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A corpus-based study of mandative subjunctive triggers in published research articles

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A corpus-based study of mandative subjunctive triggers in published research articles

by

Pamela Jo Pearson

A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

Major: Teaching English as a Second Language/Applied Linguistics
(English for Specific Purposes) and (Literacy in English as a Second Language)

Program of Study Committee:
Viviana Cortes, Major Professor
Barbara Schwarte
Dawn Bratsch-Prince

Iowa State University
Ames, Iowa
2007

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<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AmE</td>
<td>American English</td>
</tr>
<tr>
<td>AL</td>
<td>Applied linguistics</td>
</tr>
<tr>
<td>BrE</td>
<td>British English</td>
</tr>
<tr>
<td>DDL</td>
<td>Data-driven learning</td>
</tr>
<tr>
<td>EAP</td>
<td>English for academic purposes</td>
</tr>
<tr>
<td>ISURAC</td>
<td>Iowa State University Research Article Corpus</td>
</tr>
<tr>
<td>KWIC</td>
<td>Key word in context</td>
</tr>
<tr>
<td>MS</td>
<td>Mandative subjunctive</td>
</tr>
<tr>
<td>MST</td>
<td>Mandative subjunctive trigger</td>
</tr>
<tr>
<td>SLA</td>
<td>Second language acquisition</td>
</tr>
<tr>
<td>Ani Sci</td>
<td>Animal Science</td>
</tr>
<tr>
<td>App Ling</td>
<td>Applied Linguistics</td>
</tr>
<tr>
<td>Arch</td>
<td>Architecture</td>
</tr>
<tr>
<td>Art &amp; Des</td>
<td>Art and Design</td>
</tr>
<tr>
<td>Bio</td>
<td>Biology</td>
</tr>
<tr>
<td>Bus</td>
<td>Business</td>
</tr>
<tr>
<td>Econ</td>
<td>Economics</td>
</tr>
<tr>
<td>Elec Eng</td>
<td>Electrical and Computer Engineering</td>
</tr>
<tr>
<td>Mat Eng</td>
<td>Materials and Civil Engineering</td>
</tr>
<tr>
<td>Phys &amp; Ast</td>
<td>Physics and Astronomy</td>
</tr>
<tr>
<td>Stat</td>
<td>Statistics</td>
</tr>
<tr>
<td>Inf</td>
<td>Infinitive</td>
</tr>
<tr>
<td>Ing</td>
<td>-ing clause</td>
</tr>
<tr>
<td>M aux</td>
<td>Modal auxiliary</td>
</tr>
<tr>
<td>Non-subj</td>
<td>Non-subjunctive</td>
</tr>
<tr>
<td>Pass</td>
<td>Passive</td>
</tr>
<tr>
<td>P aux</td>
<td>Primary auxiliary</td>
</tr>
<tr>
<td>Perf</td>
<td>Perfect</td>
</tr>
<tr>
<td>Subj</td>
<td>Subjunctive</td>
</tr>
</tbody>
</table>
This corpus-based investigation of the mandative subjunctive (MS) (Quirk & Greenbaum, 1973) explored the structure as it co-occurred in published research articles with 10 lexical items previously identified as MS triggers (Overgaard, 1995; Peters, 1998; Crawford & Albakry, 2004): ask, demand, direct, insist, order, propose, recommend, request, require and suggest. Through a variety of quantitative (frequency, form and pattern) and qualitative (function) analyses, the present study examined the use of these lexical items in a corpus of published research articles (~1.75 million words) by authors in four academic disciplines (Applied Linguistics, Biology, Business and Electrical & Computer Engineering) with the purpose of identifying the discourse factors that contribute to the triggering of the MS structure in academic writing as its main objective.

Results of the quantitative analyses revealed that when functioning as verbs, the majority of these lexical items infrequently co-occurred with that-clauses in the corpus; and, of the 1337 instances that did co-occur with a that-clause, only 50 (3.74%) contained a subjunctive verb form. In the qualitative analysis, 24 of the MS structures (48%) were found to be used to call for a particular action (Peters, 2004) or propose a potential course of action (Biber et al., 1999); one significant exception was require, which co-occurred with an MS structure 17 times (34% of the total instances) to report a necessary condition.

The findings of this study indicate that use of these lexical items does not alone trigger the mandative subjunctive in that-complement clauses in academic writing; rather, the factors involved in triggering the structure were determined to be multiple and complex. Thus, although the structure does indeed co-occur with certain verbs, this study has found the rules governing the triggering of the MS structure to be unpredictable.

Therefore, explicit teaching of the MS structure is not recommended. However, students in an upper level EAP course (those already familiar with advanced English grammar and the conventions of published research articles) could benefit from consciousness-raising activities to “discover” the MS structure and its use(s) for the purpose of awareness and comprehension of the structure in academic writing, and not necessarily production.
CHAPTER 1: INTRODUCTION

For more than a century, linguists have reported that the subjunctive is disappearing from the English language (Ramsey, 1892; Krapp, 1908; Fowler, 1926; Vallins, 1956; Strang, 1962), describing it with terms like ‘archaic’, ‘moribund’, ‘fossilized’, ‘nearly extinct’ or ‘nearly perished’. In fact, “the statement that the English subjunctive is dying has been made so often and by so many that it has come to be generally accepted and has been handed down from one generation of grammarians to another” (Jacobsson, 1975, p. 219).

Some grammarians have downplayed the importance of the feature (Quirk, Greenbaum, Leech & Svartvik, 1972), while others have pointed to the rarity of the structure in present-day English (Biber, Conrad & Leech, 2002; Peters, 2004). Still, the subjunctive has featured quite widely in the literature of the past century, although many of the claims made about it have been based on intuition rather than on empirical evidence.

Now that corpus linguistics technology is readily available, however, it is possible to explore “rare” linguistic features—like the subjunctive—in large collections of text, and thereby gather the empirical evidence needed to make more descriptive claims about their existence in the language than ‘moribund’ or ‘nearly extinct’.

The current investigation uses a corpus-based approach to grammar to explore one aspect of the subjunctive: the mandative subjunctive, a structure occurring in that-complement clauses, recognizable for its display of the base form of a verb (where subject-verb concord would normally be expected), as in this sample extracted from the Business sub-corpus used in this study:

... potentially serious problem, some analysts have recommended the use of premium-priced stock option plans or indexed options. For example, Rappaport proposes that exercise prices be fixed at a premium above the market price on the date options are granted. He suggests that ... (Bus)

The mandative subjunctive is often described in the literature as being “triggered” by certain verbs, nouns and adjectives (those expressing demand, necessity, obligation, etc.), such as propose in the sample above. These mandative subjunctive triggers (MSTs) have been identified through the previous corpus-based studies of Overgaard (1995), Peters (1998), and
Crawford and Albakry (2004)—10 of which were common to the findings of all three of the studies and are thus the focus for this investigation: ask, demand, direct, insist, order, propose, recommend, request, require and suggest.

While the purpose of this study is to add to what is already known about MSTs and the mandative subjunctive, it approaches the topic in a way previous research has yet to do: instead of using corpus linguistics methodology to first locate mandative subjunctive structures in subordinate clauses, then reverting back to the main clause to identify the lexical items that trigger them (as Overgaard, Peters and Crawford & Albakry have done), the present study first locates the 10 MSTs in main clauses and then examines the context subsequent to them. Hence, the aim of this study is not to simply identify the triggers of the mandative subjunctive structure but to understand the functions of these 10 lexical items and identify the factors that contribute to the triggering/non-triggering of the mandative subjunctive structure in academic writing.

More generally, this study was designed to 1) characterize the mandative subjunctive in the English of contemporary research articles, providing evidence to either support or refute its disappearance from them; 2) determine the role of the mandative subjunctive in academic writing (specifically, the research article), and establish whether prescriptive rules governing its usage indeed match its actual use; and 3) demonstrate how the investigation of actual language use (grammar in context) might inform the teaching of English as a second/foreign language.

The following research questions guided this investigation:

1. What are the frequency distributions of ask, demand, direct, insist, order, propose, recommend, request, require and suggest in the Iowa State University Research Article Corpus?

2. Are ask, demand, direct, insist, order, propose, recommend, request, require and suggest manifested strictly as lexical verbs in the corpus? If not, which other word classes do they represent?

3. When these items function as lexical verbs, do they always co-occur with that-clauses and subjunctive verb forms in actual use in academic writing;
in other words, do ask, demand, direct, insist, order, propose, recommend, request, require and suggest “trigger” the mandative subjunctive? If not, with what other structures do they co-occur?

4. Is there a correlation between the form of the trigger in the main clause and the grammatical structure of the that-complement clause?

5. What is the function of structures identified as mandative subjunctives? What is the function of structures identified as non-mandative subjunctives? Are there any significant differences in use of the mandative subjunctive structure across disciplines?

In order to accomplish the objectives set forth here in this introductory chapter, the remainder of the study is arranged as follows: Chapter 2 defines the subjunctive and its mandative use, presents the theoretical framework for this investigation, and summarizes the work previously done in this area. Chapter 3 describes in detail the data (the corpus) and procedures for data analysis (quantitative and qualitative methods) used to answer the research questions. Chapter 4 presents the results of the analyses and provides evidence through examples of each finding. Chapter 5 discusses the results, offering interpretations and pedagogical implications and applications of findings; the fifth chapter also addresses the limitations of the present study and suggests directions for further research.
CHAPTER 2: LITERATURE REVIEW

This chapter will treat the subjunctive and its mandative use in greater depth, situating them within the applied linguistics literature of the past century; it will also 1) present the theoretical framework for the current investigation, and 2) review the relatively few relevant studies that have been conducted into the use of the mandative subjunctive structure to date.

2.1. The Subjunctive

A definition of “the subjunctive” isn’t easily procured, as there has traditionally been considerable disagreement among grammarians about its features and functions: some have called it an idea or a mood, others a tense, and still others a form. Cannon (1959) recognizes the difficulty in arriving at consensus when attempting to define the subjunctive: “the person who would attempt to define the subjunctive mood wholly in notional or in formal terms is on the horns of a dilemma, for the mood successfully resists definition if either of these two approaches is used to the exclusion of the other” (p. 11).

Curme (1947) offers the broadest definition, claiming that the subjunctive is an idea, which “has never been associated with a particular form, but has always been expressed by a variety of means” (Jacobsson, 1975, p. 219), and classifying it into two uses: “the optative subjunctive, which represents the utterance as something desired or planned, and the potential subjunctive, which represents the statement, not as an actual fact, but only as a conception of the mind” (1947, p. 234).

According to Poutsma (1922), the subjunctive is a mood, “a form of the finite verb, or verb-group, by means of which the speaker expresses his mental attitude towards fulfillment of the action or state expressed by the predicate” (p. 1). Cannon concurs, adding that “if the attitude is one of uncertainty, nonfulfillment, unreality, improbability, or impossibility, most grammarians would recommend the use of the subjunctive mood” (1959, p. 11).

Quirk, Greenbaum, Leech and Svartvik have also called it a mood, suggesting, however, that there are two forms, “traditionally called the present and past subjunctive, although the distinction relates more to mood than to tense” (1990, p. 43), and defining the present subjunctive as a structure “used in that-clauses…even if the matrix verb is past, after
verbs, adjectives or nouns that express a necessity, plan or intention for the future” (p. 294). This definition extended on a previous claim made by Quirk and Greenbaum that “mood is expressed in English to a very minor extent by the subjunctive” (1973a, p. 51).

Biber, Conrad and Leech focus more on form in their definition of the subjunctive in the glossary of the student version of the Longman Grammar: “the form of a finite verb that is sometimes used in hypothetical or non-factual cases…The subjunctive is rarely used in English” (2002, p. 460). The text handles the topic in a section on “Subjunctive verbs in dependent clauses,” where its structure is explicitly defined, though its use and function are not:

“[It] is the base form of the verb, used where the s-form of the verb would occur normally. It occurs in special kinds of finite dependent clauses, particularly in some that complement clauses and occasionally in some adverbial clauses… With regular verbs, the present subjunctive is recognizable only with a singular subject. The past subjunctive is restricted to the form were used in the singular, usually to express unreal or hypothetical meaning” (p. 261).

Suffice it to say that defining the subjunctive is no simple task: for over a century, it has not only been described in the literature with much inconsistency (see Table 2.1), but it appears to have generated a lot of debate in linguistic circles, as well.

<table>
<thead>
<tr>
<th>Publication, Author(s), Year</th>
<th>Number of Uses</th>
<th>Uses</th>
<th>Definition Highlights of the “Mandative” Use and Form + an Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <em>A University Grammar of English</em>, Quirk &amp; Greenbaum (1973)</td>
<td>3</td>
<td>Mandative; formulaic; were</td>
<td>“in that-clauses…has only one form, the base (V)…lack of the regular indicative concord between subject and finite verb in the 3rd person singular present…can be used with any verb in subordinate that-clauses when the main clause contains an expression of recommendation, resolution, demand and so on…It is/was necessary that every member inform himself of these rules” (p. 51).</td>
</tr>
<tr>
<td>2. <em>The Grammar Book: An ESL/EFL Teacher’s Course</em>, Celce-Murcia &amp; Larsen-Freeman (1983)</td>
<td>1</td>
<td>-----</td>
<td>“for a small class of English verbs that take that-clause object complements, the subjunctive form of the verb is used…indicated by the lack of the –s inflection for third person singular verbs…We {suggest, insist, recommend, urge, propose} that she leave the arrangements to us” (p. 482).</td>
</tr>
</tbody>
</table>
Table 2.1: An Overview of the Subjunctive in English Grammars (cont’d)

| 3. *The Longman Grammar of Spoken and Written English*, Biber, Johansson, Leech, Conrad & Finegan (1999). | 5 | Subjunctive “forms;” communication verbs; necessity or importance adjectives; special cases of inversion (formulaic); exclamations (expletives) | “subjunctive forms, which are possible in certain finite dependent clauses, do not show subject-verb concord…

*I told her she could stay with me until she found a place, but she insisted that she pay her own way* (FICT)” (emphasis in original, p. 180).

“some communication verbs can be used with a *that*-clause to propose a potential course of action (rather than report information…

*We ask that this food be blessed* (CONV)” (emphasis in original, p. 667).

“necessity or importance adjectives also control extraposed *that*-clauses…reflect[] the writer’s belief that a proposed course of action is essential or important…most common in academic prose…

*It is important that it be well sealed from air leakage* (ACAD)” (emphasis in original, p. 674). |
| 4. *The Cambridge Guide to English Usage*, Peters (2004) | 3 | Mandative; “unreal” or impossible conditions; formulaic | “the kind of construction that calls for a particular action…use the present forms of the *subjunctive*…often only detectable in the third person singular…can be prefaced by any one of a number of verbs including: *advise, ask, beg, demand, desire, direct, insist, move, order, propose, recommend, request, require, stipulate, suggest, urge*…appears in positive and negative constructions…primarily associated with formal style…

*They recommended that he present hard evidence for the claim*” (emphasis in original, p. 520). |

2.2. The Mandative Subjunctive

As previewed in the table above, one “surviving use” (Peters, 2004, p. 520) of the subjunctive is the mandative subjunctive, which is triggered by a class of verbs known as mandatives (Quirk & Greenbaum, 1973a, 1973b, 1990; Peters, 2004), suasives (Nichols, 1987; Crawford & Albakry, 2004) or indirect-discourse imperatives (Jacobsson, 1975), such as *demand, insist, recommend, require* and *suggest*. The right-hand column of Table 2.1 summarizes the mandative use and form, and provides examples of it as featured in well-
known English grammars from each of the past four decades; it shows that while some differences in terminology to express the mandative subjunctive exist, unlike the general subjunctive, it seems there is more agreement than not regarding both its function and form.

The function of mandative subjunctives appears to be closely related to that of imperatives—Jacobsson admits that “it is sometimes difficult to keep them apart” (1975, p. 220), which is logical, given that the term ‘mandative’ derives from mandate, meaning ‘command’. According to the information contained in English grammar handbooks, this construction is used to “call for a particular action” (Peters, 2004, p. 520) or to “propose a potential course of action (rather than report information)” (Biber et al., 1999, p. 667), if the “main clause contains an expression of recommendation, resolution, demand and so on” (Quirk & Greenbaum, 1973, p. 51), thus conveying a force similar to that of a command.

The definition of the form of mandative subjunctives in English grammars generally involves: 1) a **main verb trigger**: “for a small class of English verbs” (Celce-Murcia & Larsen-Freeman, 1983, p. 482), “some communication verbs” (Biber et al., 1999, p. 667), “prefaced by any one of a number of verbs including: advise, ask, beg, demand, desire, direct, insist, move, order, propose, recommend, request, require, stipulate, suggest, urge” (Peters, 2004, p. 520); 2) a **that-clause**: “in subordinate that-clauses” (Quirk & Greenbaum, 1973, p. 51), “that-clause object complements” (Celce-Murcia & Larsen-Freeman, 1983, p. 482), “possible in certain finite dependent clauses” (Biber et al., 1999, p. 180), “used with a that-clause” (p. 667); and 3) a **subjunctive verb form**: “has only one form, the base (V)…lack of the regular indicative concord between subject and finite verb in the 3rd person singular present” (Quirk & Greenbaum, 1973, p. 51), “indicated by the lack of the –s inflection for third person singular verbs” (Celce-Murcia & Larsen-Freeman, 1983, p. 482), “do not show subject-verb concord” (Biber et al., 1999, p. 180), and “often only detectable in the third person singular” (Peters, 2004, p. 520).

At present, apart from mostly prescriptive information in grammar books, little has been written on the mandative subjunctive. Of the few studies that do exist, most are corpus-based and will be discussed at the end of this chapter after an orientation to the corpus-based methodology and approach to grammar used in both them and the present study.
One non-corpus-based study on the use of the “suasive” subjunctive was conducted by Nichols (1987), who explored student preference for complements following mandative subjunctive triggers (e.g., importance adjectives, request verbs) through a modified cloze test. She found that students in Freshman Composition at Winona State University, including some classified as ‘semiliterate’, tended to provide subjunctive forms following request verbs: 70% of the responses after the prompt suggesting that were subjunctive, 18% modal and 0% infinitive; 53% after asked that were subjunctive, 30% modal and 0% infinitive; order, unaccompanied by that, produced 7% subjunctive forms, 14% modal and 72% infinitive, as in ordered him to (p. 143).

Nichols then substantiated her findings by replicating the study at two other academic institutions: Western Illinois University and Duke University. Similar results were found, leading Nichols to conclude that “the suasive subjunctive, at least, still flourishes, and students classified as REMEDIAL use it appropriately” (emphasis in original, p. 150).

2.3. Corpus Linguistics

“In the language sciences a corpus is a body of written text or transcribed speech which can serve as a basis for linguistic analysis and description. Over the last three decades the compilation and analysis of corpora stored in computerized databases has led to a new scholarly enterprise known as corpus linguistics” (Kennedy, 1998, p. 1).

Corpus linguistics makes use of technology to process and describe (usually very large quantities of) naturally-occurring language:

“The unifying characteristics of corpus-based research include the use of a large, representative electronic database of spoken or written texts, or both (the corpus), and the use of computer-assisted analysis techniques (Biber & Conrad, 2001, p. 331).

“Corpus linguistics technology requires a computer that can store a collection of text files (the corpus) and then apply software to those files to produce frequency lists, lists of key words, and most importantly, strings of words showing which words co-occur (or collocate) with others” (emphasis in original, Simpson & Swales, 2001, p. 1).

While data retrieved using the technology of corpus linguistics may be seen by some as “objective evidence” (Sinclair, 1991, p. 1), the undisputed advantage of a corpus-based approach to language is its emphasis on describing actual language use: “the most important
achievement of corpus linguistics is undoubtedly that it has put the use of language at the centre of linguistics” (Aijmer & Altenberg, 2004, p. 1). In any case, corpus linguistics is “not an end in itself but is one source of evidence for improving descriptions of the structure and use of languages, and for various applications, including…understanding how to learn or teach a language” (Kennedy, 1998, p. 1).

2.4. A Corpus-Based Approach to Grammar

A corpus-based approach to grammar focuses on describing language “based on the patterns of structure and use found in a large collection of spoken and written texts, stored electronically, and searchable by a computer” (Biber et al., 1999, p. 4), patterns that are “otherwise impossible to ascertain” without the quantitative analyses characteristic of this kind of approach (Biber & Conrad, 2001, p. 332).

Since the quantitative analyses of a corpus-based approach provide natural examples of words or grammatical features in context, several researchers have pointed to the benefits of using corpus-based techniques to examine the co-occurrence of lexis and grammar, “lexicogrammar” (Biber & Conrad, 2001; Biber, Conrad & Reppen, 1998) or “lexical grammar” (Sinclair, 2004). Biber and Conrad (2001) assert that with a corpus-based study, “researchers can analyze associations between grammatical features and lexical items” (p. 334), adding that lexicogrammar “show[s] how related grammatical constructions tend to be used with different sets of words” (p. 335).

2.5. Previous Corpus-Based Investigations of the Mandative Subjunctive

Several researchers have previously used corpus-based methodologies to investigate the mandative subjunctive (Johansson & Norheim, 1988; Overgaard, 1995; Peters, 1998; Crawford & Albakry, 2004).

Johansson and Norheim (1988) compared the frequency of the mandative subjunctive to the modal paraphrase should following “mandative governing verbs” in two, million-word corpora, the American Brown Corpus (Francis & Kucera, 1979) and the British LOB Corpus (Johansson et al., 1985). They found that in the Brown Corpus, the subjunctive was used 116 times, compared to 14 times in the LOB Corpus; should was used 19 times in the Brown
Corpus, as opposed to 97 times in the LOB Corpus (p. 29). To Johansson and Norheim, this confirmed the general view that “the mandative subjunctive is more common in American English, while British English prefers the should construction” (p. 28).

Similarly, Overgaard (1995) examined the use of the mandative subjunctive in American and British English; however, her study traces the structure’s use diachronically (throughout the 20th century), as triggered by both verbs and nouns. Using corpora representing the two varieties of English at five given points during the 1900’s, Overgaard determined that “in the course of the last hundred years the drift [“the unidirectional change leading to the possible elimination of the non-inflected subjunctive”] has been reversed in both AmE and BrE, though at a different pace and at different times and for different reasons” (p. 89).

Peters (1998) explored the preference for the subjunctive and subjunctive paraphrases (e.g., modals, quasi-modals) following suasive verbs in the ACE (Australian Corpus of English, 1986), a million-word corpus of written text. She found that the subjunctive count (78) was higher than the paraphrase count (36), and that the modal paraphrase should was the most common alternative to the mandative structure (29). Peters compared her findings to those of Johansson and Norheim (1988), and noted that the mandative subjunctive construction was still most frequent in American English but that the Australian totals “show it to be quite resilient in comparison with the earlier British data from the LOB” (p. 98).

Crawford and Albakry (2004) examined the marked mandative subjunctive as triggered by verbs, nouns and adjectives in two corpora of US news writing: 1) the Associated Press sub-corpus of the Longman Grammar of Spoken and Written English (two million words), and 2) a smaller, local corpus collected from newspapers in Arizona (500,000 words). After normalizing their findings to 1,000,000 words, they found that verbs were the strongest triggers of the marked mandative subjunctive (197 instances), followed by nouns (39) and adjectives (11). Crawford and Albakry were able to identify seven “triggers” of the marked mandative subjunctive (those that “resulted in the subjunctive at least 10 times/million words” (p. 4)): demand (57), recommend (30), ask (20), insist (18), propose (18), suggest (15), and request (10).
The following corpus-based, lexicogrammatical investigation of MSTs took the definitions, approaches to grammar and findings of previous research presented here in this review of literature, and used them as the foundation on which to base the remainder of this study.
CHAPTER 3: METHODOLOGY

In order to begin this investigation, verbs normally co-occurring with mandative subjunctive structures—mandative subjunctive triggers (MSTs)—had to be identified. The following lexical items were selected for analysis, as they were found to be the 10 most frequently appearing verbs triggering the mandative subjunctive common to the work of Overgaard (1995), Peters (1998, 2004) and Crawford and Albakry (2004): ask, demand, direct, insist, order, propose, recommend, request, require and suggest. Once the MSTs were identified, they then had to be located in the corpus for analysis.

3.1. The Corpus

The collection of texts used to carry out this study was the Iowa State University Research Article Corpus (ISURAC), a compilation of published research articles from 11 different academic disciplines (Cortes, 2006). The articles from each discipline form a sub-corpus, resulting in 11 discipline-specific sub-corpora, which range from 383,669 to 506,366 (mean = 444,711) words for a total of nearly 5,000,000 words of written text in all (see Table 3.1 for disciplines and word counts). The sub-corpora sample between two and six online journals identified by academics at Iowa State University as writing that could be considered exemplary within their fields. Articles were collected in reverse chronological order, beginning with those published in 2004 and dating back no further than 2001.

<table>
<thead>
<tr>
<th>Discipline/Sub-Corpus</th>
<th>Number of Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Science</td>
<td>459,303</td>
</tr>
<tr>
<td>Applied Linguistics</td>
<td>437,427</td>
</tr>
<tr>
<td>Architecture</td>
<td>496,351</td>
</tr>
<tr>
<td>Art &amp; Design</td>
<td>506,366</td>
</tr>
<tr>
<td>Biology</td>
<td>383,669</td>
</tr>
<tr>
<td>Business</td>
<td>476,122</td>
</tr>
<tr>
<td>Economics</td>
<td>447,845</td>
</tr>
<tr>
<td>Electrical &amp; Computer Engineering</td>
<td>449,699</td>
</tr>
<tr>
<td>Materials &amp; Civil Engineering</td>
<td>452,813</td>
</tr>
<tr>
<td>Physics &amp; Astronomy</td>
<td>393,956</td>
</tr>
<tr>
<td>Statistics</td>
<td>388,269</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,891,820</strong></td>
</tr>
</tbody>
</table>
The ISURAC was selected as the corpus for this investigation of MSTs based on 1) existing claims (i.e., Quirk & Greenbaum, 1973b) that “the use of this subjunctive [the mandative] occurs chiefly in formal style” (p. 51), and 2) corpus availability. Moreover, written texts were desired in order to be able to compare the present study’s findings with those of previous research on MSTs in written English, such as Johansson and Norheim (1988), Overgaard (1995), Peters (1998), and Crawford and Albakry (2004).

Although the ISURAC in its entirety was used for the initial analyses of the present investigation, it was narrowed to a sub-corpus consisting of research articles from only four disciplines to conduct the later analyses. Specifically, 69 articles, or files, in Applied Linguistics, 89 in Biology, 61 in Business and 105 in Electrical and Computer Engineering comprised the sub-corpus to represent 1,750,000 (mean = 436,729) words of academic prose. (Incidentally, as comparison of the structure across these four disciplines was only a secondary objective of this study, no normalization for corpora of differing sizes was performed.) Table 3.2 below offers a description of the sub-corpus.

<table>
<thead>
<tr>
<th>Sub-Corpus Disciplines</th>
<th>Files (Articles)</th>
<th>Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Linguistics</td>
<td>69</td>
<td>437,427</td>
</tr>
<tr>
<td>Biology</td>
<td>89</td>
<td>383,669</td>
</tr>
<tr>
<td>Business</td>
<td>61</td>
<td>476,122</td>
</tr>
<tr>
<td>Electrical &amp; Computer Engineering</td>
<td>105</td>
<td>449,699</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>324</strong></td>
<td><strong>1,746,917</strong></td>
</tr>
</tbody>
</table>

3.2. The Concordancing Program

The first step in investigating mandative subjunctive triggers in context was to locate them in the corpus. To facilitate the search for each and every instance of the 10 MSTs in almost 1.75 million words of text, a commercially available computer concordancing program was employed: MonoConc Pro 2.2 (Barlow, 2004). MP2.2 is software that reads electronic text, allowing the user to search for a key word in context with a high degree of reliability. Figure 3.1 shows a sample concordance return for the search term require in the Biology sub-corpus.
Because lexemes, instances of the lexical item in all its linguistic variants (i.e., require, requires, required, requiring) were desired for analysis, it was necessary to structure each concordance in a way so as to capture the sum of the data (forms) and not simply one-to-one correlations (words). This was achieved through a wildcard search parameter: the asterisk (e.g., ask*), which retrieves any context subsequent to the search pattern.

Despite the fact that the 10 lexical items under investigation here constitute regular verbs, thus receiving normal inflections (base form + suffix -(e)s, -ing, or –ed), and therefore not requiring modified searches for retrieval of irregular verb forms (see, saw, seen, for example), one additional search accommodation was arranged in order to locate all lexemes: as propose and require end in a vowel, they had to be concordanced without the final vowel (e.g., requir*); overlooking this detail would have resulted in a significant loss of data. The difference in data return of these two search types can be observed by comparing the results in Figure 3.1 to those in Figure 3.2: the discrete item require returned 58 matches in the Biology sub-corpus, whereas requir* returned 524 in the same corpus.

![Figure 3.1: Sample Concordance Return for require in the Biology Sub-Corpus](image-url)
3.3. Procedures

A combination of quantitative and qualitative research measures was used to answer the questions underpinning this investigation of MSTs in academic writing. Pairing these distinct methodologies allowed for the analysis of function (qualitative procedures) in addition to form and frequency (quantitative procedures) of each lexical item in context, thereby ensuring a more thorough overall methodology, and, consequently, more comprehensive findings.

Figure 3.2: Sample Concordance Return for requir* in the Biology Sub-Corpus

3.3.1. Preliminary Analysis: Frequency

In order to answer the first research question [What are the frequency distributions of ask, demand, direct, insist, order, propose, recommend, request, require and suggest in the Iowa State University Research Article Corpus?], each of the 10 lexical items was concordanced in each discipline-specific sub-corpus (all 11 sub-corpora) of the ISURAC, and the 110 resulting KWIC displays were sorted—first by the search term, and then by the first
word to the right of it in context. Then, the unanalyzed strings of text, the search term plus 20 words of context to both the left and right, were copied and saved into Word® files and archived in folders according to discipline. Counts of these raw instances of the lexical items in the unanalyzed strings were then tabulated.

Next, each string was analyzed for irrelevant data. Some returns were undecipherable, while others constituted cases in which the writer had no autonomy in word choice: instances of headings, bibliographic entries, direct quotations, citations, dialogue, proper names, titles, parenthetical notes, lexical items as themes (say, explain, tell and ask), and lexical bundles (in order to) were discarded based on their inflexibility in use. This data was not deleted, rather saved in separate files (e.g., ask_other); this way, it could be referred to later in the study, if needed. The remaining strings were then counted and tabulated.

3.3.2. Secondary Analysis: Form

To answer the second research question [Are ask, demand, direct, insist, order, propose, recommend, request, require and suggest manifested strictly as lexical verbs in the corpus? If not, which other word classes do they represent?], two separate steps were taken: the first to establish how the lexical items appear in the corpus (morphological possibilities), and the second to determine how they function within their respective clauses (grammatical constituency).

First, to establish how the lexical items are realized in the corpus (and retrieve all morphological possibilities), each item was again concordanced under the same conditions as in the preliminary analysis, but this time in the entire corpus (not by discipline). Returns were then sorted, variants and their frequencies tallied and the results recorded.

Next, each of these instances needed to be individually, or manually, analyzed to determine grammatical constituency—that is, their function at the sentence level. In order to do this, the archived data from the preliminary analysis was utilized. Each instance was examined in context, and classified by constituency, or word class (verb, noun, adjective, adverb or other), with the descriptions of word class in the Longman Grammar of Spoken and Written English (Biber et al., 1999) serving as the taxonomy. Findings were again tallied, recorded, tabulated and archived.
It was at this point in the investigation that the initial data set needed to be narrowed to a smaller sub-corpus in order to perform the more qualitative analyses (those relying heavily on human analytic techniques) involved in the remaining procedures. As mentioned previously, four disciplines were selected for in-depth analysis: Applied Linguistics, Biology, Business and Electrical & Computer Engineering. These four sub-corpora were chosen due to the fact that they contained the highest number of lexical items occurring as part of a verb phrase—which could be hypothesized as MSTs, thus potentially triggering the highest number of mandative subjunctive structures (see Figure 3.3 below).

![Graph showing frequency of lexical items as verbs in the ISURAC](image)

**Figure 3.3: Frequency of Lexical Items as Verbs in the ISURAC**

3.3.3. Tertiary Analysis: Pattern

In order to answer the third research question [When these items function as lexical verbs, do they always co-occur with *that*-clauses and subjunctive verb forms in actual use in academic writing; in other words, do *ask, demand, direct, insist, order, propose, recommend, request, require* and *suggest* “trigger” the mandative subjunctive? If not, with what other structures do they co-occur?], the analysis was again broken down into two steps, the first to locate a pattern, and the second to classify the structure following the pattern.

In the first step, each instance of the lexical items in verb form (from the archived data of the secondary analysis) in each of the four sub-corpora (Applied Linguistics, Biology,
Business and Electrical & Computer Engineering) was analyzed and classified as either containing a co-occurring *that*-clause or not. As a check and balance for this procedure, the lexical items were again concordanced in each of the four disciplines for the pattern (item* *that*) to ensure that no instance was overlooked. Results were sorted, tallied, recorded, archived and tabulated.

Next, in order to perform the second step of the third analysis, the mandative subjunctive structure itself had to be identified; that is, the exponents and features that “mark” the mandative subjunctive as such needed to be defined. Therefore, based on a synthesis of previous researchers’ descriptions (Quirk & Greenbaum, 1973; Celce-Murcia & Larsen-Freeman, 1983; Biber et al., 1999; Peters, 2004), the following pattern was established as the criterion to be met in order to be considered a mandative subjunctive:

\[
\text{lexical item (any form)} + (\) that + singular subject + verb (base form)
\]

Strings of *that*-clause co-occurrence were analyzed; those conforming to the above pattern were classified as subjunctive structures, and those that didn’t, as non-subjunctive structures. For the structures classified as non-subjunctives, a syntactic analysis of the structures following the co-occurring *that*-clause was performed and a new taxonomy created to describe them: modal, non-subjunctive (finite verb forms (e.g., indicative, present perfect)) or other (see Figure 3.4 for the organization of the taxonomy). All coding was then validated by a second researcher, and the results were tallied and tabulated.
Finally, in the event that any of the instances of non-that-clause co-occurrence contained a zero (that) complementizer, the pattern analysis described above was repeated for strings not co-occurring with that-clauses.

3.3.4. Quaternary Analysis: Structure

To answer the fourth research question [Is there a correlation between the form of the trigger in the main clause and the grammatical structure of the that-complement clause?], a syntactic analysis of the strings used in the tertiary analysis was performed. Each string was re-examined for two things: first, for the grammatical form of the lexical item (MST) in the main clause, and second, for the structure it triggered in the co-occurring complement clause. The results were recorded, tallied and tabulated. Then, the data was analyzed for correlations.

Additionally, the MS structures were further examined in isolation. Each instance was reverse-analyzed: that is, as the structure of the that-complement clause was known, only the structure preceding it (the form of the MST) was analyzed and general trends noted.

3.3.5. Quinary Analysis: Function

In order to answer the fifth, and final, research question [What is the function of structures identified as mandative subjunctives? What is the function of structures identified
as non-mandative subjunctives? Are there any significant differences in use of the mandative subjunctive structure across disciplines?], a semantic (contextual) analysis of each MS structure was performed to determine whether it was used to indicate a proposed course of action or not.

Instances were classified as either expressing a proposed course of action or ‘other’, and taxonomized accordingly (Figure 3.5). This two-step process was repeated for structures identified in the tertiary analysis as “non-subjunctive” (modals, non-subjunctives and others), as well. All coding was then validated by a second researcher. Finally, the results of the functional analysis were compared across disciplines for similar/dissimilar trends in use.

**Figure 3.5: Taxonomy for Classifying the Function of MS and Non-MS Structures**
<table>
<thead>
<tr>
<th>Research Question</th>
<th>Method(s)</th>
<th>Steps</th>
</tr>
</thead>
</table>
| 1. What are the frequency distributions of ask, demand, direct, insist, order, propose, recommend, request, require and suggest in the ISURAC? | Quantitative (Frequency) | 1. Concordance the lexical items in each of the sub-corpora.  
2. Archive strings in electronic files.  
3. Discard instances of irrelevant uses.  
4. Count and tabulate findings. |
| 2. Are ask, demand, direct, insist, order, propose, recommend, request, require and suggest manifested strictly as lexical verbs in the corpus? If not, which other word classes do they represent? | Quantitative (Form) | 1. Concordance each lexical item in the corpus. Sort, tally and record variations and frequencies.  
2. Individually examine unanalyzed strings and classify each use by word class: verb, noun, adjective, adverb or other. Count, record, tabulate and archive uses by word class.  
3. Narrow the corpus for in-depth analysis. |
| 3. When these items function as lexical verbs, do they always co-occur with that-clauses and subjunctive verb forms in actual use in academic writing; in other words, do ask, demand, direct, insist, order, propose, recommend, request, require and suggest “trigger” the mandative subjunctive? If not, with what other structures do they co-occur? | Quantitative (Pattern) | 1. Examine the instances of the lexical items in verb form and distinguish between co-occurrence with or without a that-clause.  
2. Perform a syntactic analysis of the structures co-occurring with that-clauses and classify them according to the taxonomy as either subjunctive or non-subjunctive; further classify non-subjunctives as modals, non-subjunctives or other. Tally, record and tabulate findings.  
4. Repeat the process for instances of non-that-clause co-occurrence. |
| 4. Is there a correlation between the form of the trigger in the main clause and the grammatical structure of the that-complement clause? | Quantitative (Structure) | 1. Perform a syntactic analysis of the verb form of the main clause (of the MST) and the verb form of the complement clause (that-clause) it triggers.  
2. Analyze the findings for correlations.  
3. Examine the form of the MST in each MS structure to determine if a structural preference exists. |
| 5. What is the function of structures identified as mandative subjunctives? What is the function of structures identified as non-mandative subjunctives? Are there any significant differences in use of the mandative subjunctive structure across disciplines? | Qualitative (Function) | 1. Perform a semantic analysis of each MS structure to determine if its function is to express a proposed course of action or not.  
2. Classify functions and taxonomize, tallying and tabulating findings.  
3. Repeat the process for non-MS structures.  
4. Compare use across disciplines. |
CHAPTER 4: RESULTS

Results of the five analyses described in Chapter 3: Methodology are presented here in Chapter 4: Results, with a discussion of the findings to follow in Chapter 5: Discussion and Conclusions.

4.1. Preliminary Analysis: Frequency

An initial concordancing of the lexical items ask, demand, direct, insist, order, propose, recommend, request, require and suggest in the corpus produced the following frequency distributions:

Table 4.1: Preliminary Concordance Results: Unanalyzed Strings

<table>
<thead>
<tr>
<th></th>
<th>Ani Sci</th>
<th>App Ling</th>
<th>Arch</th>
<th>Art &amp; Des</th>
<th>Bio</th>
<th>Bus</th>
<th>Econ</th>
<th>Elec Eng</th>
<th>Mat Eng</th>
<th>Phys &amp; Ast</th>
<th>Stat</th>
<th>Totals (by lexical item)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ask</td>
<td>4</td>
<td>379</td>
<td>138</td>
<td>132</td>
<td>9</td>
<td>130</td>
<td>91</td>
<td>66</td>
<td>3</td>
<td>8</td>
<td>18</td>
<td>983</td>
</tr>
<tr>
<td>demand</td>
<td>20</td>
<td>100</td>
<td>135</td>
<td>108</td>
<td>11</td>
<td>209</td>
<td>272</td>
<td>62</td>
<td>78</td>
<td>5</td>
<td>8</td>
<td>1096</td>
</tr>
<tr>
<td>direct</td>
<td>239</td>
<td>412</td>
<td>486</td>
<td>420</td>
<td>439</td>
<td>448</td>
<td>298</td>
<td>643</td>
<td>450</td>
<td>466</td>
<td>216</td>
<td>4621</td>
</tr>
<tr>
<td>insist</td>
<td>0</td>
<td>9</td>
<td>23</td>
<td>64</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>113</td>
</tr>
<tr>
<td>order</td>
<td>154</td>
<td>386</td>
<td>254</td>
<td>336</td>
<td>177</td>
<td>183</td>
<td>315</td>
<td>398</td>
<td>262</td>
<td>320</td>
<td>387</td>
<td>3319</td>
</tr>
<tr>
<td>propose</td>
<td>54</td>
<td>296</td>
<td>217</td>
<td>209</td>
<td>160</td>
<td>169</td>
<td>320</td>
<td>193</td>
<td>272</td>
<td>79</td>
<td>568</td>
<td>2661</td>
</tr>
<tr>
<td>recommend</td>
<td>126</td>
<td>59</td>
<td>90</td>
<td>21</td>
<td>12</td>
<td>24</td>
<td>18</td>
<td>23</td>
<td>103</td>
<td>4</td>
<td>58</td>
<td>553</td>
</tr>
<tr>
<td>request</td>
<td>2</td>
<td>101</td>
<td>24</td>
<td>13</td>
<td>7</td>
<td>23</td>
<td>15</td>
<td>610</td>
<td>2</td>
<td>1</td>
<td>20</td>
<td>822</td>
</tr>
<tr>
<td>require</td>
<td>461</td>
<td>323</td>
<td>524</td>
<td>246</td>
<td>524</td>
<td>291</td>
<td>314</td>
<td>842</td>
<td>333</td>
<td>312</td>
<td>278</td>
<td>4567</td>
</tr>
<tr>
<td>suggest</td>
<td>356</td>
<td>428</td>
<td>291</td>
<td>336</td>
<td>811</td>
<td>482</td>
<td>523</td>
<td>159</td>
<td>176</td>
<td>293</td>
<td>292</td>
<td>4328</td>
</tr>
<tr>
<td><strong>Totals</strong> (by discipline)</td>
<td><strong>1416</strong></td>
<td><strong>2493</strong></td>
<td><strong>2182</strong></td>
<td><strong>1885</strong></td>
<td><strong>2150</strong></td>
<td><strong>1964</strong></td>
<td><strong>2169</strong></td>
<td><strong>2997</strong></td>
<td><strong>1679</strong></td>
<td><strong>1496</strong></td>
<td><strong>1845</strong></td>
<td><strong>22,276</strong></td>
</tr>
</tbody>
</table>

As stated in the methodology, some instances of these preliminary 22,276 hits had to be eliminated, however, due their status as either a) undecipherable, such as the following example of order:

…measurements are commensurate and need not be standardised. We varied L oversmallervalues than those used for the arti$cial data sets in order to$nd small peaks with smallersupport. The numberof peaks signi$cant at the 5% level found by PEAKER for these parametervalues on the Quakes… (Stat)
or b) non-representative of the author’s own writing (word choice) or part of a fixed phrase, as in these uses of suggest, order, direct and request:

... example: Some processes may be classified under more than one type depending on their use in the text. Verbs like suggest and indicate can be categorised as relational processes when the nominal elements in the transitivity structure are abstractions, or as ... (AL)

... isolation required the assumption that the population density within each species was uniform across the area where it occurred. In order to allow for differences in density between species, the species proportions in all mixed sites combined (pj and pb for ... (Bio)

... issued their reports in early 2002.30 The International CSR and Social Reporting Working Group was led by Geoffrey Bush, Director of Corporate Citizenship at Diego (a leading food maker which owns Pillsbury and other big U.S. brands as well) ... (Bus)

... framework. Current technology for building distributed, component-based applications uses sockets, messages, remote procedure calls such as DCE™, or Object Request Brokers (ORBs, such as CORBA, JavaRMI™, and DCOM). Without too much loss of generality, we focus on ORB frameworks and ... (Elec Eng)

Once the extraneous uses were discarded, the results were again tabulated:

<table>
<thead>
<tr>
<th></th>
<th>Ani Sci</th>
<th>App Ling</th>
<th>Arch Art &amp; Des</th>
<th>Bio</th>
<th>Bus</th>
<th>Econ</th>
<th>Elec &amp; Comp Eng</th>
<th>Mat &amp; Civ Eng</th>
<th>Phys &amp; Ast</th>
<th>Stat</th>
<th>Totals (by lexical item)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ask</td>
<td>4</td>
<td>364</td>
<td>135</td>
<td>132</td>
<td>9</td>
<td>130</td>
<td>89</td>
<td>66</td>
<td>3</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>demand</td>
<td>19</td>
<td>99</td>
<td>135</td>
<td>108</td>
<td>11</td>
<td>207</td>
<td>271</td>
<td>62</td>
<td>76</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>direct</td>
<td>236</td>
<td>403</td>
<td>475</td>
<td>406</td>
<td>439</td>
<td>438</td>
<td>294</td>
<td>639</td>
<td>441</td>
<td>460</td>
<td>216</td>
</tr>
<tr>
<td>insist</td>
<td>0</td>
<td>9</td>
<td>23</td>
<td>64</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>order</td>
<td>94</td>
<td>161</td>
<td>85</td>
<td>128</td>
<td>70</td>
<td>49</td>
<td>132</td>
<td>288</td>
<td>68</td>
<td>182</td>
<td>257</td>
</tr>
<tr>
<td>propose</td>
<td>54</td>
<td>288</td>
<td>217</td>
<td>205</td>
<td>160</td>
<td>169</td>
<td>135</td>
<td>192</td>
<td>270</td>
<td>75</td>
<td>536</td>
</tr>
<tr>
<td>suggest</td>
<td>126</td>
<td>59</td>
<td>83</td>
<td>21</td>
<td>12</td>
<td>24</td>
<td>18</td>
<td>23</td>
<td>97</td>
<td>4</td>
<td>58</td>
</tr>
<tr>
<td>require</td>
<td>1</td>
<td>95</td>
<td>24</td>
<td>13</td>
<td>0</td>
<td>20</td>
<td>8</td>
<td>600</td>
<td>2</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>request</td>
<td>448</td>
<td>322</td>
<td>517</td>
<td>246</td>
<td>524</td>
<td>290</td>
<td>314</td>
<td>840</td>
<td>333</td>
<td>311</td>
<td>277</td>
</tr>
</tbody>
</table>

|        | 356     | 420      | 291            | 336 | 811 | 482  | 523              | 158           | 176        | 293    | 292                    |

| Totals (by discipline) | 1338 | 2220 | 1985 | 1659 | 2036 | 1814 | 1787 | 2869 | 1466 | 1347 | 1677 | 20,198 |

Table 4.2: Preliminary Concordance Results Less Extraneous Uses
4.2. Secondary Analysis: Form

Concordancing revealed that the lexical items were realized in various ways in the corpus. Table 4.3 below presents the five most frequent manifestations of each lemma (see Appendix A for a comprehensive listing).

<table>
<thead>
<tr>
<th>Lexical Item</th>
<th>Five Most Frequent Realizations and their Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>ask</td>
<td>asked (526), ask (219), asking (131), asks (62), bid/askspread (26)</td>
</tr>
<tr>
<td>demand</td>
<td>demand (649), demands (233), demanding (62), demanded (46), demand-driven (6)</td>
</tr>
<tr>
<td>direct</td>
<td>direct (1270), directly (1046), direction (864), directions (352), directors (171)</td>
</tr>
<tr>
<td>insist</td>
<td>insist (27), insisted (24), insists (22), insistence (21), insisting (9), insistent (5)</td>
</tr>
<tr>
<td>order</td>
<td>order (2794), orders (162), ordered (81), ordering (70), orderly (16)</td>
</tr>
<tr>
<td>propose</td>
<td>proposed (1309), proposition (377), propose (317), proposal (152), proposals (133)</td>
</tr>
<tr>
<td>recommend</td>
<td>recommended (285), recommendations (104), recommendation (68), recommend (49), recommends (19)</td>
</tr>
<tr>
<td>request</td>
<td>requests (358), request (312), requested (115), requesting (25), request’s (3)</td>
</tr>
<tr>
<td>require</td>
<td>required (1726), requires (842), requirements (718), require (653), requirement (358)</td>
</tr>
<tr>
<td>suggest</td>
<td>suggests (1260), suggest (1218), suggested (910), suggesting (531), suggestion (90)</td>
</tr>
</tbody>
</table>

Variations on the lexical item, as overviewed in brief above in Table 4.3 and in detail in Appendix A, were not, as the second research question asks, manifested solely as verb constituents (e.g., direct, directed, directing, directs). Results of an analysis of form show that the realizations of the lexical items were also manifested as nouns (e.g., direction, directive, director, directory), adjectives (e.g., direct, directional), adverbs (e.g., directly, directionally) and others. Figures 4.1 to 4.10 depict each item (ask, demand, direct, insist, order, propose, recommend, request, require and suggest) broken down by word class.
Lexical Items by Word Class in the ISURAC

Figure 4.1: ask

Figure 4.2: demand

Figure 4.3: direct

Figure 4.4: insist

Figure 4.5: order

Figure 4.6: propose
Figures 4.1 to 4.10 demonstrate that *ask, insist, require* and *suggest* appear to be the most frequently used as verbs of the 10 lexical items, with over two-thirds of their occurrences in the corpus representing a verb use. *Propose* and *recommend* rank in as the second-most frequent, with approximately half of their manifestations functioning as verbs; *demand* and *request* do so less than a quarter of the time, while *direct* and *order* in particular almost never manifest themselves as verbs in the corpus.

Based on this information, an informal hypothesis was formed: if the mandative subjunctive structure is indeed “triggered” by a verb controlling a *that*-clause, then *ask, insist, require* and *suggest* should produce the form more consistently than the other lexical items.
The numerical data corresponding to the verb sections of the pie graphs in Figures 4.1 to 4.10 follow in Table 4.4 below.

| Table 4.4: Frequency Distributions of the Lexical Items as Verb Constituents |
|---------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| ask                            | 4     | 353   | 125    | 123   | 9      | 127    | 20      | 65      | 3       | 8      | 17      | 854    |
| demand                         | 1     | 13    | 29     | 39    | 3      | 26     | 14      | 15      | 3       | 3      | 0       | 146    |
| direct                         | 5     | 46    | 49     | 66    | 26     | 17     | 4       | 17      | 9       | 16     | 8       | 263    |
| insist                         | 0     | 8     | 18     | 42    | 0      | 5      | 3       | 1       | 0       | 5      | 0       | 82     |
| order                          | 3     | 10    | 9      | 14    | 4      | 4      | 2       | 18      | 0       | 4      | 10      | 77     |
| propose                        | 49    | 69    | 117    | 102   | 135    | 74     | 63      | 148     | 160     | 58     | 321     | 1296   |
| recommend                      | 26    | 20    | 40     | 7     | 5      | 14     | 7       | 18      | 63      | 4      | 43      | 247    |
| request                        | 1     | 29    | 14     | 6     | 0      | 14     | 8       | 66      | 0       | 2      | 140     |        |
| require                        | 187   | 272   | 305    | 190   | 461    | 222    | 200     | 594     | 251     | 223    | 233     | 3138   |
| suggest                        | 341   | 378   | 246    | 286   | 795    | 458    | 510     | 145     | 169     | 267    | 272     | 3867   |
| Totals (by discipline)         | 617   | 1198  | 952    | 875   | 1438   | 961    | 831     | 1087    | 658     | 588    | 906     | 10,110 |

Based on the totals (by discipline) of Table 4.4 above, the four disciplines containing the highest frequencies of the lexical items as verbs (collectively) were selected for in-depth analysis due to the fact that they could potentially trigger the mandative subjunctive structure.

Figure 4.11: Frequency of Lexical Items as Verbs in the ISURAC
As can be inferred from Table 4.4 and Figure 4.11, the four disciplines chosen for the three subsequent analyses consisted of two social sciences, Applied Linguistics and Business, and two hard sciences, Biology and Electrical & Computer Engineering. Biology boasted the highest number of the lexical items appearing as verbs (1438), followed by Applied Linguistics (1198), Electrical & Computer Engineering (1087), and Business (961).

4.3. Tertiary Analysis: Pattern

The results of the pattern analysis indicate that four of the lexical items as verbs rarely co-occur with that-clauses in actual use: direct and order never co-occur with a that-clause, while ask does only .18% and request .92% of the time. Four more of the lexical items co-occur with that-clauses only somewhat more frequently: require (4.91%), demand (10.53%), recommend (14.04%) and propose (16.43%). Insist co-occurs with a that-clause 28.57% of the time, while suggest, with 65.93% of all its instances co-occurring with that-clauses, demonstrates the highest rate of co-occurrence. A comparison by lexical item of that-clause co-occurrence versus non-co-occurrence is represented in Table 4.5 below and Figure 4.12 on the next page, with a graphical representation for each in Appendix B.

<table>
<thead>
<tr>
<th>Lexical Item</th>
<th>+ that-clause</th>
<th>no that-clause</th>
<th>that-clause co-occurrence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ask</td>
<td>1</td>
<td>553</td>
<td>0.18</td>
</tr>
<tr>
<td>demand</td>
<td>6</td>
<td>51</td>
<td>10.53</td>
</tr>
<tr>
<td>direct</td>
<td>0</td>
<td>106</td>
<td>0.00</td>
</tr>
<tr>
<td>insist</td>
<td>4</td>
<td>10</td>
<td>28.57</td>
</tr>
<tr>
<td>order</td>
<td>0</td>
<td>36</td>
<td>0.00</td>
</tr>
<tr>
<td>propose</td>
<td>70</td>
<td>356</td>
<td>16.43</td>
</tr>
<tr>
<td>recommend</td>
<td>8</td>
<td>49</td>
<td>14.04</td>
</tr>
<tr>
<td>request</td>
<td>1</td>
<td>108</td>
<td>0.92</td>
</tr>
<tr>
<td>require</td>
<td>76</td>
<td>1473</td>
<td>4.91</td>
</tr>
<tr>
<td>suggest</td>
<td>1171</td>
<td>605</td>
<td>65.93</td>
</tr>
</tbody>
</table>

Of the 1337 instances of the lexical items co-occurring with a that-clause, just 50 (3.74%) actually triggered a subjunctive structure. Table 4.6 reveals that four of the lexical items (direct, insist, order and request) did not trigger the mandative subjunctive even once, whereas ask, demand, and recommend do only once apiece; samples of each of these are found after Table 4.6.
Figure 4.12: That-clause Co-occurrence vs. Non-co-occurrence by Lexical Item

Propose produced three instances of the mandative subjunctive pattern in the that-complement clause, suggest eight, and require 36. The verb require is noteworthy, as it triggers the subjunctive more often than modals or non-subjunctives, which was atypical of the present data set. Again, a sample of a mandative subjunctive structure per MST can be found following Table 4.6 below, while a complete listing of all of the instances of the mandative subjunctive structure occurring in the sub-corpus is located in Appendix C.

<table>
<thead>
<tr>
<th>Lexical Item</th>
<th>Subjunctive</th>
<th>Modal</th>
<th>Non-Subj</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>ask</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>demand</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>direct</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>insist</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>order</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>propose</td>
<td>3</td>
<td>15</td>
<td>51</td>
<td>1</td>
</tr>
<tr>
<td>recommend</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>request</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>require</td>
<td>36</td>
<td>2</td>
<td>32</td>
<td>6</td>
</tr>
<tr>
<td>suggest</td>
<td>8</td>
<td>354</td>
<td>807</td>
<td>2</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>50</strong></td>
<td><strong>378</strong></td>
<td><strong>898</strong></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>
Samples of mandative subjunctive structures occurring in the ISURAC

ask
... involving a mining company’s impact upon human rights—the Rio Tinto case involving human rights violations in New Guinea. The Department asked that it be dismissed and the judge agreed. While this case was quite different, it also raises the question of ... (Bus)

demand
... came to believe that the power of multinationals to influence the U.S. and foreign governments must be checked. They demanded that the U.S. government send clear signals as to what business practices were unacceptable and how violators would be punished. ... (Bus)

propose
... reduces their rate of divergence between species, relative to those levels experienced by the core genes. Lan and Reeves thus propose that the species-specific shared, core genes, which comprise the shared species genome, be used to define species boundaries. The consensus molecular ... (Bio)

recommend
... the British government should promote consensus on such codes of practice “whilst ensuring a level playing field.” It also recommended that the government integrate CSR more widely into procurement practices. The third ministerial working group looked at social labeling. It ... (Bus)

require
... abilities to understand and use mainstream narratives to succeed in the academic setting. By third through fifth grades, mainstream curricula require that students be able to comprehend and to produce goal-directed stories. Such stories rely on thoughts and feelings of characters to ... (App Ling)

suggest
... into their lives. The system now allows them to easily add new contacts manually, one at a time. Users also suggested that any automatic updates be incremental and preserve the spatial relations among preexisting contacts. They viewed ContactMap as a visual workspace ... (Elec Eng)
It is evident that, even when functioning as verbs, the lexical items do not always co-occur with *that*-clauses—nor do they always trigger the mandative subjunctive in actual use in published research articles. Figure 4.13 above compares the percentages of mandative subjunctive structures (by MST) to those of the other structures with which they were found to co-occur: modals, non-subjunctives and others.

Several of the lexical items were found to trigger modals: *require* (3%), *propose* (21%), *suggest* (30%), *insist* (50%) and *recommend* 63% of the time. For example:

... Internet Relay Chat (IRC). Log-file analysis is becoming the greatest time consumer for system administrators. Identifying actual intrusions and misuses requires that they must know the user’s intentions while examining the user’s activity because the same activity can have a more disconcerting ... (Elec Eng)
... in neurite extension. We further determined that extracellular domain four of N-cadherin was necessary and sufficient for this activity and proposed that it may interact directly with the FGF receptor (Kim et al. 2000). Hazan’s laboratory recently showed that N-cadherin is also ... (Bio)

... is user friendly for consumers in one culture may be different for another group of consumers in another culture. This suggests that Web interfaces should be designed with the correct mix of cognitive and behavioral stimuli for the different cultural audiences. Conclusion ... (Elec Eng)

... when the paper is assigned and ends when we hand back that last draft. Plus, it bears great weight (some insist that grading should be done away with in comp classes) in terms of the whole process, their process, of addressing and ... (App Ling)

... Citizenship at Diego (a leading food maker which owns Pillsbury and other big U.S. brands as well). The group recommended that ultimately for CSR to succeed, companies would have to adopt “internationally agreed Codes of Practice.” The Group also suggested ... (Bus)

Others were found to trigger non-subjunctive structures: recommend (25%), require (43%), demand and insist (50%), suggest (69%), propose (73%), and request 100% of the time.

These non-subjunctive structures could consist of the base form of a verb displaying subject-verb concord (e.g. plurals); any finite verb form (including primary auxiliaries, but excluding modal auxiliaries, as they have their own category); or any verb phrase displaying aspect (i.e., perfects or progressives) or voice (e.g., passives), as in the following samples:

... Unfortunately, all timings—such as average frame time, total time, and so on—can’t be made such without losing their meaning. We recommend that users report both the deviation and continuity. The deviation reports a deviation globally, while the continuity is good because ... (Elec Eng)

... environmental conditions is then called a reaction norm (Schmalhausen, 1949). As for any biological feature, the evolution of phenotypic plasticity requires that (1) it is adaptive, (2) it is genetically based, and (3) it exhibits sufficient genetic variability in the population considered. ... (Bio)

... or something. K1 106. Teacher: Yep. Marion is her servant. Good. In move 103, David selects imperative mood as he demands that students stop reading. However, the imperative force of this demand is mitigated, both by his selection of the inclusive ("let's" ... (App Ling)
... dispute was not satisfactorily resolved. The end of April marked 6 months of the experimental 1-mile buffer zone. The monks insisted that this was not acceptable. In an attempt to break the stalemate, Mother Tessa requested to meet alone with Mr. Irving ... (Bus)

... intensity of courtship behaviour and the rate and intensity of courtship song (e.g. Partridge et al., 1987b). We thus suggest that female mate choice for large males in D. melanogaster results primarily from sexually antagonistic coevolution, where female preference for large ... (Bio)

... We can roughly divide theories of object perception into two general approaches: image- and structure-based perception. Image-based theories propose that human perception stores multiple views of an object in memory, specifying processes for matching the stored views to what’s ... (Elec Eng)

... asked to record on audio tape recorders the natural spontaneous classroom discourse that took place during literacy-oriented lessons. We specifically requested that teachers do not prepare special lessons or activities, but rather engage in everyday interactions with their students. Teachers were asked ... (App Ling)

The final category of the new taxonomy is ‘other’, which houses all those examples that were unclassifiable due to symbols or undecipherable text, lack of subject-verb concord (with a plural subject), or certain literary constructions, such as:

... C) > T(A) + T(B). (1) Now, assume that A marries B, and C marries D. Equal taxation of couples demands that T(AB) = T(CD). (2) Marriage neutrality demands that T(A) + T(B) = T(AB) (3) and that T(C) ... (Bio)

... P-cadherin is highly expressed by the basal cells of the epidermis and on the hair matrix. Nishimura et al. (1999) proposed that changes in expression of E-cadherin and P-cadherin in the melanoblast leads to differential interactions with the surrounding cells and serves ... (Bio)

... coefficient b is the true effect of TSPs on infant mortality. For consistent estimation, the least squares estimator of b requires that E[ xjt z ejt ] 5 0. If there are omitted permanent (aj) or transitory (ujt) factors that covary with TSPs ... (Bus)

... we found empirical support for all hypotheses except Hypothesis 4. DISCUSSION This meta-analysis suggests that the higher a firm’s corporate social performance the lower the financial risk incurred by the firm. That is, being a ... (Bus)
Finally, a pattern analysis of the instances of the lexical items as verbs not co-occuring with *that*-clauses did not reveal many instances of the mandative subjunctive structure introduced by a zero (*that*) complementizer in the ISURAC (only three out of 3347 strings of non-*that*-clause co-occurrence (.000009%)); however, the three instances which were discovered verified that the possibility did exist. In addition, other patterns conforming to the taxonomy classifications were found during this analysis: the frequency distribution of the grammatical patterns of the structures of zero *that*-complement clauses can be seen in *Table 4.7*, with the three examples of the MS structure immediately following.

*Table 4.7: Distributions of the Grammatical Pattern of Zero That-Complement Clauses*

<table>
<thead>
<tr>
<th>Lexical Item</th>
<th>Subjunctive</th>
<th>Modal</th>
<th>Non-Subj</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>ask</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>demand</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>direct</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>insist</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>order</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>propose</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>recommend</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>request</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>require</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>suggest</td>
<td>2</td>
<td>4</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>3</strong></td>
<td><strong>5</strong></td>
<td><strong>25</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>

... and subsequently solicit completed questionnaires from both users and ISF professionals. Before we would include a company’s answers, however, we **required** respondents from both the user department and the ISF be involved with each IT innovation from inception through implementation. After ... (Elec Eng)

... use of computer-assisted instruction to improve mentally retarded individuals’ language skills, recommending development of learner-based applications for this group and **suggesting** the computer be used by students and instructors in a shared context. Strommer et al. found that including images along ... (Elec Eng)

... views might be appropriate here. Some users also talked about the visual complexity of the network when executing specific tasks, **suggesting** **ContactMap** **construct** task-specific views where relevant parts of the network are highlighted and others hidden when they execute certain tasks. ... (Elec Eng)
4.4. Quaternary Analysis: Structure

No significant general correlation was found between the form of MST in the main clause and the structure (verb form) triggered in the complement clause. Table 4.8 below shows the frequency and distribution of each type of correspondence by lexical item. The data indicate that propose tends to occur in present tense and trigger a non-subjunctive (finite) verb form (23/65 occurrences), and while the same is true for require (25/73), it seems to prefer the present…subjunctive structural pairing even more, with 32 of its 73 occurrences

<table>
<thead>
<tr>
<th>Main clause…that-complement clause (see List of Acronyms and Abbreviations, p. vii, for key)</th>
<th>ask</th>
<th>demand</th>
<th>direct</th>
<th>insist</th>
<th>order</th>
<th>propose</th>
<th>recommend</th>
<th>request</th>
<th>require</th>
<th>suggest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present…subj</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>32</td>
<td>3</td>
</tr>
<tr>
<td>Present…modal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>248</td>
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<tr>
<td>Present…non-subj</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>23</td>
<td>1</td>
<td>-</td>
<td>25</td>
<td>547</td>
</tr>
<tr>
<td>Past…subj</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Past…modal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>6</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>23</td>
</tr>
<tr>
<td>Past…non-subj</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>8</td>
<td>-</td>
<td>1</td>
<td>4</td>
<td>70</td>
</tr>
<tr>
<td>P aux…subj</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>P aux…modal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>P aux…non-subj</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>M aux…subj</td>
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<td>M aux pass…non-subj</td>
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<td>Pres perf…subj</td>
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<td>Inf…non-subj</td>
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<td>18</td>
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<tr>
<td><strong>Totals</strong> (without ‘other’ functions, but with zero that-clauses)</td>
<td><strong>1</strong></td>
<td><strong>4</strong></td>
<td><strong>0</strong></td>
<td><strong>5</strong></td>
<td><strong>0</strong></td>
<td><strong>65</strong></td>
<td><strong>8</strong></td>
<td><strong>1</strong></td>
<td><strong>73</strong></td>
<td><strong>1185</strong></td>
</tr>
</tbody>
</table>
clustering into that category. *Suggest* again demonstrates its high frequency and flexibility of use, which spreads out over almost all of the possible pairings. Although *suggest* is highly flexible, it only really favors two pairings: the present…non-subjunctive (547/1185) and the present…modal (248/1185) combinations.

A structural analysis of the MSTs of the MS structures revealed that there is a tendency for the form of the trigger to occur in present tense: 44/50 occurrences (88%) conformed to this pattern, as in:

> ... grammars exist would hinder a modeler’s ability to understand why certain grammars might or might not be advantageous. We therefore **propose** that grammar-based and cognitive-based approaches **be** combined to create methods for comparing modeling techniques. Framework for Comparison Given these considerations, ... (Elec Eng)

The remaining six included five instances of the trigger in past tense (10%) and one instance of the MS construction triggered by an –ing clause (2%):

> ... of the policy. Specifics should be included as to how to handle a variety of potential situations. It is also **suggested** that employees **be** required to sign a statement saying they have read and understand the policy. Figure 1 contains a sample ... (Bus)

> ... someone’s action. Rights can be negative by requiring that others not interfere in someone’s actions; they can be positive by **requiring** that someone **confer** some benefit; and they can be reciprocal by requiring that a community’s members offer one another both forbearance ... (Bus)

### 4.5. Quinary Analysis: Function

The semantic analysis revealed that of the 50 structures identified as mandative subjunctives, 24 (48%) were used to “call for a particular action” (Peters, 2004, p. 520) or “propose a potential course of action (rather than report information)” (Biber et al., 1999, p. 667): one in Applied Linguistics, five in Biology, 12 in Business, and six in Electrical & Computer Engineering. *Figures 4.14 to 4.17* demonstrate the functionality of the MS structures in each of the four disciplines, contrasting the “proposed course of action” function
to “other” functions; each figure is followed with an example of an MS structure from the sub-corpus it represents, wherein the writer appears to use it to call for a particular action.

![Figure 4.14: Function of MS Structures in Applied Linguistics]

... The criterion that academic studies be applied to practical situations is so strong that the editorial policy of the journal requires that every article accepted for publication include a section on implications for managers. 2.2. Nonverbal text Editorial policies take into ... (App Ling)

![Figure 4.15: Function of MS Structures in Biology]

... employed. Because of the profound differences between eukaryotes and prokaryotes with regard to reproduction, application of the BSC to bacteria requires that the definition of an interbreeding group be revised to include groups participating in LGT, and that barriers to reproduction be ... (Bio)
... pecking order for the distribution of life-saving health care products, macro social contracts might, in their respect for human life, suggest that such products be made accessible to all, particularly those in need. Referring back to the inherent tension between economic and ... (Bus)

... grammars exist would hinder a modeler’s ability to understand why certain grammars might or might not be advantageous. We therefore propose that grammar-based and cognitive-based approaches be combined to create methods for comparing modeling techniques. Framework for Comparison Given these considerations, ... (Elec Eng)
Figures 4.14 to 4.17 further reveal that even though the verbs *require* and *suggest* frequently trigger the mandative subjunctive structure, their function is not always to call for a proposed course of action.

As far as differentiated use within the disciplines is concerned, it appears that writers of research articles in the field of Business use the MS structure to call for a particular action more frequently than writers of research articles in Applied Linguistics, Biology and Electrical & Computer Engineering (see *Figure 4.18*), although trends are not generalizable due to small numbers of occurrences.

![Figure 4.18: Functional Analysis of MS Structures: Proposed Course of Action](image)

As for the MS structures not used to propose a course of action, there are no generalizable trends in functionality, except for the use of *require* in Electrical & Computer Engineering, which is used 17 times, or 34% of the total occurrences of the MS structure (see *Figure 4.19*), generally to report a necessary condition, as in:

... data into subvolumes with sizes matching the available texture memory on each graphics pipe. Note that most graphics- hardware implementations *require* that texture dimensions *be* a power of two. The original volume may need to be supersampled or padded to match this ... (Elec Eng).
Figure 4.19: Functional Analysis of MS Structures: Other
CHAPTER 5: DISCUSSION AND CONCLUSIONS

In this study, 10 lexical items previously identified as mandative subjunctive triggers (MSTs) were analyzed in a corpus of published research articles using a variety of quantitative and qualitative methods in order to gain a better understanding of the discourse factors that contribute to their triggering/non-triggering of the mandative subjunctive structure in academic writing. This final chapter will 1) summarize the results of this study and discuss its main findings, 2) offer pedagogical implications and applications of these findings, 3) address the limitations of the present study, and 4) suggest directions for further research.

5.1. Summary of the Results

The first research question asked for the frequency distribution of the selected lexical items in the corpus; direct was found to be the most frequent, followed by require and suggest. The discipline of Electronic & Computer Engineering contained the highest number of the 10 lexical items collectively, Applied Linguistics the second, and Biology the third. This preliminary analysis also demonstrated the importance of combining automatic and human analytic techniques “to verify the accuracy of automatic analyses and to correct any inaccurate analyses that would affect results” (Biber et al., 1998), as nearly 10% of the data returned in the initial concordancing was irrelevant.

The second research question explored the word class of the lexical items in context, uncovering that they were not manifested strictly as lexical verbs. Ask, insist, require and suggest appeared most frequently as verbs, followed by propose and recommend, then demand and request, while direct and order almost never manifested themselves as verbs in the corpus. This finding illustrates the value of a corpus-based approach to minimize intuition in favor of description, as ‘linguists’ intuitions about language are often wrong” (Biber, 2001, p. 101): prior to beginning this investigation, it was thought that only instances of direct as an adjective and order and demand as nouns would have to be excluded. These results point not only to the high degree of flexibility of these items in actual use, but also to
their discipline-specific uses, such as *bid/askspread* in Business or *demand* in Electrical & Computer Engineering.

The third research question sought to determine if the instances of the lexical items as lexical verbs (hypothesized MSTs) co-occurred with *that*-clauses and subjunctive verb forms in the corpus. Analysis revealed that when functioning as verbs, the majority of the lexical items rarely co-occurred with *that*-clauses in published research articles; *insist* did some of the time (around 29%), while *suggest* did more frequently (over half the time). Of the 1337 *that*-clause co-occurrences, only 50 contained an actual subjunctive verb form.

The fourth research question examined the structure of the main clause in relation to the structure in the subordinate *that*-clause. No significant general correlations were found; however, of the 50 structures identified as mandative subjunctives, 44 (88%) were triggered by MSTs occurring in present tense.

The final research question called for a functional analysis of the MS structures and requested a comparative analysis of their use across disciplines. Semantic analysis indicated that almost half of the mandative subjunctive structures (24, or 48%) were used to call for a particular action (Peters, 2004) or to propose a potential course of action (Biber et al., 1999); the other 26 represented various functions, the main one being *require* in Electrical & Computer Engineering, which was used 17 times (34% of the total occurrences of the MS structure) to report a necessary condition. Although a cross-discipline comparison revealed no generalizable findings, it appears that writers of research articles in the field of Business use the MS structure to call for a particular action more frequently than writers of research articles in Applied Linguistics, Biology and Electrical & Computer Engineering.

### 5.2. Interpretations

The present study has attempted to characterize the mandative subjunctive in academic writing by providing evidence of its use exclusively in that register; therefore, generalizations cannot be extended into other registers to address claims of its purported “disappearance” from the English language. However, Peters’ (1998) study of MS triggers in the million-word ACE Corpus (of non-fiction and fiction texts) found the 10 lexical items in question here to trigger the MS structure 58 times; thus, if her findings were normalized to
2,000,000 words (comparable to sub-corpus of the ISURAC), the number would be expected to double to more or less 116 occurrences. Crawford and Albakry (2004) found these same 10 items to trigger the MS structure 184 times in a 2.5 million word corpus of news writing, for a normalized approximation of 147 times. Therefore, it appears that the structure is faring quite well in other written registers. So, although the structure was found to be a relatively infrequent one in published research articles—occurring just 50 times in a corpus of nearly two million words—it is still frequent and stable enough perhaps to no longer deserve to be described in the literature as ‘moribund’ or ‘nearly extinct’.

One factor that may have affected the frequency count of the MS structure in the present study was number. Often, it was difficult to classify whether the verb was singular or plural, so these “ambiguous subjects” were not included in the count. Subjects such as “the U.S. government,” as in “They demanded that the U.S. government send clear signals,” from the Business sub-corpus, however, were, for by definition of form, considered singular subjects and included in the MS count, although the writer’s intention will never be known (i.e., it may have been viewed as a collective plural and therefore the third-person plural form of the verb was used). Plurals subjects expressing a proposed course of action were not counted because, although they met the functional definition of the MS structure, they did not meet its criteria for form.

Another variable affecting the frequency count, although to a smaller degree, was negation. Johansson and Norheim (1988) report that there is “no do-periphrasis in negative constructions” of the MS (p. 27). This indicator of the subjunctive was not discovered until after the data analysis of the present investigation was complete and thus not accounted for in the methodology, so a few instances of the negative MS structure, such as the sample that follows, do not appear in the count.

... takes on meaning. Rights without designated and recognized duties are mere pleas for someone’s action. Rights can be negative by requiring that others not interfere in someone’s actions; they can be positive by requiring that someone confer some benefit; and they can ... (Bus)

A second objective of the present research was to determine the role of the mandative subjunctive in academic writing and establish whether prescriptive rules governing its usage
indeed match its actual use. It appears that while English grammars provide sufficient information about the form of the MS structure (a certain type of controlling verb + that + a singular subject + uninflected (base) form of the verb), they could provide much more information about its function; more research may be needed, however, before that can happen.

Early in this study, an informal hypothesis was formed: if the MS structure was indeed triggered by a verb controlling a that-clause, then ask, insist, require and suggest should produce the form more consistently than the other lexical items since they were most often manifested as verbs in the corpus. Figure 4.13 would seem to confirm that, as ask was found to trigger an MS structure 100% of the time, require 49% and so on. However, a closer inspection reveals that insist does not trigger the structure even once; suggest triggers it only 1% of the time; and, although ask triggers the MS structure 100% of the time, it does so one time out of one occurrence. Therefore, the only “true” MS trigger found in this investigation, and very unreliably at that, was require.

Require itself was peculiar because, of its 36 occurrences of the MS structure, 11 co-occur with the uninflected be form of the verb, though not to propose a course of action, but rather to report a necessary condition. This may be explained if one considers Turner’s (1980) claim that “the increased formality associated with the use of the passive voice encourages the selection of the marked subjunctive form” (p. 276) and that:

“the verb to be, as so frequently in the history of the language, has resisted developments affecting the majority of other verbs and has remained a stronghold of the subjunctive. It is highly significant, of course, that whereas for all other verbs the present subjunctive in Modern English is marked solely in the third person singular, for the verb to be, the whole of the present tense has retained distinctive forms” (ibid).

Due to the claims of previous researchers (“that-clauses with the Subjunctive can be converted into that-clauses with should without any change of meaning” (Leech, 2004, S. 165)), and separate categories of classification for modals of previous studies (“the periphrastic subjunctive” (Overgaard, 1995) or “subjunctive paraphrases” (modals and quasi-modals (Peters, 1998)), a separate category for modals was also allowed for in the design of the present study. However, modals did not play as significant a role in the outcome of this
investigation as thought prior to beginning it: only *suggest* returned any substantial data, with 30% of its instances representing a modal co-occurrence, the majority of which were in fact *should*.

Finally, concerning *that*-clause co-occurrence, one significant finding of the present study was that the 10 lexical items in focus here did not regularly co-occur with *that* in the context of academic writing, as English handbooks often prescribe. Only *suggest* co-occurred with *that* over half the time in academic writing. The check for the zero (*that*) complementizer did not turn up many instances—there were only 33 (out of the 3347 non-*that*-clause co-occurrences) versus 1337 *that*-clause co-occurrences; this time, the grammar manual’s claims were substantiated: “retention of *that* is the norm in academic prose” (Biber et al., 1999, p. 680).

5.3. *Pedagogical Implications and Applications*

More and more, corpus linguistics is seen as “not only expanding our understanding of linguistic phenomena but also becoming an increasingly powerful pedagogical tool for both students of linguistics and learners of languages” (Simpson & Swales, 2001, p. 3), with the case for using corpora in the classroom being featured to a greater extent recently in the literature of applied linguistics (Johns, 1994; Partington, 1998; Conrad, 1999, 2000; Biber & Conrad, 2001).

Corpora may be used either *prior to* instruction (e.g., in materials design or lesson planning): “even simple quantitative analyses can provide important information that teachers and material writers can use to revise current teaching materials” (Biber & Conrad, 2001, p. 333); or *during* instruction, as in “data-driven learning” (Johns, 1991, 1994): the DDL approach “makes possible a new style of ‘grammatical consciousness-raising’” (Rutherford, 1987) by placing the learner’s own discovery of grammar at the centre of language learning” (Johns, 1991 in Partington, 1998, p. 6).

Considering the complexity of the factors triggering the MS structure, and recognizing that textbooks often “simplify a complex linguistic situation for pedagogical purposes,” (Lee, 2006, p. 91), instructors of English for academic purposes could opt to use “real-life” samples gleaned from a corpus to introduce this structure to students instead of
material in a textbook; alternatively, if technology is available, students could perform concordances themselves in search of the MS structure in the corpus.

However, exploring rare grammatical features like the MS structure through DDL wouldn’t be appropriate for just any learner, especially not one in a general or introductory-level English class; in fact, it would be most effective to address the topic if 1) a student first noticed the structure in a meaningful context—a “focus on form” approach (Long, 1991); 2) there was “developmental readiness” on the part of the student (Pienemann, 1989); and 3) the primary objective of the lesson was on “consciousness-raising” and not on production (Fotos, 1993), as “[w]e cannot assume that with mere presentation of language information, whether implicitly or explicitly, learners will necessarily convert it to output” (Gass & Selinker, 2001, p. 412).

The concept of grammatical consciousness-raising, or attention or salience, is a core issue of instructed second language acquisition (SLA), yet the factors promoting it are not entirely understood. However, frequency, and in this case infrequency, are thought to be two of the main contributors:

“particularly at more advanced stages of learning, stages at which expectations of language data are well established, something that is unusual because of its infrequency may stand out for a learner. For example, given a particular context, one that is familiar to the learner, a new word or phrase may appear. This then may be noticed by the learner, and it thus available for eventual integration into the learner’s system” (Gass & Selinker, 2001, p. 402).

Therefore, the findings of the present study could be applied in an English for academic purposes class, where students with an advanced level of English and a good understanding of the conventions of published research articles would participate in activities to become aware of the MS structure and inductively “discover” its use(s) for the purpose of comprehension, and not necessarily production.

5.4. Limitations

Although this study was carefully planned and carried out, a few caveats were still encountered and should be mentioned here before closing. First, the size of the corpus,
although large (4,891,820 words in the ISURAC as a whole and 1,746,917 in the four sub-corpora), could have been even larger to explore a rare grammatical phenomenon.

Second, because much of the analysis involved in this investigation had to be conducted by hand, the scope of the study, and subsequently its findings, was narrowed. In addition, the human analytic techniques involved in the analyses account for some imprecision in the data; however, this was mitigated to an extent by having a second researcher validate the coding.

Third, the MS structures were not traced back to their original source (i.e., author or journal), a step that might have provided information regarding an individual author’s idiosyncrasy or a particular editor’s style. McEnery and Wilson (2001) would caution, however, against using corpora of professional writing to make assumptions about the writing of an individual author anyway, as “the process of production often means that the work of any supposed author is actually the work of many readers/editors/copyeditors/proof-readers” (p. 193). Still, this step could have provided additional information about who actually uses this structure.

Finally, the approach to grammar used in the present study was limited to the sentence-level. In the future, when conducting a study such as this—one that involves some rather complex discoursal elements—a discourse-based approach to grammar (Celce-Murcia, 1991; Hughes & McCarthy, 1998) should be taken.

5.5. Suggestions for Further Research

While the questions posed at the outset of this study were answered here, others arose in the course of investigation. Findings of the present work could be complemented in the following ways.

Exploring Other Registers. This study looked exclusively at written academic English—specifically, the published research article. Before any generalizations about the use of the mandative subjunctive structure could be made or conclusions drawn about its appearance/disappearance in present-day English, replication studies would need to be performed in other registers. An exploration of the feature in spoken English registers would particularly be in order, as the results of this study indicate that the structure may prefer an
animate subject (which tends not to be the case in some scholarly writing, especially in the sciences).

Examining Alternate Structures. Other than suggest, the lexical items of this investigation did not frequently co-occur with that-clauses when functioning as lexical verbs; therefore, alternate structures may make it possible to achieve the mandative function while “avoiding” the subjunctive construction altogether, as in:

... an agent allows the agent to have actions based on other agents’ requests. For example, a Manager interface agent may **ask a Trader interface agent to report** a particular trading activity and the Trader interface agent reports such activity “reactively.” ... (Elec Eng)

Nichols (1987) also found through her elicitation test that certain verbs tended to prefer certain constructions: order unaccompanied by that, produced the infinitive construction 72% of the time, “as in **ordered him to**” (p. 143), so this area compels further study.

Surveying Native Speaker Attitudes/Writer Intentions. Fowler reported that English speakers found the structure “misused or pretentious” (in Peters, 2004, p. 520) and “fussy, awkward, self-conscious, genteel nonstandard” (in Jacobsson, 1975, p. 219). Celce-Murcia and Larsen-Freeman (1983) have suggested that the subjunctive “may seem overly formal and thus make some native speakers of English uncomfortable” (p. 483). Jacobsson (1975) suggests that native speakers “feel” the structure in discourse even if it is unmarked:

“I suggest that you go now. Although go is not formally marked as subjunctive it must be felt as such by those speakers who invariably say I suggest that he go now... [it] is subjunctive functionally if not morphologically, in much the same way as **sheep** is ‘zero plural’ in many **sheep**. Here, as often elsewhere, absence of formal opposition does not mean absence of functional distinction” (p. 222).

Thus, a qualitative study of the effect(s) of the mandative subjunctive structure on human subjects could be extremely helpful in assembling native speaker perceptions of the less formal definitions of the mandative subjunctive in order to better understand its role in discourse. Additionally, writers themselves could be questioned about their choice to use/not use the structure. Moreover, both groups could be polled about the semantic force of these lexical items (e.g., insist and require vs. propose and suggest), as a possible factor for the triggering/non-triggering of the MS structure.
Quantifying the Distance Factor. Due to the present researcher’s impression that the smaller the distance between the trigger and the verb in the that-clause, the greater the chance of the writer using the subjunctive, a computer program to quantify the distance between the two would be useful. Distance could be a triggering factor, as perhaps the indicative is selected over the subjunctive as the “force” of the mandative gets “lost in discourse” the farther away the verb moves from the trigger.

Performing a Diachronic Analysis. In order to end the disappearance-reappearance debate surrounding the mandative subjunctive, this study could be replicated with similarly built corpora from different periods over the past century. That is, it could be traced diachronically as did Overgaard (1995) or Harsh (1968), who traced it from biblical translations, to secular texts and translations, Middle English dialects, and then modern dramatic texts.

Comparing British and American Use. Most grammarians report a difference in use between British and American varieties of English (Bevier, 1931; Cannon, 1959; Visser, 1966; Jacobsson, 1975; Turner, 1980; Quirk et al., 1990; Overgaard, 1995; Leech, 2004; Peters, 2004), with the general tendency being that the mandative subjunctive construction is used much more frequently in American English. However, as Peters (2004) claims that “[s]igns of a late C20 revival of the mandative subjunctive in British English have been detected by Overgaard (1995), so this regional difference may disappear in C21” (emphasis in original, p. 521), this topic deserves investigation in the near future.

Exploring Temporal Reference. Many of the structures in this study classified as MS were observed to have a future time reference, while the tense of the controlling verb was found to nearly always be present; this aspect alone merits further study from a discourse analysis perspective.

5.6. Conclusions

This corpus-based lexicogrammatical study aimed to identify the linguistic factors contributing to the appearance of the mandative subjunctive structure in academic writing in English. It was concluded through various quantitative and qualitative analyses that the use of the lexical items under investigation here (ask, demand, direct, insist, order, propose,
recommend, request, require and suggest) does not alone trigger the mandative subjunctive, rather that the factors involved in triggering the structure are multiple and complex, going beyond linguistic and into the realms of situational, social, psychological, and pragmatic factors. Therefore, although the structure does appear to co-occur with certain verbs, it would be imprudent to suggest that the concept of “an MST” exists without further research into factors such as these.
## APPENDIX A

### List of Realizations of the Lexical Items and their Frequencies in the ISURAC

<table>
<thead>
<tr>
<th>Lexical Item</th>
<th>Variations and their Frequencies in the Entire Corpus</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>ask</em></td>
<td>ask (219), askance (1), asked (526), asking (131), askprice (7), askquotes (2), asks (62), bid/askspread (26)</td>
</tr>
<tr>
<td><em>demand</em></td>
<td>demand (649), demand-driven (6), demanded (46), demanding (62), demand-led (2), demand-management (2), demands (233), demand-supply (1), demand-to-capacity (1)</td>
</tr>
<tr>
<td><em>direct</em></td>
<td>direct (1270), direct-beam (1), direct-discourse (1), directed (217), directedness (2), directing (32), direction (864), directional (73), directionality (13), directionally (4), direction-finding (1), directions (352), directive (36), directives (113), directivity (2), directly (1046), direct-maternal (2), directness (2), direct-only (1), director (168), director's (6), directorate (6), director-designers (2), directorial (2), directories (6), directors (171), directors’ (12), directorship (3), directorships (1), directory (57), directs (20), direct-volume (1)</td>
</tr>
<tr>
<td><em>insist</em></td>
<td>insist (27), insisted (24), insistence (21), insistent (5), insistently (4), insisting (9), insists (22)</td>
</tr>
<tr>
<td><em>order</em></td>
<td>order (2794), ordered (81), ordered-random (1), ordering (70), orderings (11), orderedliness (3), orderly (16), order-of-complexity (1), order-of-magnitude (1), order-processing (2), order-processing (11), order-routing (1), orders (162), order-statistic (2)</td>
</tr>
<tr>
<td><em>propose</em></td>
<td>proposal (152), proposals (133), propose (317), proposed (1309), proposed-estimators (3), proposer (3), proposers (2), proposes (73), proposing (32), proposition (377), propositional (39), propositionally (2), propositions (84)</td>
</tr>
<tr>
<td><em>recommend</em></td>
<td>recommend (49), recommendation (68), recommendations (104), recommended (285), recommending (11), recommends (19)</td>
</tr>
<tr>
<td><em>request</em></td>
<td>request (312), request’s (3), requested (115), requesting (25), requestor (1), requests (358)</td>
</tr>
<tr>
<td><em>require</em></td>
<td>require (653), required (1726), requirement (358), requirements (718), requires (842), requiring (143)</td>
</tr>
<tr>
<td><em>suggest</em></td>
<td>suggest (1218), suggested (910), suggesting (531), suggestion (90), suggestions (65), suggestive (63), suggests (1260)</td>
</tr>
</tbody>
</table>
APPENDIX B

Instances of Co-occurrences Compared: With and without That-clauses

- **ask**
  - v + that-clause: 600
  - no that-clause: 500

- **demand**
  - v + that-clause: 50
  - no that-clause: 60

- **direct**
  - v + that-clause: 120
  - no that-clause: 100

- **insist**
  - v + that-clause: 12
  - no that-clause: 10

- **order**
  - v + that-clause: 30
  - no that-clause: 40

- **propose**
  - v + that-clause: 300
  - no that-clause: 400
Instances of Co-occurrences Compared, cont’d: With and without That-clauses

- **recommend**
  - v + that-clause: 10
  - no that-clause: 60

- **request**
  - v + that-clause: 0
  - no that-clause: 120

- **require**
  - v + that-clause: 200
  - no that-clause: 1600

- **suggest**
  - v + that-clause: 1400
  - no that-clause: 1200
APPENDIX C

Complete Listing of Occurrences of Mandative Subjunctive Structures in the ISURAC

ask
... involving a mining company’s impact upon human rights—the Rio Tinto case involving human rights violations in New Guinea. The Department asked that it be dismissed and the judge agreed. While this case was quite different, it also raises the question of ... (Bus)

demand
... came to believe that the power of multinationals to influence the U.S. and foreign governments must be checked. They demanded that the U.S. government send clear signals as to what business practices were unacceptable and how violators would be punished. ... (Bus)

direct
0

insist
0

order
0

propose
... reduces their rate of divergence between species, relative to those levels experienced by the core genes. Lan and Reeves thus propose that the species-specific shared, core genes, which comprise the shared species genome, be used to define species boundaries. The consensus molecular ... (Bio)

... potentially serious problem, some analysts have recommended the use of premium-priced stock option plans or indexed options. For example, Rappaport proposes that exercise prices be fixed at a premium above the market price on the date options are granted. He suggests that ... (Bus)

... grammars exist would hinder a modeler’s ability to understand why certain grammars might or might not be advantageous. We therefore propose that grammar-based and cognitive-based approaches be combined to create methods for comparing modeling techniques. Framework for Comparison Given these considerations, ... (Elec Eng)

recommend
... the British government should promote consensus on such codes of practice “whilst ensuring a level playing field.” It also recommended that the government integrate CSR
more widely into procurement practices. The third ministerial working group looked at social labeling. It ... (Bus)

**request**

0

**require**

... abilities to understand and use mainstream narratives to succeed in the academic setting. By third through fifth grades, mainstream curricula require that students be able to comprehend and to produce goal-directed stories. Such stories rely on thoughts and feelings of characters to ... (App Ling)

... The criterion that academic studies be applied to practical situations is so strong that the editorial policy of the journal requires that every article accepted for publication include a section on implications for managers. 2.2. Nonverbal text Editorial policies take into ... (App Ling)

... in which they reached the age of 5 years). Procedures To be successful, the eliciting of narratives in this way requires that the audience be well known to the children. This was the case here. The teacher had worked with the particular ... (App Ling)

... basic to the definition of a stem cell, there is inconsistency about how sustained the self-renewal must be. Some definitions require that stem cells be able to self-renew indefinitely, or at least for the lifetime of the organism, whereas others do not. ... (Bio)

... employed. Because of the profound differences between eukaryotes and prokaryotes with regard to reproduction, application of the BSC to bacteria requires that the definition of an interbreeding group be revised to include groups participating in LGT, and that barriers to reproduction be ... (Bio)

... essential for the establishment and maintenance of tissue architecture. For example, the formation of hollow structures lined by epithelial cells requires that the cells that are not in contact with the basement membrane be eliminated. During embryo cavitation, the ectodermal cells that ... (Bio)

... but these findings are cell-type specific and have not been demonstrated in vivo (Kanduri et al. 2002). The insulator model requires that a given gene and its enhancers be located on opposite sides of the presumed insulator. Although no enhancer for any ... (Bio)

... feedback system that reinforces adhesion and signaling and leads to the formation of focal adhesions. Full execution of this program requires that the matrix be organized in a tri-dimensional network (Cukierman et al. 2001). Genetic studies in flies and worms have revealed ... (Bio)
... to mean that expected profits and wages are equal in the two markets.15 Although our solution concept does not require that wages be equalized, expected wages are the same in both markets in the equilibria we analyze.16 Theorem 1 now ...

... in uncertainty concerning future income is a joint hypothesis on the formation of beliefs and on the precautionary motive. It requires both that planning reduce uncertainty, and that this reduction in uncertainty increase wealth accumulation. The data suggest that while the hypothesis on ...

... to introduce themselves or to discuss the impact that the logging activities might have on the monastery’s livelihood. FSC certification requires that any stakeholder affected by logging operations be consulted beforehand and compensated for any losses resulting from such operations. Although the ...

... rate peg and the non-Ricardian policy render the dynamics of government liabilities inherently unstable. Condition (12), on the other hand, requires that a transversality condition be satisfied in equilibrium. The existence of equilibrium therefore hinges on the initial condition of the system. ...

... hygiene inspections. Restaurants had been subject to hygiene inspections for many years prior to the change, but the new regulation requires that the results of the inspections be revealed to consumers via a standard-format grade card to be prominently displayed in the ...

... someone’s action. Rights can be negative by requiring that others not interfere in someone’s actions; they can be positive by requiring that someone confer some benefit; and they can be reciprocal by requiring that a community’s members offer one another both forbearance ...

... AR applications as well as Azuma et al. for an overview of recent advances in AR. All these interactive applications require that the augmented scene be continually updated as the user moves about the real scene. Hence, while there are several problems ...

... data into subvolumes with sizes matching the available texture memory on each graphics pipe. Note that most graphics-hardware implementations require that texture dimensions be a power of two. The original volume may need to be supersampled or padded to match this ...

... these methods use analyses and conclusions about efficiency and speedup based on randomly generated line lengths and directions (slopes); others require that the majority of
lines drawn not be very short (see the “Earlier Work” sidebar). However, those who study lines know ... (Elec Eng)

... described in detail in Castro and Liskov [2000]. As mentioned earlier, to implement check-pointing and state transfer effi- ciently, we require that the abstract state be encoded as an array of objects, where the objects can have variable size. This representation allows ... (Elec Eng)

... object. The file handles used by the clients are the oids of the corresponding objects. To ensure deterministic behavior, we require that oids be assigned deterministically, and that directory entries returned to a client be ordered lexicographically. Some errors in the NFS ... (Elec Eng)

... and Litow, Castle and Pitteway, Tran-Thong, and many other authors espousing methods based on run length or symmetry techniques all require that the majority of lines not be very short. However, many researchers studying lines know from experience that in general applications ... (Elec Eng)

... image regeneration model for this purpose. In decreasing order of CPU intensity, these three states are as follows: ??Users can require that the 4D slice remain continuously current as they drag the coordinate system. The system spawns several threads (at least one ... (Elec Eng)

... requires that branch prediction accuracy be worse than 95% in order for speculation to hurt performance; the latter (ILP 1) requires that it be lower than 46%. The four labeled points represent the average basic block sizes and branch prediction accuracies for ... (Elec Eng)

... as servlets within existing enterprise web servers. For efficiency and scalability reasons, hosts preferably receive through a nearby ALG, which requires that a sufficient number of servers be deployed across the Internet. Note also that machines that are already directly connected to ... (Elec Eng)

... all instructions in 4 cycles, while a thread with an ILP of 1 would need 16 cycles; the former workload requires that branch prediction accuracy be worse than 95% in order for speculation to hurt performance; the latter (ILP 1) requires that ... (Elec Eng)

... Figure 5 shows an example of selected and unselected subimages and cells. Detecting parameters with a two-step process Equation 5 requires that no more than four parameters be traced, which are the rotating angles for panning (??, ??) and tilting (??), and the focal length ... (Elec Eng)

... the bit vector to a single page). A larger size is used for MGRID because the structure of the program requires that the data set be cubical. The problem size used in our earlier experiments was only 20% larger than the available ... (Elec Eng)
... than the available memory. For FFT, APPLU, and APPBT the problem size used in this experiment is approximately 200MB, which requires that each bit in the bit vector represent two contiguous virtual memory pages (recall from Section 2.4 that we restrict ... (Elec Eng)

... schemes could be used to save storage space, such approaches are not amenable to a GD-like performance-robust technique, as GD requires that an alternate data source be readily available to serve data under a performance fault. When reading a block in a ... (Elec Eng)

... of a handle-based programming model. Instead, it attempts to provide transparent support for fine-grained sharing using VM protection. This effectively requires that every object reside in a separate virtual page. Different virtual pages are mapped to a single physical page by offsetting ... (Elec Eng)

... the user specified memory limit. Then, it must break the update extent into smaller pieces until it does fit. This requires that the data set be separable. More flexible streaming algorithms can switch between dividing a data set by blocks or slabs ... (Elec Eng)

... this, we extend the definition of an unstructured extent to be piece M of N with G ghost levels. This requires that any source of unstructured grid data be capable of supplying ghost cells. There’s a related issue in that some unstructured ... (Elec Eng)

... guarantee that the cells in an extent are collocated or topologically related. So to generate one extent of structured output requires that the algorithm examine all the unstructured data. Although the algorithm can do this within a loop, our current implementation requires ... (Elec Eng)

... consultation or patient assessment and management. The ultimate success of telemedicine as a viable alternative for service delivery and collaboration requires that adopting organizations adequately address issues pertinent to technology and management. One key issue is technology implementation, a fundamental managerial challenge ... (Elec Eng)

... sufficient for reviewing vast periods. Attack analysis Analyzing the collected information and determining if an attack or misuse is occurring requires that an administrator analyze the individual’s intent or behavior. Currently, when suspicious behavior is noted, the individual’s activities are examined, most ... (Elec Eng)

... requested. Supporting parallelism Most large-scale simulations use parallel processing and often the results are distributed across many processing nodes. This requires that the visualization algorithms be capable of operating in such an environment. Supporting parallelism requires some of the same conditions as ... (Elec Eng)

suggest
... threatening situations. Alternatively, if the teacher wished to focus on writing, particularly the writing up of research papers, we might suggest that students' attention be drawn,
through specially designed practice activities, to the use of course-of-event conditionals in operational definitions in Methods ... (App Ling)

... that the more instrumental business orientation typically lends itself to lower levels of moral reasoning than a nonbusiness orientation. We suggest that this be researched further to clarify association between business as an academic major or career and moral reasoning level. Finally, ... (Bus)

... control is heavily emphasized, with a particular focus upon financial risk exposure. However, the “risk net” is spread wider to suggest that a broader span of risks be considered on a regular basis. The aim is not “zero risk” but rather a ... (Bus)

... pecking order for the distribution of life-saving health care products, macro social contracts might, in their respect for human life, suggest that such products be made accessible to all, particularly those in need. Referring back to the inherent tension between economic and ... (Bus)

... of the policy. Specifics should be included as to how to handle a variety of potential situations. It is also suggested that employees be required to sign a statement saying they have read and understand the policy. Figure 1 contains a sample ... (Bus)

... proposes that exercise prices be fixed at a premium above the market price on the date options are granted. He suggests that the exercise price remain at that level throughout the life of the option. Similarly, various kinds of indexed options ... (Bus)

... significant at conventional levels for nonwhite men. Combining these results with insights gained from the experienced agent data discussed above suggests that the bulk of dealer rents accrue when they strike a deal with na•¨ve minority buying agents. This finding may make ... (Bus)

... into their lives. The system now allows them to easily add new contacts manually, one at a time. Users also suggested that any automatic updates be incremental and preserve the spatial relations among preexisting contacts. They viewed ContactMap as a visual workspace ... (Elec Eng)
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