-technical and Technical Vocabulary**

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### **Abstract**

This study is a corpus-based lexical study that is aimed at comparing semi-technical vocabulary and technical vocabulary to address the specific needs of undergraduates majoring in information engineering in mainland China through the study of bilingual specialized courses. A 1,024,882-word corpus of Information Engineering English Corpus (IEEC) was built using texts from ten specialized courses. Semi-technical and technical vocabulary items were profiled using West's (1953) General Service List and Coxhead's (2000) Academic Word List. A quantitative analysis was carried out to find the optimal frequency threshold for high-frequency academic/semi-technical and technical vocabulary specific to the discipline of Information Engineering. As a result, 248 semi-technical and 166 technical word families were extracted covering 9.16% and 4.95% of the total tokens of the corpus. The pilot study further explored the selected vocabulary of varying specificity in terms of their lexical features as well as collocations and found that there is a continuum rather than distinct boundaries between the GSL, discipline-specific academic and technical words when they are manipulated to serve specific purposes.

Pedagogical implications are that language instructors should take advantage of corpus linguistic expertise in the teaching of specialized English vocabulary.

**Keywords:** technical vocabulary, semi-technical vocabulary, corpus linguistics, information engineering

## 1. Introduction

For many students at the tertiary level who major in science, technology, engineering and mathematics (STEM) around the world, there has been a growing need for ESP/EAP courses in the past decade. At the same time, foreign language learners are typically conscious of the extent to which limitations in their vocabulary knowledge affect their communication skills since lexical items carry the basic information they wish to comprehend and express (Nation, 2001; Akbarian, 2010, p. 392). It is particularly true for science and engineering students whose major studies involve a significant number of specialized terms and concepts, theories and technologies either classical or emerging, indicating that a good command of English under technical, academic or mixed settings is required not only for the study of specialized courses (Lam, 2001; Pritchard & Nasr, 2004; Mudraya, 2006; Coxhead & Hirsh, 2007; Martínez, Beck & Panza, 2009; Ward, 2009; Kaewpet, 2009; Evans & Morrison, 2011; Csomay & Petrovic, 2012) but also to get prepared for their future professions in an increasingly internationalized working environment (Evans, 2010; Kassim & Ali, 2010; Handford & Matous, 2011). With the rapid development of information and communication technologies (ICT), vocabulary-related research has also echoed the technology advancements represented by the development of computerized corpora, corpus processing software and corpus-based research on educational theories and practices (Gardner, 2007) among many other innovations in computer-assisted language teaching and learning.

This study attempts to combine the needs of learners' vocabulary development in EAP/ESP programs and the strengths of technological tools and approach vocabulary issues under mixed academic and technical contexts at the tertiary level. Based on a case study specific to the discipline of information engineering for undergraduates in mainland China, it aims to seek a holistic way to determine learners' vocabulary threshold for varying specificity levels on a continuous spectrum from generally academic to highly technical. Quantitative and qualitative analyses are conducted to assist university language teachers to set explicit vocabulary

instructions priorities and evaluate the effectiveness to integrate subject content and vocabulary learning in general EAP courses and more discipline-specific ESP courses.

## **2. Literature review on corpus-based vocabulary studies**

When the vocabulary in a text is approached from the perspective of frequency and coverage, it typically falls into four main groups: high-frequency words, academic words, technical words and low frequency words (Nation, 2001). High-frequency words refer to the most commonly and widely used words and technical words involve words "recognizably specific to a particular topic, field or discipline" (Ibid, p. 198). The academic words refer to words resting somewhere in between, thus also called *semi-technical* or *sub-technical* words which will be used interchangeably in this article. These words are not salient in academic texts but perform an important role in the construction of the scientific experience (Coxhead, 2000). For example, the academic words allow writers to refer to others' work (*assume, establish, indicate, conclude, maintain*) and to work with data in academic way (*analyse, assess, concept, definition, establish, categories, seek*) (Nation, 2001, p. 18). The high frequency words and the academic words have been collected into West's (1953) General Service List (GSL) and Coxhead's (2000) Academic Word List (AWL) respectively and are considered useful for vocabulary teaching, course design and materials development (Martínez et al., 2009, p. 185). So far, the GSL is widely regarded as a foundation wordlist containing the most commonly used 2000 high-frequency words in general contexts. By comparison, Coxhead's AWL is more *specific* in nature and is generally regarded as the first successful attempt to adopt computerized corpus philosophy and methodology in compiling word lists of recurrent vocabulary in academic texts excluding the GSL (Li & Qian, 2010, p. 402).

The AWL is a list of 570 word families grouped into 10 sublists that are developed by using a 3.5 million-word written Academic Corpus covering 28 subject areas from four disciplines areas, arts, commerce, law and science (Coxhead, 2011, p. 355). The overall coverage of academic words in the Academic Corpus is 10.0%, but in terms of their coverage across disciplines, Coxhead (2000, p. 222) noted that the list appears to be slightly more advantageous for commerce as it covers 12.0% of the commerce subcorpus and the coverage of science is the lowest among the four disciplines at 9.1%. The notable gap in lexical coverage has led to a number of further studies that adopt the AWL as a reference wordlist for the verification of AWL

coverage in a wider range of disciplines or subject areas and different types of academic texts. For instance, recent corpus-based studies on the frequency and coverage of AWL in discipline-specific or genre-specific corpus consisting of data from applied linguistics research papers (Vongpumivitch, Huang & Chang, 2009) and financial texts (Li & Qian, 2010) reported the AWL coverage of 11.17% and 10.46% respectively. Similar studies in the field of science and technology have also been carried out focusing on academic words in medical and agricultural research articles and general university-level engineering textbooks (Chen & Ge, 2007; Martínez et al., 2009; Ward, 2009) with the AWL covering 10.073%, 9.06% and 11.3% of the corpus data investigated. Coxhead (2011, p. 357) indicated that it is safe to conclude over time that "the coverage figures of AWL over the various university-level corpora are consistently around 10%".

Behind the collectively confirmed findings, there have been discussions in the literature on the necessity of compiling adapted AWLs in specialized fields with an ESP orientation. This shift of focus is derived largely from two major concerns: the first is that the frequency-based rankings of individual academic words across different subject areas may not correspond with the ranking of Coxhead's AWL though collectively their coverage run stable; the second is that academic words may take on extended meanings under more specific contexts which makes Coxhead's AWL better for a general academic purposes than for more specific ones. For example, Hyland and Tse (2007, p. 235) examined the value of academic vocabulary by using Coxhead's AWL to explore the distribution of its 570 word families in a 3.3 million-word multi-discipline academic corpus. The results showed that only 35 out of the 60 most frequently used word families in their corpus coincided with Coxhead's Sublist 1 of AWL although its coverage (3.9%) was similar to that of the top 60 headwords in Coxhead's corpus (3.6%). In Martínez's genre-specific corpus containing 218 agricultural research articles, the number of overlapped top 60 items was just 26 (Martínez et al., 2009). In Hyland and Tse's words (2007, p. 240), "the fact that all disciplines shape words for their own uses seriously undermines attempts to describe a core academic vocabulary".

Therefore, as initiatives to explore academic vocabulary which take specificity into consideration, a number of discipline- or subject-specific wordlists of varying lengths have been developed recently. Wang et al. (2008) compiled a 623-word Medical Academic Word List (MAWL) based on the GSL and with reference to Coxhead's academic words selection criteria.

Wang's MAWL is about 10% longer than Coxhead's AWL for it includes a number of words beyond the AWL that meet the frequency criterion and are viewed by medical English experts as not strictly technical. Martínez et al. (2009) developed a highly restricted list from Coxhead's AWL consisting of 92 word families from a corpus of research articles of agriculture and identified some words from the AWL used with technical senses in their corpus. Some other wordlists were developed independently without taking any wordlists as the base list such as Ward's (2009) 112-word Basic Engineering List (BEL) compiled for less proficient foundation engineering undergraduates. In comparison with the wordlist development endeavors devoted to academic or semi-technical vocabulary, corpus-based studies of technical vocabulary are rather limited largely as the result of widely-held assumption that technical words are less accessible to language teachers due to their technicality and the development of technical vocabulary is usually set as part of the teaching objectives of content teachers in universities. However, as the name suggests, academic words being semi- or sub-technical can by no means be cut off from technical words and the gap between them tends to be blurred.

As Coxhead and Hirsh (2007, p. 66) noted in their pilot study to develop a science-specific word list, "EAP teachers often wonder whether they could better serve the needs of students heading into particular areas of study". With the aim to address the needs of first-year undergraduates for early specialization in EAP vocabulary programs, they developed a pilot science corpus covering 14 subject areas with 1.76 million running words. A 318-word pilot science word list was built neatly with a coverage of 3.79% on the basis of the GSL and AWL which contains frequent words used in university-level science texts beyond the reference word lists. The study also suggested that applying Chung & Nation's (2003) rating scale of technical words could validate the continued use of the first 2000 and AWL word lists for science students and provide insights into the nature of the word families in the pilot science word list. The scaling approach investigates technical words on 4 layers, i.e. words with a meaning with no particular relationship with the subject area; words connected to the subject area but only minimally; words closely related to a specific subject area that may not be technical terms in other fields with the same meaning; and words with a meaning specific to a certain field and clearly restricted usage. Two sample texts from applied linguistics and anatomy were used to demonstrate the scaling approach and it was suggested that "a much larger, representative corpus of a technical field would be needed to come near to listing a definitive technical vocabulary for

that field" (Chung and Nation, 2003, p. 114). In a recent corpus-based study on determining technical vocabulary, Kwary (2011) examined the merits and demerits of four methods including vocabulary classifications adopted in Coxhead and Hirsh's (2007) pilot study, keyword analysis, term extraction and systematic classifications. It can also be regarded as a comparative study of the strengths and weaknesses of corpus tools and analysis methodologies represented by the Range program (Nation and Heatley, 2007) for vocabulary classification, AntConc program (Anthony, 2010) for keyword analysis, TermoStat program (Drouin, 2011) for term extraction and ESP lexicographical methodologies for systematic classifications. A Study Session of 23,719 words from Chartered Financial Analyst textbook (CFA, 2008) was taken as a sample to compare the technical vocabulary obtained by running different programs or procedures and it is suggested that a hybrid method could be used to achieve an optimal selection of technical vocabulary which has yet to be verified with a much larger sized corpus.

In short, the development of specialized academic word lists and technical word lists has been carried out largely separately, leaving either component little touched instead of processing the two categories simultaneously. As a result, the length and specificity of an academic word list derived from a particular subject area can hardly be benchmarked without any reference to the technical vocabulary used frequently in the same field. Furthermore, statistics on the lexical coverage of both academic vocabulary and technical vocabulary in a single study can hardly be available on a concrete basis if it is targeted at one category only and relies on previous studies for estimated results of the other category. Therefore, this study attempts to adopt a holistic and dynamic approach in the development of specialized academic wordlist and technical wordlist and seek for an optimal balance between the length of wordlists and their coverage to facilitate language teachers' vocabulary instruction planning and priority setting for EAP/ESP programs.

### **3. Research questions and methodology**

This pilot study is a comparative lexical study based on an independently assembled corpus and it is designed to answer the following research questions:

- 1) Is it possible to develop word lists outside the GSL containing academic and technical words used with reasonable frequency in a discipline-specific corpus?

- 2) What are the sizes of the academic vocabulary and technical vocabulary like in each frequency band and at what point will the sizes be optimized to balance the coverage and the length of word list?
- 3) Are there better options for engineering students than starting with general English, followed by a focus on academic vocabulary and then moving on to specialized vocabulary? Is it possible to synchronize the latter two rather than tackle them in a linear way in EFL teaching contexts?
- 4) It is generally assumed that technical words are less accessible to language teachers due to their high degree of technicality. Is it truly the case for the discipline of information engineering? Can language teachers help learners in the acquisition of technical vocabulary?

To meet these ends, the Information Engineering English Corpus (IEEC) was developed based on English-language university-level textbook materials selected from ten compulsory courses in the discipline of information engineering, including *Programming Principle*, *Operating System*, *Information System*, *Computer Network*, *Computer Security*, *Data Structure and Algorithm*, *MySQL Database*, *Java*, *Artificial Intelligence* and *Cryptography*. Textbooks rather than a mixture of research articles, book reviews, textbooks, manuals and other academic genres were adopted based on the considerations that textbooks play a fundamental role in building undergraduates' academic English proficiency as a main source of language input, as opposed to research articles for researchers or manuals for professional engineers. In addition, whole texts were used in the compilation of the IEEC except the table of contents, figures, bibliographies, acknowledgements and appendices. The final IEEC is composed of 1,024,882 running words with about 15,000 word types.

The language data in IEEC were processed with Range program (Nation and Heatley, 2007) to profile words in the GSL, the AWL and the words beyond the two lists in the corpus ([www.vuw.ac.nz/lals/staff/paul-nation/RANGE32.zip](http://www.vuw.ac.nz/lals/staff/paul-nation/RANGE32.zip)) with output data containing the frequency, coverage and distribution of the words. Frequency and coverage criteria are prioritized in the development of word lists based on the fact that IEEC is a discipline-specific corpus indicating that students who take the course *Operating System* are also required to take the course *Data Structure & Algorithm*, for instance. As long as the potential word candidates

meet the threshold frequency requirement even with a heavy concentration in certain courses, i.e. low range or dispersion, learners are still expected to learn these words since their prominence in certain courses is highlighted to get their due attention.

Meanwhile, there are some items removed from the initial list including proper nouns (such as *America, Asia, Europe, Google, and Microsoft*), symbols (such as *Ni* and *Mk*), abbreviations (such as *etc*) and acronyms (such as *IP, LAN, MBPS, RSA* and *TCP*).

## 4. Results and discussion

### 4.1 Vocabulary profile in the IEEC as a whole and across sub-disciplines

Table 1 shows the overall coverage of tokens in the IEEC. The word list One and Two represent words covered by the first 1000 (K1) and the second 1000 (K2) words of the GSL (West, 1953). The word list Three represents the words of the AWL (Coxhead, 2000) which contains 570 families and Not in the lists represents the words outside the GSL and the AWL.

Table 1: Vocabulary profile in the IEEC as a whole

Word list	Tokens/ %	Types/ %	Families
One	768811/ 75.01	3162/ 20.7	973
Two	59246/ 5.78	1896/ 12.41	784
Three	106506/ 10.39	2251/ 14.74	564
Not in the lists	90319/ 8.81	7964/ 52.14	4968
Total	1024882	15273	7289

It can be seen that 564 word families in Coxhead's AWL are used in the IEEC and the AWL coverage of the tokens in the IEEC is 10.39% which falls in line with the coverage reported in the previous studies. The figure gives further evidence to the claim that the coverage of AWL over the academic corpora is consistently around 10% (Coxhead, 2011, p.357). As for the words beyond the GSL and the AWL, they constitute 8.81% of the total tokens of the IEEC. Generally, this group of words can be further classified into technical words and low-frequency words and the extraction of technical vocabulary is elaborated in the next section.

Table 2 shows the structure of 10 sub-corpora and vocabulary profile results for each sub-corpus. The highest coverage of the AWL words comes from *Computer Security* (16.18%), which is comparable to the coverage reported by Hyland and Tse (2007) in their sub-corpus of

computer science (16%). By contrast, the AWL words constitute only 7.98% of the tokens used in *Data Structure and Algorithm*. The sub-corpora of *Computer Network* and *MySQL Database* contain the highest proportions of vocabulary outside the GSL and the AWL, i.e. 13.25% and 12.72% of the vocabulary involves lexical items that are neither as conventional as the GSL words nor as academic as the AWL words, and very likely to be technical. In addition, courses like *Computer Security* and *Operating System* also show an increased use of technical vocabulary in addition to the need to develop an essential lexical repertoire for general academic purposes.

Table 2: Vocabulary profile across the 10 sub-disciplines of the IEEC

File No.	Code	Sub-discipline	Tokens	(Tokens) Coverage%		
				GSL	AWL	Beyond
1	PP	Programming Principle	65232	84.89	9.22	5.89
2	OS	Operating System	146719	80.92	10.97	8.11
3	IS	Information System	65802	79.66	12.57	7.77
4	CN	Computer Network	131170	74.48	12.27	13.25
5	CS	Computer Security	76972	75.12	16.18	8.69
6	DA	Data Structure & Algorithm	136756	87.48	7.98	4.54
7	MD	MySQL Database	172635	78.90	8.38	12.72
8	JV	Java	99252	82.79	9.66	7.55
9	AI	Artificial Intelligence	68649	81.72	10.64	7.64
10	Cr	Cryptography	61695	84.13	8.60	7.27
		Total	1024882	80.79	10.39	8.81

## 4.2 Frequency-based analysis on discipline-specific academic and technical words

The previous section gives an overview of the vocabulary profile in the IEEC as a whole and its individual sub-corpora, and more detailed data reflecting word behaviors in consecutive frequency bands are required in order to seek solid answers to the first two research questions, i.e. whether it is possible to 1) develop academic and technical word lists containing lexical items occurring with reasonable frequencies and 2) strike a meaningful balance between coverage and length of these wordlists. Table 3 shows the frequencies of the AWL word families in the IEEC across different frequency bands and Table 4 shows the frequencies of word families outside the GSL and AWL in the same corpus.

Table 3: Frequencies of word families of the AWL in the IEEC

Frequency	Tokens	Families	Coverage %	
			Tokens	Cumulative tokens
≥3000	6885	2	6.46	6.46
1000-2999	18788	13	17.64	24.10
200-999	54350	136	51.03	75.13
100-199	13913	97	13.06	88.19
50-99	7967	110	7.48	95.67
20-49	3615	109	3.39	99.06
1-19	988	97	0.93	99.99

Table 4: Frequencies of word families outside the GSL and AWL in the IEEC

Frequency	Tokens	Families	Coverage %	
			Tokens	Cumulative tokens
≥1000	8499	5	9.41	9.41
500-999	13506	20	14.95	24.36
200-499	14934	46	16.53	40.89
100-199	13911	95	15.40	56.29
50-99	10841	152	12.00	68.29
20-49	12399	398	13.73	82.02
1-19	16299	4252	17.97	99.99

As shown in Table 3, there are two academic word families occurring over 3000 times in the IEEC and accounting for 6.46% of the total academic tokens. Specifically, the top 2 AWL word families in the IEEC are *data* and *compute*. The headword *data* is not inflectional and for the headword *compute*, the most preferred word types were *computer(s)* with 2325 occurrences; *compute* was used much less frequently (198 times) and *computable* was extremely uncommon since it occurred only 8 times. By contrast, it can be seen that at the bottom of the list, there are 206 word families used with frequencies below 49 and covered only 4.32% of the academic tokens, or 0.45% of the total tokens in the IEEC. In a one-million-word corpus, the probability to encounter these words with reasonable repetitions may be very slim.

To take the sub-corpus *Operation System* as a specific example, the most frequently used academic headword *file* and its family members *files*, *filed* and *filing* were used 901 times. It was also found that 53 word family members were used only once including *contract*, *fund*, *license* and *fee* which are very likely to be encountered frequently in finance-related texts or legal texts. Therefore, it is of limited use to discuss word lists and word use frequencies without adequate

consideration being given to the settings the texts are supposed to fit in and the language communities formed to distinguish one from another.

When it comes to the words outside the GSL and the AWL, 5 word families (*query*, *packet*, *algorithm*, *server* and *node*) were used more than 1000 times covering 9.41% of the total in this category and it can be seen that the coverage of words in each frequency band did not show a strong declining trend along with the drop of frequencies as reflected in the case for the AWL words in Table 3. However, when the number of word families each frequency band covers is taken into account, especially when there are over 4000 words used fewer than 19 times in a one-million-word corpus, obviously a large portion of words in the table should be categorized as low frequency words. As discussed earlier, it may not be a simple matter to draw a clear boundary between technical words and low-frequency words. In this pilot study it was achieved by filtering out low-frequency words first and then technical words were reviewed and checked instead of vice versa. It is very much based on the philosophy of corpus linguistics that word selections in language use are probabilistic in essence, so regardless of any possible degree of technicality of a word may concern, extremely low frequency of word use indicates that even if it is technical, it would be very rare and may not deserve to be included into the regular and prioritized teaching and learning agenda. Since this type of word only shows up very occasionally, it is suggested that they could be acquired also through autonomous learning. Here are some sample words with technical senses in the IEEC with occurrences below 20 times like *codec*, *bitwise*, *intranet*, *multitasking*, *bluetooth*, *genome*, *mouseevent*, *bitmap*, *semaphore*, *metadata*, *spinlock*, *debug*, *timestamp*, and it is interesting to note that almost all of them are compound words consisting of stems from the GSL or derivatives that can be acquired without much conscious effort by applying existing knowledge regarding English word-formations. Therefore, in the attempts to extract frequent academic and technical vocabulary in the IEEC, narrowing down targeted frequency width should be the first step in the development of word lists with optimal length and desirable coverage balanced.

### **4.3 Frequent AWL and technical word list (TWL) in the IEEC**

In the previous studies on AWL-related corpora, there are two methodologies widely adopted to extract frequent AWL. In the compilation of Coxhead's AWL itself, word families to be included in the AWL had to follow three other principles in addition to the key principle that excluded

words in GSL, i.e. with occurrences of 100 times or more in the Academic Corpus (*frequency*), in 15 or more of the total 28 subject areas (*range*) and over 10 times in the each of the four disciplines of the corpus (*uniformity*) (Coxhead, 2000; 2011). Some subsequent studies adopted the same frequency criterion in proportion to the size of their own corpus (Vongpumivitch, et al., 2009; Wang & Ge, 2008). This means the threshold for frequent academic words in a 1 million-word corpus would be set at about 30, given that Coxhead's criterion for overall frequency was 100 occurrences in a 3.5 million-word corpus. This prescribed frequency criterion was also adopted in Coxhead and Hirsh's compilation of a science-specific word list (2007) and the frequency threshold was set at 50 for a 1.76 million-word scientific corpus. If the criterion is applied to the IEEC, the frequency of 30 falls in the range of 20-49 (see Table 3) and the coverage of the academic tokens (3.39%) may suggest that the threshold is relatively too low to define a *frequent* academic word in the IEEC. The second methodology was proposed by Hyland and Tse (2007, p. 240) as "a more rigorous standard". Words could be identified as *frequent* if "they occurred above the mean for all AWL items in the corpus". Such a standard remarkably reduced the number of frequent academic word families to 192 in Hyland and Tse's study (2007) and 92 in Martínez's study (2009). If the strict criterion is adopted, the threshold for frequent AWL words in the IEEC would be 189 and 156 word families above this frequency can be obtained covering 76.04% of the total academic tokens. The list thus obtained contains frequently occurring words, but it fails to cover about 24% of the academic words or  $24\% \times 10.39\% = 2.5\%$  of the total.

According to Laufer and Ravenhorst-Kalovski (2010:16), effective and efficient comprehension would only occur with adequate lexical coverage and the availability of sight vocabulary of a reasonable size and their statistics showed that a probabilistic 95% of threshold lexical coverage is required for a standard of minimally acceptable comprehension and for adequate comprehension to be achieved the lexical coverage is supposed to reach 98% and above (Ibid; Hu & Nation, 2000). By observing the discipline-specific academic words and technical words separately as well as in a holistic way, this pilot study attempted to seek an optimal frequency threshold so that a more meaningful overall coverage could be obtained instead of predicting learners' vocabulary gap merely on the basis of AWL coverage data of varying wordlist lengths as discussed above.

It was found in the IEEC when threshold frequency is set at 100 for IE-specific frequent academic and technical words, which is in between 30, based on Coxhead's criterion, and 189, based on Hyland and Tse's criterion, the selected target words plus the GSL words covered 94.9% of the total tokens in the IEEC which is very close to the threshold lexical coverage for minimally acceptable comprehension. Table 5 shows the specific data in terms of the number of families, types, tokens and coverage of words under the three broad categories in the corpus. The complete IE-specific AWL and TWL can be found in Appendices A and B, and Table 6 lists the top 30 academic and technical headwords in the IEEC.

As seen in Table 5, the IE-specific AWL contains 248 academic headwords which is shortened by more than half compared with Coxhead's 570-word AWL and it is not achieved at the cost of shrinking lexical coverage. Specifically, they covered 88.19% of all the academic tokens in the IEEC. By setting the threshold frequency, the number of frequent technical headwords was also narrowed down to 166 from an extremely large pool of more than 4000 word families outside the GSL and AWL and their coverage stayed at 4.95%. This result provides concrete evidence to support previous studies on academic vocabulary which indicated technical vocabulary may cover up to about 5% of the running words in academic texts (Hyland & Tse, 2007). Above all, by giving a dynamic view to the threshold frequency based on lexical coverage in consecutive frequency bands instead of attaching prescribed frequency standards, the selection of frequent words could be better adapted to a specific corpus with optimized results.

Table 5: Vocabulary profile of the GSL, frequent AWL and TWL in the IEEC

Word list	Families	Types	Tokens	Coverage %
GSL	1757	5058	828057	80.79
AWL ( $f \geq 100$ )	248	683	93936	9.16
TWL ( $f \geq 100$ )	166	726	50850	4.95
Total	2171	6467	972843	94.9

Table 6: Top 30 academic headwords and technical headwords in the IEEC

N	Academic Headword	Freq.	Technical Headword	Freq.	N	Academic Headword	Freq.	Technical Headword	Freq.
1	data	3723	query	1928	16	create	887	binary	636
2	compute	3162	packet	1736	17	protocol	883	database	636
3	process	1965	algorithm	1670	18	section	870	encrypt	630
4	secure	1810	server	1668	19	code	865	integer	608
5	network	1787	node	1497	20	link	855	segment	599
6	file	1756	transaction	980	21	input	809	switch	581
7	access	1573	execute	852	22	structure	794	web	568
8	method	1516	cache	809	23	implement	775	column	561
9	function	1304	disk	768	24	assume	740	internet	512
10	vary	1265	storage	768	25	proceed	698	queue	506
11	index	1264	graph	761	26	output	675	byte	495
12	require	1259	router	739	27	random	660	update	495
13	define	1089	optimize	672	28	element	648	replicate	493
14	transmit	1007	array	661	29	route	640	adversary	487
15	design	977	software	659	30	available	623	configure	486

#### 4.4 Major findings on IE-specific AWL and TWL comparison

The first major finding when comparing the IE-specific AWL and TWL is that although the coverage of frequent academic words (9.16%) almost doubled that of frequent technical words (4.95%), the average number of family members these headwords have in the IEEC showed a reverse trend. There are 12 technical headwords in the IEEC with more than 10 word family members. By contrast, the number of academic headwords using the same criteria is zero. On average, academic headwords in the IEEC have 2.7 family members and technical headwords have 4.2 members for each family. Figure 1 gives three examples of word families from IE-specific Technical Wordlist. Among these, the headword *process* overlapped with the same word family in Coxhead's AWL but with different derivatives. In Coxhead's AWL, *process* has 4 family members, i.e. *process* as the base word and *processed*, *processes* and *processing* are its inflectional forms. By comparison, in the IE-specific Technical Wordlist, the headword *process* consists of 15 members with prefixes and suffixes *uni-*, *dual-*, *inter-*, *micro-*, *multi-*, *per-*, *post-*, *pre-*, *-or* and inflectional suffixes *-ed*, *-es*, and *-ing* added to these base words. It can be seen that *process* in the technical wordlist is used from a more technical perspective so the series of actions referred to as *process* can be described and dealt with in a more scientific manner. This finding may also lead to the question under discussion as to whether the development of subject-specific vocabulary lists should be "started from scratch" (Coxhead, 2011, p. 357) without any base wordlists. In other words, whether words like *process* should be listed separately in the AWL and TWL or in a new all-inclusive subject-specific wordlist. In this study, it is suggested

that the same word families with forms other than those covered by Coxhead's AWL should be treated as technical words as well. They are good examples to illustrate the continuity of lexical properties transferring from being generally academic or semi-technical to strictly technical.

authenticate	configure	process
<i>authenticated</i>	<i>configuration</i>	<i>processor</i>
<i>authenticates</i>	<i>configurations</i>	<i>uniprocessor</i>
<i>authenticating</i>	<i>configurable</i>	<i>dualprocessor</i>
<i>authentic</i>	<i>configured</i>	<i>interprocess</i>
<i>authentication</i>	<i>configures</i>	<i>microprocessor</i>
<i>authenticator</i>	<i>configuring</i>	<i>microprocessors</i>
<i>authenticity</i>	<i>misconfigured</i>	<i>multiprocessor</i>
<i>inauthentic</i>	<i>misconfiguring</i>	<i>perprocess</i>
<i>unauthentic</i>	<i>misconfiguration</i>	<i>perprocessor</i>
	<i>misconfigurations</i>	<i>postprocessing</i>
	<i>preconfigured</i>	<i>preprocess</i>
	<i>reconfigure</i>	<i>preprocessed</i>
	<i>reconfiguration</i>	<i>preprocesses</i>
	<i>reconfiguring</i>	<i>preprocessing</i>
		<i>preprocessor</i>

Figure 1: Three examples of word families from IE-specific Technical Wordlist

It was also found that the boundary between technical and academic or semi-technical vocabulary in specialized texts may not be distinct. Semi-technical words can often be used with either a technical sense or non-technical sense. As pointed out by Hyland and Tse (2007, p. 245-246), "all disciplines adapt words to their own ends, displaying considerable creativity in both shaping words and combining them with others to convey specific, theory-laden meaning associated with disciplinary models and concepts." For instance, the word *global* as the most preferred type in the IEEC under the head word *globe* from the AWL is used very frequently with a technical sense "in pertinence to an entire document, file, or program rather than to a restricted segment of it" when the word is also used to refer to "the whole world" in a general sense. The following examples are from the original texts in the IEEC:

- (1) Since e-commerce supports **global** business transactions, it presents the challenge of customising web sites to appeal to people of different nationalities and cultures. (IEEC-CN)
- (2) Although a **global** network like the Internet consists of many autonomous domains, there is a need for standards that prevent the network from becoming fragmented into many non- interoperable pieces. (IEEC-CN)

- (3) Clients are considered as data producers that need to update the consumers by effectively and efficiently employing **global** resources. (IEEC-DA)
- (4) Both local and **global** replacement policies may be confronted with a situation where the total size of the processes' working sets exceeds the number of page frames available. (IEEC-OS)
- (5) MySQL 4.0 and earlier used a **global** setting for the entire server, and you could choose from among several 8-bit character sets. (IEEC-MD)
- (6) Any settings you decide to use permanently should go into the **global** configuration file, instead of being specified at the command line. (IEEC-MD)

In the first three examples, *global* is used to put *business transactions*, *network* and *resources* in a the larger context of the whole world. The latter three examples show how *global* is combined with words like *replacement*, *setting*, *configuration*, and other words such as *variable*, *operation*, *configuration*, *search* can also co-occur with *global* in IT contexts where it is used technically. It is noteworthy that the general lexical meaning can be mapped into technical contexts in many cases in the field of information engineering, which may result from the fact that information technology deals with a virtual world and many words are used metaphorically. For another example, the word *layer* generally means "a thickness of some material laid on or spread over a surface", and technically it refers to "the protocol operating at a particular level within a protocol suite" as used in frequent technical collocations in the IEEC like *layer protocol*, *network layer*, *physical layer*, *application layer* and *layer header*.

Therefore, in view of the third research questions as to whether it is possible for undergraduates to synchronize the acquisition of academic and specialized vocabulary rather than tackle them in a linear way in EFL teaching context, the findings on the continuity of variation of lexical meaning give concrete evidence that it is not only possible but also necessary to synchronize them to motivate students if they can feel language learning is better-targeted to their major study and language is not learnt just for its own sake. By using the academic word *access* as an example, Figure 2 shows how the technicality of semi-technical words is realized in specialized texts, especially when their collocations are observed. When *access* is used with modifiers from GSL like *direct*, *efficient* or *fast*, *public* or *secret*, the collocations can be used either for general purposes and technical ones. Collocations such as *memory access*, *read* and *write access* are predominantly used in technical contexts. For example:

- (7) There is an integral garage from which you can gain **direct access** to the cellar. (BNC)
- (8) The database administrator may not always have **direct access** to domain name server. (IEEC-MD)

- (9) The Net Book Agreement allows some relaxation on the matter of discount to libraries that give **public access**. (BNC)
- (10) In general, it is safe to say that when a system is made available for **public access**, the risk to the system increases -- and often the constraints on its use are tightened. (IEEC-CS)
- (11) For example, an organization may give authorized individuals **write access** to an application at any time from within the office but only **read access** during normal working hours if they dial-in. (IEEC-CS)

As shown in the above examples, technicality is not strictly confined to the use of technical vocabulary. Collocations made up of GSL and AWL words can also function as technical terms in specialized context. As the GSL is generally taken as the threshold vocabulary of undergraduates in their college English learning, it would be relatively easy for these words to be adapted for technical purposes. To take it a step further, when *access* co-occur with other academic words like *arbitrary*, *discretionary*, *distributed*, *exclusive* or *sequential* among other examples in Figure 2, the processing loads will be upgraded not only because the average length of the words is longer than the GSL words but also because the meaning conveyed is more complicated and abstract with mixed academic and technical flavor. It is argued here that at this stage the teaching and learning of EAP and ESP can be blended to achieve better and more lasting effects for learners' major studies. For instance, when *appropriate* was searched for in the BNC, the results showed that 11418 occurrences were found. However, only 8 of them were used in the collocation *appropriate access* and 6 out of the 8 concordance lines were from computer science and technology texts. To a certain extent, *appropriate* can be regarded as a signature collocate of *access* in the field of information technology. Language teachers could use corpus tools to explore these findings which they may not be aware of. If we go another step further to see frequently-used collocations combining technical words with *access*, the technical words turn out to be more obvious as they immediately stand out as being technological in meaning. For example, *array*, *cache*, *broadband*, *database*, *disk*, *hardware*, *Internet* are all discipline-specific and as these words tend to be the focus of classroom instructions and discussions and the acquisition of these words tends to be informal rather than explicitly taught. There are also words like *compliant*, *legitimate*, and *mandatory* etc. in the *TWL + access* pattern. However, these words are less frequently used and not in the frequent technical wordlist extracted in the study. Instead, collocations using academic words such as *legal access*, *illegal access*, *compulsory access* were used as more accessible alternatives in the IEEC.

Pattern	Frequent collocation forms		
GSL + <i>access</i>	direct <i>access</i> ; efficient <i>access</i> ; fast <i>access</i> free <i>access</i> ;	memory <i>access</i> ; public <i>access</i> ; read <i>access</i> ;	recent <i>access</i> ; secret <i>access</i> ; write <i>access</i> .
AWL + <i>access</i>	appropriate* <i>access</i> ; arbitrary <i>access</i> ; data* <i>access</i> ; discretionary <i>access</i> ; distributed* <i>access</i> ;	exclusive* <i>access</i> ; external* <i>access</i> ; file* <i>access</i> ; functional* <i>access</i> ; illegal* <i>access</i> ;	initial* <i>access</i> ; physical* <i>access</i> ; random* <i>access</i> ; restricted* <i>access</i> ; sequential* <i>access</i> .
TWL + <i>access</i>	array* <i>access</i> ; authorized* <i>access</i> ; cache* <i>access</i> ; compliant <i>access</i> ; broadband <i>access</i> ;	database* <i>access</i> ; disk* <i>access</i> ; hardware* <i>access</i> ; internet* <i>access</i> ; legitimate <i>access</i> ;	mandatory <i>access</i> ; modulated* <i>access</i> ; optimal* <i>access</i> ; remote* <i>access</i> .

Modifiers marked by \* occur as family members of headwords in IE-specific AWL and TWL in Appendix A and B.

Figure 2: Frequent collocation forms containing the semi-technical word *access* used as noun

## 5. Pedagogical implications

At this point, we need to critically reflect on the general assumption that technical words are less accessible to language teachers due to their high degree of technicality and the last research question: is it truly the case for the discipline of information engineering and how can language teachers facilitate learners' acquisition of technical words in the EAP/ESP programs they take? As the above findings indicate, technicality on the lexical level is not simply achieved by using specialized vocabulary. More often than not, it is conveyed by multiple combinations of words that can be general, academic or adaptations and expansions based on one's previous lexical knowledge. Therefore, if academic words in specific contexts are measured strictly quantitatively, their technicality can be a variable correlated with the nature of adjacent words they collocate with and may be manifested as either semi-technical or one with a higher-or-lower sense of technicality. Take the academic word *job* as an example, when it is used in its singular form, it is frequently found in the IEEC collocating with *description*, *function*, *categories* and *responsibilities*. By contrast, when it is used in its plural form in the corpus, it becomes more technical and occurs in terms such as *batch jobs*, *rescheduled jobs*, *periodic jobs*, *purge jobs*, *maintenance jobs*, *cron jobs*, and *archive jobs*. The way a corpus can help language teachers in vocabulary teaching is to offer an efficient and effective tool to observe the behaviors of individual words and groups of words as collocations or colligations. For instance, typical collocates of *strategy* in the IEEC include *heuristic strategy*, *allocation strategy*, *divide-and-*

*conquer strategy* and *greedy strategy* which refers to an algorithm for a global optimum in problem solving, whereas *strategy* was used frequently with *market* in business texts, *learning* in applied linguistics, *coping* in sociology, and *control* or *management* in agriculture (Hyland & Tse, 2007; Wang & Nation, 2004; Martínez et al., 2009).

Figure 3 contains a 211-word sample text from the sub-corpus *Computer Network*. In this text, the GSL words cover 68.26% of the total, and the coverage of the academic words and technical words are 15.16% and 10.42%. Although both academic words and technical words reach a double-digit percentage of coverage, the range of word selections and frequencies shows a strong disparity. Specifically, the text covers 24 academic headwords with 32 occurrences which means each headword is used only 1.33 times on average. It also suggests that a clear, accurate and detailed definition and explanation of a technical mechanism (Transmission Control Protocol in this example) may involve a rich variety of academic words. By contrast, there are 7 technical headwords with 22 occurrences in this sample text indicating that technical words are used more repeatedly than academic words in theme-based texts. Therefore, AWL should still be important in undergraduates' vocabulary learning in both EAP and ESP programs. The IE-specific frequent AWL and TWL successfully cover 20 academic headwords and all the technical headwords used in the sample text, which can also be regarded as a satisfactory verification of effectiveness of the two wordlists of moderate lengths.

The *TCP* service model provides a **communication abstraction** that is **reliable**, ordered, point-to-point, **duplex**, **byte-stream**, and flow and **congestion** controlled. *TCP's notion* of “**duplex**” is that the same **logical** connection handles **reliable data** delivery in both directions. Unlike *ARQ protocols* described in *Section 1.3*, which treat **data packets** as **atomic** units, *TCP* treats **bytes** as the **fundamental** unit of **reliability**.

*TCP* sender uses the received **cumulative acknowledgments** to determine which **packets** have reached the receiver, and provides **reliability** by **retransmitting** lost **packets**. The sender **detects** the loss of a **packet** either by the arrival of several **duplicate acknowledgments** or the **expiration** of the **timeout timer** due to the absence of an **acknowledgment** for the **packet**. To **accurately** set the **timeout interval**, the sender **maintains** a running average of the **estimated** round-trip delay and the mean **linear deviation** from it. The **timeout interval** is calculated as the **sum** of the smoothed round-trip delay **plus** four times its mean **deviation**. *TCP reacts* to **packet** losses by decreasing its **transmission (congestion)** window size before **retransmitting packets**, **initiating congestion** control or avoidance **mechanisms** (e.g., slow start), and backing off its **retransmission timer** (*Karn's algorithm*). These actions result in a reduction in the load on the **intermediate links**, **thereby** controlling the **congestion** in the **network**.

Figure 3: Sample text from sub-corpus Computer Network in the IEEC

The GSL words are in normal font; the AWL words (semi-technical) in bold and italics; technical words in bold; low-frequency words and acronyms in italics.

There is a common concern among ESP teachers as to what role we should play in connecting language findings and content knowledge of a specialized field and to what extent we should be familiar ourselves with specific subject, disciplines or professions (Chung & Nation, 2003; Coxhead & Hirsh, 2007; Kwary, 2011). This paper attempts to shed some light on this question and we believe that language teachers can be a special contributor in constructing learners' ESP experience and knowledge by positioning ourselves as a reliable source of linguistic knowledge to promote their own major studies. Some language teachers avoid specialized language materials for fear that they may not be able to handle the terms, concepts, principles, processes etc. well enough as content knowledge. There is no doubt that ESP teachers should build up an adequate amount of knowledge of specialized fields to be able to select appropriate teaching materials, process and organize them and most important of all, evaluate them against the language learning objectives of students. However, language teachers are not supposed to serve the role to instruct on the technical content itself. Content materials like the sample text in Figure 3 creates a greater linguistic sense rather than a purely technical one to language teachers who should take advantage of their linguistic expertise to help engineering students increase their cognitive awareness level in content-language integrated learning. Another piece of evidence to validate language teachers' role in the language programs for science and engineering students lies in the great dynamics and versatility of academic vocabulary in their technical reading materials indicating that language teachers, especially EAP teachers, have unique strengths in connecting language used for general academic purposes and technical purposes and then making them strategically integrated. To fulfill this end, language teachers need to make timely adaptations in their vocabulary teaching design, especially in the fast evolving discipline of information engineering, have access to authentic texts which provide meaningful contexts for the transition from EAP to ESP teaching and learning.

## **6. Conclusion**

This study was designed to examine the possibilities of developing discipline-specific academic word lists and technical word lists based on corpus linguistics methodologies and explore the

differences and connections between the two types of words by conducting a comparative study. A one-million-word Information Engineering English Corpus (IEEC) was compiled as the subject of research and 248 academic headwords and 166 technical headwords were obtained and compiled into the frequent IE-specific AWL and TWL in the IEEC with 1409 family members covering 14.11% of the total tokens of the corpus. Upon mastering the first 2000 words contained in West's General Service List and the specialized AWL and TWL, students majoring in information engineering should be able to develop a lexical repertoire covering about 95% of the running words they encounter in their textbooks for specialized courses. Compared with Coxhead's AWL, the length of IE-specific AWL was shortened by more than half with only a minor loss of coverage of about 1.23%. The 166-word IE-specific TWL is also of a manageable length for language teachers and material designers to use and help them to set their priorities. The study also explored the technical use of GSL, AWL and TWL words in the field of information engineering. The results suggest that technicality is not simply defined by the term "technical words". There is a scale of continuity instead between the GSL, AWL and TWL in terms of the technical uses of lexical items. Some technical words are based on basic stems from GSL and AWL but usually display more morphological variations to assume more sophisticated technical roles. Furthermore, the degree of technicality of GSL and AWL words can be more fully manifested in technical discourses especially when collocation and other recurrent patterns are observed. It is suggested that the discipline-specific AWL and TWL function as guidelines for language teachers to better integrate English teaching into students' major study and endeavors should also be made in classroom topic and texts selection, task design and activity organizations to provide students with meaningful contexts to get concrete access to the use of language in their specialized field of study and adequate language input to activate real learning. In this process, corpora can serve as rich resources of authentic language materials. To further validate the research findings, it is expected that future research could be carried out on a larger scale and laterally across different subjects within a certain discipline. The development of specialized corpora could also target university students at different levels to better meet their language learning objectives at different stages of study or different groups of professionals to help them shape their own lexical repertoire that is essential to fulfill their responsibilities more effectively.

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## Appendix A

### Headwords of the frequent academic wordlist in the IEEC

abstract	concept	evaluate	interval	potential	somewhat
access	concurrent	exclude	invoke	precede	source
accurate	considerable	expert	involve	precise	specific
achieve	consist	explicit	isolate	predict	specify
acknowledge	constant	external	issue	previous	statistic
acquire	constrain	facilitate	item	primary	status
adjust	construct	factor	job	prime	strategy
administrate	consume	feature	label	principle	structure
affect	context	file	layer	priority	subsequent
aggregate	convert	final	legal	proceed	sufficient
allocate	coordinate	finite	link	process	sum
alter	correspond	focus	locate	project	summary
alternative	create	format	logic	protocol	symbol
analyse	cycle	formula	maintain	publish	task
approach	data	function	major	quote	team
appropriate	define	generate	manual	random	technical
approximate	denote	globe	maximise	range	technique
area	derive	goal	mechanism	recover	technology
aspect	design	guarantee	medium	region	temporary
assess	detect	hence	method	relevant	terminate
assign	device	hierarchy	minimum	rely	text
assume	dimension	hypothesis	mode	remove	theory
assure	display	identify	modify	require	topic
attribute	distinct	ignorant	monitor	research	tradition
automate	distribute	illustrate	negate	resource	transfer
available	document	impact	network	respond	transform
aware	domain	implement	normal	restore	transit
benefit	dynamic	incidence	notion	restrict	transmit
brief	edit	index	obtain	reverse	trigger
capable	element	indicate	obvious	role	underlie
capacity	eliminate	individual	occur	route	unique

category	emphasis	initial	option	scenario	utilise
challenge	enable	input	output	schedule	valid
channel	ensure	insert	overall	scheme	vary
chapter	entity	instance	parameter	section	version
clause	environment	instruct	period	secure	via
code	equate	integrate	persist	select	virtual
commit	equip	intelligence	phase	sequence	whereas
communicate	equivalent	interact	physical	significant	
complex	error	intermediate	plus	similar	
component	establish	internal	policy	simulate	
compute	estimate	interpret	positive	site	

## Appendix B

### Headwords of the frequent technical word list in the IEEC

accomplish	column	flush	matrix	recall	subproblem
adversary	compute	forward	merge	recurse	subset
algorithm	concur	fragment	middleware	redundant	subtree
architect	configure	generalize	mod	reference	swap
arithmetic	congestion	generator	modulo	remote	switch
array	contingency	graph	multicast	replicate	symmetric
atom	corrupt	hardware	mutex	retransmit	synchronize
audit	cryptography	hash	node	retrieve	tag
authenticate	database	header	notation	rewrite	technology
authorize	datagram	height	online	router	theorem
backup	deadlock	hop	optimize	routine	throughput
bandwidth	default	identifier	oracle	scale	token
benchmark	delete	increment	overhead	scan	traffic
binary	destination	initial	packet	scheduler	trail
blockcipher	diagram	install	partition	segment	transaction
browse	digit	integer	password	serial	update
buffer	directive	interface	personnel	server	usage
bug	directory	internet	polynomial	session	vector
byte	disk	iterate	port	shard	verify
cache	duplicate	kernel	prefix	simultaneous	vertex
cell	efficiently	legacy	primitive	skip	video
chess	electronic	linear	process	smart	virus
chunk	encode	literal	profile	snapshot	vulnerability
ciphertext	encrypt	log	programmer	software	web
circuit	ethernet	lookup	quantum	sophisticated	wireless
client	execute	loop	query	span	workload
cluster	exponent	map	queue	stack	
collision	feasible	mathematics	raid	storage	

