Thesis for the Degree of Master of Arts

# A Study of 'that' Omission in the English Relative Clause




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February 2007

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## (영어 관계사절에서 'that' 생략에 관한 연구)

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by

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# 영어 관계사절에서 ‘that’ 생략에 관한 연구

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요약

언어의 연산적 효율성 (computational efficiency)과 처리상의 용이성 (Ease of processing)이란 두 명제는 음성-접합부 (phonetic interface)에서의 상충이라는 문제를 발생시킨다 (Chomsky 2006). 삭제 (erasure)는 연산의 최소화라는 점에서는 효율성이라는 가치를 가지지만 오히려 복잡한 filler-gap 이라는 문제를 일으키는 역설에 봉착한다. 연결효과 (connectivity effect)는 의미-접합부 (semantic interface)를 충족시키면서 연산적 효율성 (computational efficiency)이 의사소통의 용이성에 우선한다는 것을 보여준다.

본 논문에서는, 보문소 ‘that’의 (비) 출현이 발화와 이해의 상호작용에 끼치는 영향을 영어의 목적격 관계대명사의 생략을 조사함으로써 밝혀보고자 했다. 반응시간의 분석은 언어의 발화와 이해에 연관된 연구방법으로 최근들어 많이 활용되어 오고 있다. 본 논문의 코퍼스 분석 (corpus analysis)과 반응 시간 분석 (RT analysis) 실험 결과는 선행사의 의미적 복잡성이 관계대명사절 내부의 발화상의 난이도에 어떠한 영향을 미치는 지 보여주고 있다. 보문소 ‘that’의 (비) 출현에 관한 최근의 연구들은 관계 대명사절 자체의 발화상의 난이도의 증가와 이해의 용이성 (ease of comprehension)에 영향을 미치는 요인으로, 관계 대명사절 내부의 요인을 지목하고 있다 (Race et al. 2003). 본 논문에서는 Race와 MacDonald의 ‘that’의 출현/비 출현은 목적격 관계대명사절 자체의 발화상의 난이도에 기인한다는 개념을 재 확인하기 위하여, 조사 대상을 관계대명사절의 선행사에까지 확장하여 이를 코퍼스 분석과 반응시간 분석을 통해 선행사의 의미적 복잡성이 목적격 관계대명사 ‘that’의 출현/비 출현에 영향을 미친다는 증거를 제시하고 있다.

**A Study of 'that' Omission in English Relative Clause**

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## Abstract

There is a conflict at the phonetic interface with respect to 'computational efficiency' and 'ease of processing' (Chomsky 2006). Erasure can help minimize the computation, but brings about complicated 'filler-gap' problems. Connectivity effects show the preference of computational efficiency to ease of communication, satisfying the semantic interface (Park 2005).

The optional use of 'that' in the English relative clause also shows such preference of computational efficiency in production to ease of processing in comprehension (Race et al. 2003). But their research on 'that' omission has been focusing at finding the internal factors within the relative clause which increase the burden in production process, and at investigating the reaction of comprehenders to the appearance/absence of 'that.'

In line with the perspective of Race et al. (2003), I carried out further investigations to explore the possibility of existence of another party which is, in this paper, an external factor (antecedent) corresponding to the factors within the scope of relative clause itself. More specifically, I examined the relationship between so-called 'object-relative pronoun' omission and antecedent in the English relative clause by corpus and RT analyses to see whether or not the presence/absence of object relative pronoun 'that' affects the interplay between production and comprehension.

The analyses of reading time (RT) and corpus are frequently used in various related fields (especially language production and comprehension research) over many years. Whereas, according to the RT analysis of this paper, comprehenders are accordingly sensitive to the distributional properties of "that" in language production and the inclusion of "that" is helpful to comprehenders but only in environments that parallel

its use in language production, the corpus analysis in this paper shows that the specificity of antecedent modulates the appearance/absence of ‘that’ in the object relative clause.

# Chapter 1 Introduction

## 1.1 Purposes

One of the biggest questions concerning the human mind is the question of how we, as humans, can be distinguished from other beings. To answer that, we have to find the biggest distinction of humankind from other beings. The language of human beings would be the first on the list. If that is the case, it is so natural that human curiosity provokes the desire to seek the answers to what language and its mechanisms are and how each component of human language interacts with the others.

Language processing can be divided into two parts, which are language production and comprehension. There have been many once-worked-and-vanished theories to the language processing mechanism over the years and there will be presumably a lot more to come.

Park (2005) wrote:

> "To claim that the grammar we have hypothesized in order to explain a range of different facts is "psychologically real" as well as "neurophysiologically real" is to claim that it is correct."

As the paragraph quoted above, to confirm that the hypotheses of any linguistic theories are correct, it would be better to bring them into the realm of scientific rationality, namely cognitive science or psycholinguistics, and then examine accordingly.

Three primary areas that cognitive psychology and generative linguistics have shared are:

(1) a. Language processing (Language production and language perception)
b. Language acquisition by children
c. Language loss in cases of pathology

Among the above-mentioned, (1a) is the field with which the hypothesis of this paper has the most significant relations. Therefore, it will be wise to keep in mind those two fields while reading this paper.

The particular purpose of this paper is to support the speculation that the semantic complexity (specificity or modifiability) of the antecedent to an object relative clause can contribute highly to modulating the production difficulty of its following relative clauses.

There have been two theoretical suggestions from preceding research. First, Race and MacDonald (2003) suggested that the optional use of 'that' is modulated by production difficulty rather than comprehension ease. From their research results, the internal factors which increase production difficulty were found but they did not explore and confirm the possibility that the external factors also can affect the production difficulty.

Second, Mak et al. (2006) hypothesized that the combination of the antecedent of relative clauses and their internal NPs can also create the distributional patterns of perception ease. They scrutinized the relationship between the antecedent (in this present paper, considered as 'the external factor) and the NP (internal factor) with the "Topichood[1]" hypothesis but not other aspects of the antecedent which are possibly animacy, specificity (in this paper, modifiability), and so on.

On the basis of prior research, a new hypothesis can be suggested, which is that the antecedent's semantic complexity can be another factor in raising production difficulty in the following object relative clauses.

To examine the possibility of the existence of other factors which this paper suggests, 2 types of tests will be run. More specifically, corpus analysis and reading time analysis will be presented.

[1] The 'topichood hypothesis' claims that the choice of one of the entities, as the subject of relative clause, is determined by the topicworthiness of the entities.

## 1.2 Organization

The content of this paper is organized as follows:

Chapter 2 addresses the conceptual and theoretical background for the previous research on relative clauses, which are the account of Race et al. (2003), the topichood account of Mak et al. (2006), and “New Entity vs. Old Entity” approach to the production-comprehension system. The actual factors shown by previous researches will be provided to inspect and compare the consistency of this paper with their previous results.

Chapter 3 will introduce the detailed research procedures, methods, and results of two experiments conducted to find another factor which increases the production difficulty.

Chapter 4 will analyze the results of the experiments, discuss their implication, and provide some comments on the previous research related to this paper’s results.

In chapter 5, the conclusion, analyses of the results and their implications will be summarized. The fact that the semantic complexity of the antecedent modulates the burden of both production and comprehension will be reviewed. In addition, some suggestions for further investigation to this object relative pronoun omission will be presented.

# Chapter 2 Theoretical Background

## 2.1 Incremental Nature of Language Production

According to Bock (1982), Kempen et al. (1987), and Levelt (1989), language production is incremental, so that variations in the order in which information is delivered from one component to the next can readily affect the order in which elements appear in speech. When higher level processing components drive lower level ones, incremental production implies that the higher levels need not complete their work on an utterance before the next level begins.

The implementation of incrementality requires the formulation, at every level, of piecemeal units relevant to the form and content of the developing utterance.

## 2.2 Two Strategies in Production

The notion of a series of levels or stages is typically applied to the production of complete sentences as well as individual words, but the case of the sentence is more complicated and less known. Most theories of production imply that speakers generate a representation of its constituent structure in the process of producing a sentence, encoding the relationship

of its constituents as well as word order.

There are two perspectives on its mechanism. In the first perspective (two-stage approach), there is an initial stage where the hierarchical relationship of constituents is confirmed and a second stage where the constituents are placed in their final order (Hartsuiker et al., 2000; Vigliocco et al., 1998). The alternative to the first one is that the hierarchical relationship and linear order are fixed at the same time (Pickering et al., 2002).

To understand the distinction between the two approaches, consider how a speaker would produce a phrase such as (2).

(2) a. chips and a drink
b. a drink and chips

On the two-stage view, the first step is to construct a representation encoding the fact that there is some type of node that dominates both *chips and a drink*. It is important to note that this representation would be exactly the same whether the speaker eventually produces *chips and a drink* or *a drink and chips*. After that, only at the following stage is the linear order of the two constituents fixed.

On the contrary, the single-stage postulates a single production stage in which constituent structure and its liner order are concurrently processed.

In this perspective, (2a), and (2b) do not share a point (a node, in the same conceptual extension of the two-stage approach) which each representation of (2a), and (2b) in production would be the same but more likely these two phrases shows two distinctive syntactic representations.

### 2.3 Comprehension-constraint Approach to Children's English

IM[2] leaves a copy, which is carried to the semantic interface. There is, however, a conflict at the phonetic interface:

(i) Ease of processing (in language perception)

(ii) Minimization of computation (in language production)

A paradox arises due to the fact that (i) and (ii) cannot be satisfied at the same time. For (i), all copies as in (3) are expected to remain to help processing, by eliminating 'filler-gap' problems, but for (ii), they should be erased to minimize the computation (Park, 2005).

As for children's English acquisition process, sentences like (3a), (3b), and (3c) can be easily observed in children's long-distance *wh*-movement (Felser, 2003). In (3a), (3b), and (3c) extra *wh*- markers are still left behind in situ. In (3d), an extra auxiliary verb 'did' is also in situ.

[2] intermediate structure

(3) a. What **do** you think ***what*** Cookie Monster eats?

b. Who **do** you think ***who*** the cat chased?

c. How **do** you think ***how*** superman fixed the car?

d. Why **did** the farmer ***did***n't brush his dog?

Such phenomena as in (3a), (3b), (3c) and (3d) violate (ii), showing that production efficiency does not always take precedence over comprehension ease. The phenomenon as in (3a), (3b), (3c) and (3d) supports comprehension-oriented explanations. Because of the left copy of *wh*- markers, the reanalysis stage is not needed in the process of comprehension.

The left copy of *wh*-movement in children's English as in (3) is positively efficient in ease of processing, whereas the deleted copy of *wh*-marker in Adult's English is also efficient in terms of minimization of computation.

## 2.4 The New Production-constraint Approach to 'that' Omission

Language inherently depends on the integration of production and comprehension, yet each of these processes is typically studied in isolation (isolationist approach). MacDonald (1999) argued against this tendency

and suggested that a consideration of production processes could shed light on ambiguity resolution during comprehension. The incremental nature of production (in which words or phrases that are relatively easier to access and produce tend to be placed earlier in the sentence, Bock & Levelt, 1994) creates distributional patterns of word order in the language.

Sensitivity to these distributional patterns creates biases in ambiguity resolution on comprehension. Macdonald (1999) suggested that sensitivity to production-motivated patterns could be the explanation for patterns of ambiguity resolution preferences that were otherwise unexplained in comprehension accounts.

Macdonald et al. (1999) investigated production constraints on word order and their effect on ambiguity resolution. Furthermore, Race and MacDonald (2003) conducted experiments to investigate the factors in production processes which possibly affect the behavior on the optional use of ‘that’ in object relative clauses (ORCs) and the comprehension consequences of the optional ‘that’ appearance in the syntactically unambiguous structure.

In object-relative clauses such as (4) the relative pronoun ‘that’ can be optionally inserted or omitted without changing the meaning of the sentence.

(4) The story (that) she read was long.

Previous comprehension studies have found that the use of ‘that’ in the sentence reduces the comprehension difficulty (Hakes et al., 1970; Hakes et al., 1976). However, recent evidence from production of the complementizer ‘that’ in sentential complement constructions as in (5a), (5b) suggests the use of optional ‘that’ is modulated by production difficulty.

(5) a. I know (that) you missed practice.

b. The police reported (that) Sharon’s car had broken down.

Race and Macdonald (2003) suggested that the production difficulty modulates the distributional pattern of the optional ‘that’ use. In their paper, only internal factors of relative clauses were considered as the possible factors increasing the load in production process.

In Race and Macdonald (2003), they posited the factors which increase the production difficulty. The factors as in Table.1 illustrate the relationship between the frequencies of ‘that’ appearance in object relative clause and the weight of each factor on how much it increases production difficulty.

**Table.1 Five Factors of Production Difficulty (Race and MacDonald 2003)**

| Entering Factors | Direction of Effect | $r^2$ |
|---|---|---|
| 1. Embedded Subject noun Type | 'that' use associated more with full noun phrase than pronoun | .09 |
| 2. Embedded subject noun length | 'that' use increased with increasing length of the embedded subject NP | .11 |
| 3. Determiner in embedded NP | Less 'that' use if embedded subject contained determiner. | .13 |
| 4. Main subject noun phrase length | Increased use of 'that' with the increasing length of the main NP. | .14 |
| 5. Rest of Embedded clause Length | Increased use of 'that' with increasing length of embedded clause after the embedded subject. | .15 |

Race and MacDonald (2003) suggest that comprehenders are accordingly sensitive to the distributional properties of 'that' in language production and the inclusion of 'that' is helpful to comprehenders, but only in environments that parallel its use in language production. They claimed that those results are supporting the production-constraint approach to the interaction between the production and comprehension system.

## 2.5 Animacy Account: Topicality of the Antecedents

In a recent paper of Mak et al. (2006), they showed that the animacy of the antecedent is not the decisive factor in the preference for subject relative clauses over object relative clauses. On the contrary, in relative clauses with an inanimate antecedent and an inanimate relative-clause-internal noun phrase (in other words, one of the internal subject or internal object in SRC or ORC), the usual preferences for subject relative clauses are found.

The results of the first experiment show that there was no such effect at the relative-clause-internal noun phrase in English. Rather, an effect was found on the words following the clausal-final verb (e.g. Dutch), and it was in the opposite direction, showing that readers prefer a subject relative clause when both the antecedent and the relative-clause-internal phrase are inanimate. Thus, for these relative clauses the preference is the same as for a relative clause with two animate noun phrases.

Mak et al. (2002) found that there was no difference in reading times between subjects and object relative clauses when the subject of the relative clause is animate and the object is inanimate. However, their data do not give conclusive evidence about the precise way animacy influences the parsing process.

Syntax-first theories claim that initially readers opt for the subject

relative clauses reading on the basis of syntactic parsing preference. Hence a non-syntactic factor, such as animacy, will not influence this first stage of parsing.

According to the Active Filler Strategy (Frazier, 1987), on reading the relative pronoun, readers in all cases analyze the clause as a subject relative on the basis of the alternative gap-positions on which filler (the relative pronoun) can be placed. This implies that animacy can only influence the parsing process during a reanalysis.

However, the data from Mak et al. (2002) do not show any evidence of such a reanalysis in object relative clauses with an inanimate antecedent and an animate relative-clause-internal noun phrase. Therefore this result does not support the Active filler Strategy. However, the absence of a delay in reading times in these relative clauses compared to their subject relative counterparts may be caused by the fact that the reanalysis that the reader has to make is spread over a long region, in the sentences of Mak et al (2002) from the antecedent up to the auxiliary.

According to the interpretation of data in Mak et al (2006), their three experiments can be explained by the 'topichood hypothesis' (Mak et al 2001). Topichood hypothesis claims that the choice of one of the entities as the subject of the relative clause is determined by the topicworthiness of the entities. Other things being equal, the antecedent of the relative clause is more topicworthy than the relative-clause-internal noun phrase, since it

is the topic of the relative clause.

However, there are other factors that determine the topicworthiness of an entity. One of those is whether a noun phrase is a full noun phrase or a pronominal noun phrase. Personal pronouns refer to entities that are topical. Evidence for the influence of this factor comes from experiments in which the relative-clause-internal noun phrase is pronominal (Gordon et al 2001)

(6) a. The banker that you praised climbed the mountain

b. The banker that the lawyer praised climbed the mountain

According to Gordon et al (2001), the difficulty readers have with object relative clauses as in (6a) and (6b) comes from the fact that these relative clauses require two noun phrases to be stored in memory and subsequently accessed whereas in English this is not the case for subject relative clauses.

The difficulty of accessing the two representations is reduced when they are dissimilar[3] as in (6a), compared to when they are similar as in (6b). Therefore, to get in line with the terms of Gordon et al, less processing difficulty is found in (6a) than (6b).

The explanation of the difference in processing difficulty between subject and object relative clauses in terms of the number of noun phrases

[3] They use a similarity-based explanation on why the processing difficulty of object relative clause is reduced when the subject of that relative clause is a pronoun, as in (6a) – also see (6b) to compare.

to be stored in memory does not hold for Dutch relative clauses. In Dutch the requirement of holding two NPs in memory would be present in both subject and object relative clause, since both subject and object relative clauses are verb-final.

(7) Subject Relative Clause (a) vs. Object Relative Clause (b)

a. Volgens de folder moet de gel, die de lekkages verhelpt, in één keer werken. (Dutch)

   According-to the brochure must the gel, that the leakages remedies, in one time work.

   According to the brochure the gel, that remedies the leakages, should work at once.

b. Volgens de folder moeten de lekkages, die de gel verhelpt, in één keer verdwenen zijn.

   According-to the brochure must the leakages, that the gel remedies, in one time disaapeared be.

   According to the brochure the leakages, that the gel remedies, should disappear at once.

Whereas with the account of Gordon et al for the difficulty of (6), the similar case of Dutch as in (7a), and (7b) cannot be adequately explained

and also the same case of another verb-final language, by the account of Topichood hypothesis the easier processing difficulty of (6a) over (6b) can be explained. Because of the fact that pronouns typically refer to entities that are topical, they are likely candidates for the syntactic function of subject, which eliminates the difficulty of object relative clauses with a pronominal relative-clause-internal noun phrase.

## 2.6 New Entity vs. Old Entity Explanation

Fox and Thompson (1990) found that non-human antecedent noun phrases that refer to a new entity in the discourse tended to occur with object relative clauses in an analysis of corpus data. The subject of these relative clauses often was a pronoun referring to a discourse topic. Fox and Thompson explained this phenomenon using the concept of grounding, relating a new entity to the discourse. The relative clauses were used to link the antecedent, a new entity, to the discourse by explicitly relating it to a discourse topic.

The topicworthiness of an entity is determined by more than just the question whether or not it is the sentence topic. Animacy is another factor that contributes to the topicworthiness of an entity. Animate entities are more topicworthy than inanimate entities. Thus, animacy and topicality are in fact both related to the broader notion of topicworthiness. These two

factors can also be found in the hierarchy of properties that Silverstein (1976) and Van Valin et al. (1996) introduce. In this hierarchy there are two dimensions, which correspond closely to an animacy hierarchy and a topicality hierarchy. The position of the noun phrase on the topicality and animacy scale determines whether a particular noun phrase has what they call the “effector” role. This role subsumes both animacy and topicality.

Topicworthiness does not only apply to effects at the sentence level. An entity that is the discourse topic is more topicworthy than an entity that is not. Therefore, the Topichood Hypothesis makes the prediction that the processing difficulty of object relative clauses should be reduced when the relative-clause-internal noun phrase is the discourse topic compared to when it is not, even if it is a full noun phrase. To sum up, the Topichood Hypothesis provides an account for the pattern of results found in the present experiments as well as for the commonly reported preference for subject relative clauses and other results on relative clause processing. According to the Topichood Hypothesis the reader opts for one of the noun phrases in the relative clause as the subject on the basis of topicworthiness, which subsumes both animacy and topicality of the antecedent.

The topichood hypothesis also provides additional predictions that can be tested empirically. The difficulty of object relative clauses should be affected by the relative-clause-internal noun phrase being a full noun phrase or a pronoun (Gordon et al. 2001). Moreover, even when the

relative-clause-internal noun phrase is a full noun phrase, parsing of object relative clauses should be easier when the referent of the full noun phrase is the discourse topic compared with when it is a new entity.

To summarize this subchapter, the animacy of antecedent itself does not modulate the preference between ORC and SRC. The difference between internal NP and external NP (antecedent) in animacy introduces the preference over another. Additionally, animacy is another factor which contributes to the topicworthiness of an antecedent.

# Chapter 3 Experiments

## 3.1 Experiment 1: Corpus Analysis

The purpose of this corpus analysis is to compare the frequencies of the reduced form of relative clauses with of the unreduced form of object-relative clauses. In line with the claim of Race and MacDonald (2003), the rest of the object-relative pronouns should follow the same principle with the cases of 'that' insertion and omission. Therefore, by comparing the frequencies of the rest of the object relative pronouns over the reduced clausal expression, the relationship between the antecedents and object relative pronouns per se can be investigated.

**Tools**

BNC On-Line (British National Corpus)[4]

The interface of this website allows a user to search for a wide range of words and phrases of English in the 100 million words British National Corpus. Like some other BNC interfaces, a user can search for words and phrases by exact word or phrase, wildcard or part of speech, or combinations of these. In addition, this website gives a user an interface

[4] with the web-interface on "*http://view.byu.edu/*"

to search for surrounding words within a ten-word window (e.g. all nouns somewhere near paper, all adjectives near woman, or all nouns near spin).

**Procedure & Design**

First, to minimize the possibilities of the cases that some other factors affect data patterns besides antecedents per se, the factors which are known to affect the presence/absence of object relative pronoun were controlled. To control the factor, these factors are considered;

a) Variations of the subjects in the embedded clauses were narrowed down only to personal pronoun category[5].
b) Length of the subject NP is controlled by only including personal pronoun for subject.
c) Determiner in subject NP was excluded by only including personal pronoun for subject.
d) Length of antecedent is narrowed down to a one word
e) Length of the rest of the embedded clause was controlled (see Table.4)

Second, to investigate an effect of the semantic complexity of the antecedent itself, the simplification of experimental environments must

[5] I, you, he, she, they, it

have unbiased and analyzable results from the rest of the possible factors.

In a consideration of simplifications, definite and indefinite article are used to make two different types of NPs positioning at an opposite side to each other on the continuum of the specificity (or modifiability).

As shown in Table. 2, the frequency of definite article ‘the’ is 2.47162 times more than the frequency of indefinite article “a/an.” So, the calculation of the ratio has been corrected accordingly.

**Table.2 Frequencies of Indefinite Article ‘a/an’ vs. Definite Article ‘the’ in BNC**

| DISTRUB | WORD/PHRASE | TOKENS/REG1 | PER MIL |
|---|---|---|---|
| 1 | THE | 6046883 | 60,468.83 |
| 2 | A / AN | 2446526 | 24465.26 |
| | **TOTAL** | **8493409** | **84,934.09** |

## Results & Discussion

**Table.3 Indefinite Article vs. Definite Article**

**(Length of the Rest of Embedded Clause after Subject)**

| Length of the rest of embedded clause after subject | Frequencies | | | |
|---|---|---|---|---|
| | a/an | the | Sum ('a/an' + 'the') | Percentile of 'the' |
| ***1*** | 7.41486 | 192 | 199.41486 | *96%* |
| ***2*** | | 125 | 125 | *100%* |
| ***3*** | 2.47162 | 75 | 77.47162 | *97%* |
| ***4*** | 9.88648 | 81 | 90.88648 | *89%* |
| ***5*** | 2.47162 | 43 | 45.47162 | *95%* |
| ***6*** | 12.3581 | 21 | 33.3581 | *63%* |
| ***7*** | 4.94324 | 14 | 18.94324 | *74%* |
| ***8*** | | 9 | 9 | *100%* |
| ***9*** | | 4 | 4 | *100%* |
| ***10*** | | 2 | 2 | *100%* |
| | *39.54592* | *566* | *605.54592* | *93%* |
| | **Sum** | | | |

As presented in Table.3, the ratio of definite to indefinite noun phrase antecedent in reduced ORC form is 0.934693772 (93%), and this result implies that there is a strong indication of the possibility that the specificity of antecedent preceding ORC plays an important role to modulate the optional 'that' use.

On top of that, one thing which should be mentioned is the fact that in any case the ratio of the reduced to the unreduced is over 0.93. This alone could be the indication of something in production sense, if there is a language strategy, the strategy must be taken with production efficiency.

The result of corpus analysis shows that the specificity (or modifiability) of antecedents have considerable effects on the given patterns of 'that' omissions. The results of experiment 1 support the hypothesis that the external factors, at least one (specificity of antecedents), exist to increase production difficulty.

### 3.2 Experiment 2: RT[6] Analysis

**Participants**

Twenty instructors from the Foreign Language Education Center of

[6] Response Time (to stimulus, in this case, Reading Time of each given word)

Pukyong National University volunteered for this experiment. All participants were native speakers of English, and had normal or corrected to normal vision.

**Materials**

The experimental sentences consisted of 10 ORCs that were manipulated for investigating the patterns between the indefinite noun phrase antecedent and the definite noun phrase antecedent.

First, every sentence material in Experiment 2 is accordingly designed to get rid of the chance which can introduce in the materials by the factors[7] Race et al. shown in their research (2003).

Second, each sentence in (8) has an indefinite article ‘a/an’ with a noun phrase and in (9) has a definite article ‘the’ with a noun phrase as an antecedent. (8a), (8c), (9a), and (9c) have their object relative pronoun reduced. (8b) and (9b) have a “which” as their object relative pronoun. (8d) and (9d) have a ‘that’ in the same respect. (8e) and (9e) have two differences which are; (8e) has the combination of indefinite article “a” and a reduced object relative pronoun, (9e) has the combination of definite article ‘the’ and unreduced object relative pronoun ‘that’ to investigate what difference will be shown in RT.

[7] To see these factors, see Table 1. (page 11 or 20)

(8) a. I will hire a person I can lean on in this situation.

b. I would buy a product which I used to buy in America.

c. He should accept an order she would give in any situation.

d. The book is all about a person that I used to associate with in Korea.

e. That book gives us an important historical lesson everyone should learn something from in this society.

(9) a. She will hire the person she can lean on in this situation.

b. Tom would buy the brand which he used to wear in America.

c. I have to follow the order he issues in any situation.

d. Her talk is all about the person that I used to associate with in Korea.

e. The movie gives us the important historical lesson that everyone should learn something from in this society.

**Design & Procedure**

A trial consisted of two stages, reading and recall. In the reading stage, all of the ten sentences were individually presented in word-by-word fashion. The recall stages mainly used to make the participants more

focused at the sentences. Before the actual experiment, the dummy experiment with filler sentences was given to the participants. The stimuli were presented on a Dell Latitude X1 laptop computer using E-Prime 1.3 software. For experimental trials, all the sentences were presented in random fashion for each participant. The filler sentences never contained a relative clause of any sort. All words were presented in the horizontal and vertical center of the screen until the participant hit the spacebar. After each sentence was completed, the cue massage appeared to notice the participants to start to repeat the sentence to a microphone. The experiment lasted about 3~5 minutes for each participant.

**Results**

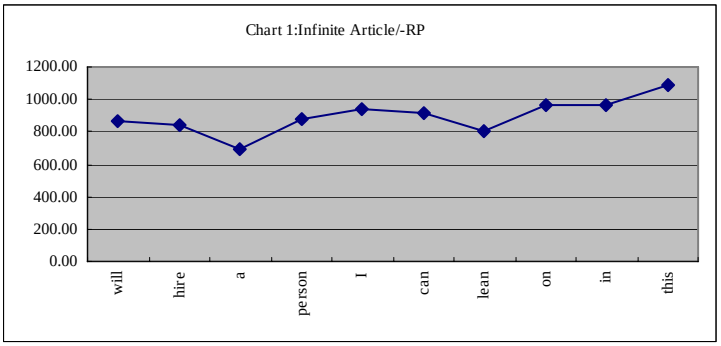
To make this analysis simple, the three regions were set as follows;

Region 1: article (indefinite/definite) + antecedent

Region 2: object-relative pronoun (+RP/-RP)

Region 3: subject (personal pronoun) + [aux] + verb

**-RP**



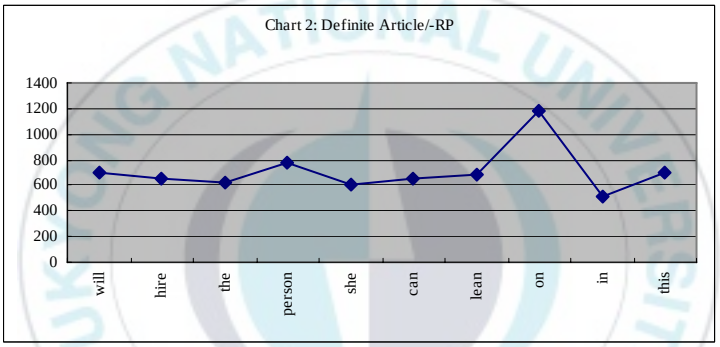
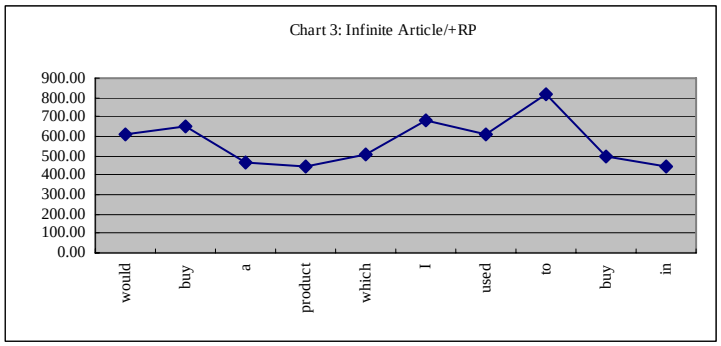




Chart 1: Region1 < Region3

Chart 2: Region1 > Region3

The results of chart 1 and 2 show that the difference in RT of Region 3 according to a choice of an article (indefinite article ‘a/an’ vs. definite article ‘the’).

**+RP**



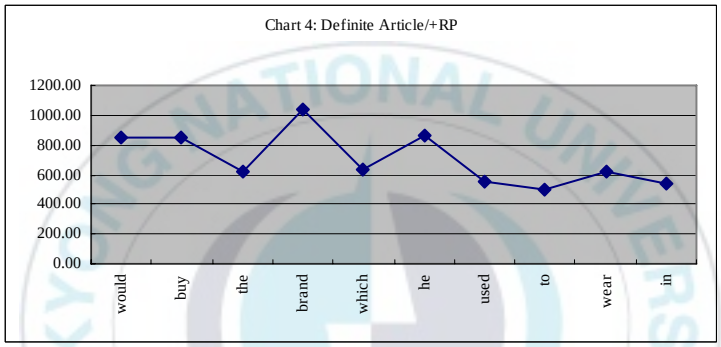
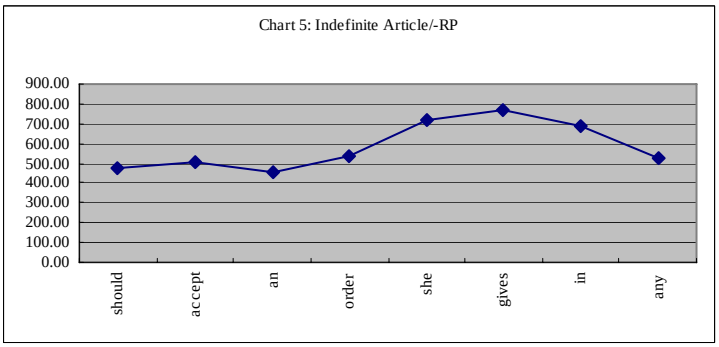




Chart 3: Region1 < Region3

Chart 4: Region1 > Region3

The results of chart 3 and 4 illustrate that the difference in RT of Region 3 according to a choice of an article (indefinite article ‘a/an’ vs. definite article ‘the’). Although a choice of an article shows the difference in RT, the inclusion of object relative pronoun does not show clear distinction from chart 1 and chart 2.

**-RP**



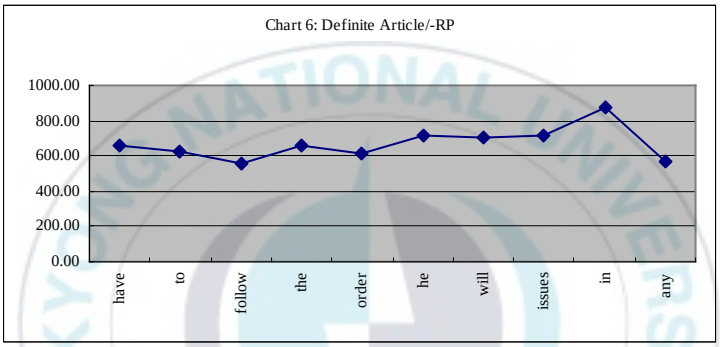



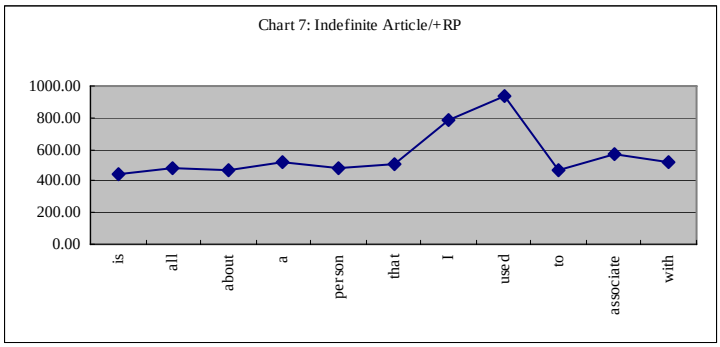

Chart 5: RT1 < RT 3

Chart 6: RT1 < RT 3

RT3 of Chart 5 > RT3 of Chart 6

The only difference of Chart 5 and 6 from Chart 1 and 2 in the condition is the animacy of an antecedent. But it still behaves in the same fashion with Chart 1 and 2.

**+RP**



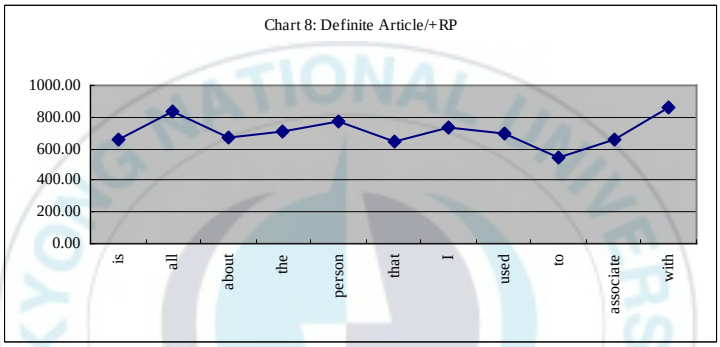
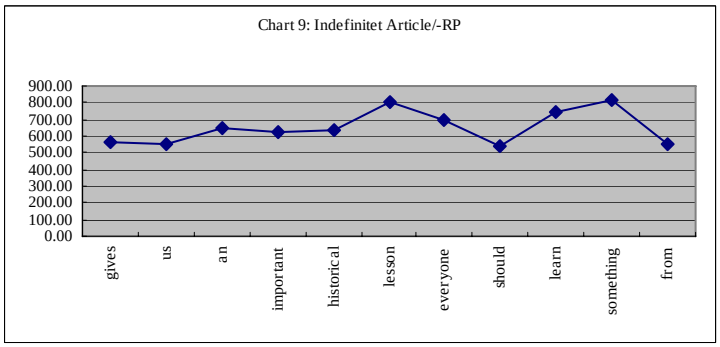




Chart 7: RT1 < RT3

Chart 8: RT1 > RT3

The case of chart 7 and 8 shows the same RT behavior with chart 3 and 4, even though the case of chart 7 and 8 has a difference from the case of chart 3 and 4 in animacy.

**-RP /+RP with an antecedent modified by multiple adjectives**



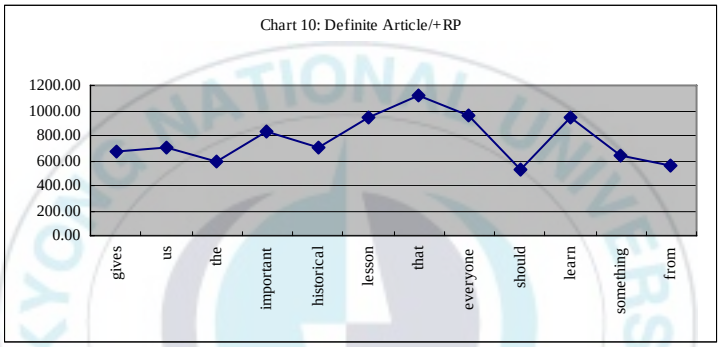




Chart 9: RT 1 > RT 3

Chart 10: RT1 < RT3

According to Race et al. (2003), the lengthened antecedent should raise the use of object relative pronoun “that.” This means that the lengthened antecedent should introduce the production difficulty. Therefore, the RT of Region 3 should be longer than RT of Region 1. But, Region 3 of both cases (-RP/+RP) shows that “V-shape” in RT with/without object relative pronoun “that.” In the observation of this case, the modifiability (or specificity) account can explain this unexpected (in Race et al)

phenomenon. The more modified word introduces the less ambiguity in the meaning of a word. The lesser ambiguity of a word demands the less modifiability. The lesser modifiability means that the specificity of a word is high enough not to provoke the modifying process of a word.

Even in this modifiability account, the explanation for an effect of 'that' inclusion is not clear because there is no overt RT difference in presence/absence of "that." In an attempt to explain this, two assumptions are made as followings;

**Assumption 1**

If the factors to give a reduced processing difficulty appear in serial manner, the effect of the consecutive factors will not be accumulated.

**Assumption 2**

The landing site of processing difficulty could have a limitation of distance from the factor.

To be more thorough, these assumptions (1 and 2) should be investigated more fully in the future research. For now these assumptions do not hurt the main idea of these analyses, the test trials of these assumptions can be reserved momentarily.

# Chapter 4
# Analysis and Theoretical Implications

## 4.1 Analysis on Experiments

The analyses of reading times included only the sentences in which the participants recalled correctly, corresponding to each given stimulus. For the analysis of data, the critical sections of the stimuli were selected and grouped into 3 regions: region 1 for article + antecedent, region 2 for object-relative pronoun itself, and region 3 for embedded subject + verb.

First, the cases with the object relative pronoun have faster RT than its corresponding parts in region 3 (embedded subject and verbs region). It shows the significance of object relative pronouns in the comprehension process.

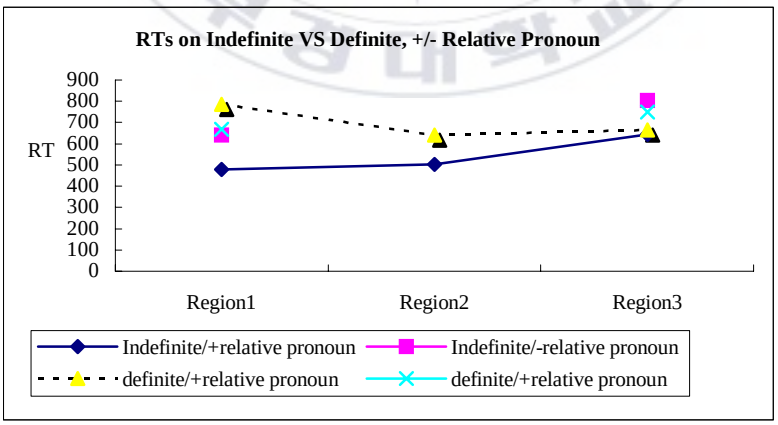



**Chart. 11 Reading Time of Reduced ORC and Unreduced ORC**

Second, among the cases with an object relative pronoun, in the case with an indefinite article, the RT of the region 3 has longer RT than the RT of the region 1 and 2. On the contrary, in the case with a definite article, the RT of the region 3 has a relatively shorter RT than the rest of its regions.

The NP with the definite article is more likely to have the higher specificity than the NPs with the indefinite article. Therefore, the more ambiguity the antecedent has, the higher the production and comprehension difficulty will be introduced into the following relative clauses. This can be rephrased into “the specificity of antecedent decreases comprehension difficulty so that the needs of object relative pronoun insertion is decreased.”

The corpus analysis of the frequencies and a ratio (0.840695) of the semantically less-complicated antecedent (or increased specificity) over semantically more-complicated (or decreased specificity) antecedent in the reduced form of ORC showed in subchapter 3.1. Those results support the hypothesis that semantic complexity of an antecedent modulates the optional use of object relative pronoun.

The RT analysis on the unreduced and the reduced ORC with definite and indefinite articles showed the consistency with Macdonald el al (2003)’s RT analysis that comprehenders are accordingly sensitive to the distributional properties of ‘that’ in language production and the inclusion

of ‘that’ is helpful to comprehenders, but only in environments that parallel its use in language production.

The results of experiments are converging in supporting the hypothesis that the external factors, which is in this paper will be the semantic complexity (the specificity or modifiability) of antecedent can be also the one of the factors to increase production difficulty besides the internal factors;

**The Specificity of Antecedents**

The more modified antecedents vs. the less modified antecedents

-The semantic complexity of antecedent (the specificity of antecedent) decreases its modifiability.

**The Modifiability of Antecedents**

The necessity[8] of relative clause affects the production difficulty of the relative clause. (The less modifiability of the antecedent, the less burden to the relative clause per se)

According to the results form the experiments carried out in this paper, the specificity of antecedents as an external factor to ORC also can create the modulation on insertion and omission of object relative pronoun in

[8] ‘necessity’ in terms of disambiguation

production and comprehension process.

Race and MacDonald (2003) hypothesized that ‘that’ is inserted in response to production difficulty rather than in response to comprehension ease. They analyzed the corpus solely focused on identifying internal factors which are causing production difficulty by comparing unreduced and reduced object relative clauses. The results were that the use of relative pronoun in ORCs would increase as production difficulty increased.

Production difficulty in ORCs can stem from several different factors. They specifically looked at the factors of Embedded Subject NP type (pronoun, common noun, and proper noun), the use of a determiner in the embedded subject, length in words of main subject NP, and length in words of the embedded clause after the embedded subject NP.

### 4.2 Specificity vs. Modifiability

Race and MacDonald (2003) posited the factors which amplify the production difficulty. The factors as in Table #1, are illustrating the relationship between the frequencies of ‘that’ appearance in object relative clause and the weight of each factor on how much it increases production difficulty.

They were also suggesting that comprehenders are accordingly sensitive

to the distributional properties of ‘that’ in language production and the inclusion of ‘that’ is helpful to comprehenders, but only in environments that parallel to its use in language production. They claimed that those results support the production-constraint approach to the interaction between the production and comprehension system.

But, in this paper, examining other possible factors, two types of experiments were carried out to examine the possibility of another factor not previously found under the same perspective as Macdonald’s account (2003) of ‘that’ omission phenomenon in object relative clause.

As the results of these experiments clearly show, this paper posits that the specificity of an antecedent to an object relative clause is highly contributing to the frequencies of ‘that’ in written production. In addition, the comprehension results are in the same line with Macdonald et al’s research data of RT analysis. That, again, means that “production-constraint approach over comprehension-constraint approach” is more persuasive to language processing.

### 4.3 Phase and Connectivity Effect

Park (2005) suggested “long-distance dependencies” and “morphological reflex,” as the evidences of supporting the connectivity hypothesis of “on phase (Chomsky, 2005).” The evidential sentences are;

(10) Long-distance Dependencies

a. *wh*-movement

*What* might Mary think Harry stirred?

*Which* car do you think Mary said John would fix?

*Who* do you hope that the candidate said that he admires?

*What* did the reporter that criticized the war eventually praise?

*Who* seems to be likely to have kissed Mary?

**What* do you wonder where John bought?

**Who* did the candidate read a book that praised?

**Who* did the fact that Bush supported upset voters in Florida?

**Who* seems it is likely to solve the problem.

(11) Morphological Reflex in Children's English

a. Multiple Copies of *wh*- in Children's English

*What* do you think *what* Cookie Monster eats?

*Who* do you think *who* the cat chased?

*How* do you think *how* Superman fixed the car?

b. Multiple Copies of Auxiliary Verb

What *did* Mary claim *did* they steal?

Why *did* the farmer *did*n't brush his dog?

On the basis of that suggestion, the behavior of optional ‘that’ use adds supporting evidence of the phase theory. The behavior which the variations of RT difference and objective-relative-pronoun omission occur, due to the production difficulty of antecedents and relative clause itself, at the area of threshold (around the complementizer ‘that’), is related to the question of ‘Phase vs. Chunk’[9].




[9] Phase vs. Chunk: CP, vP, and possibly DP (Legate 2004; Matushansky 2002)

# Chapter 5 Conclusion

Race and MacDonald (2003) hypothesized that 'that' is inserted in response to production difficulty rather than in response to comprehension ease. They analyzed the corpus focusing solely on identifying internal factors which are causing production difficulty by comparing unreduced and reduced object relative clauses. The results were that the use of relative pronoun in ORCs would increase as production difficulty increased. Production difficulty in ORCs can stem from several different factors. They specifically looked at the factors of Embedded Subject NP type (pronoun, common noun, and proper noun), the use of a determiner in the embedded subject, length in words of main subject NP, and length in words of the embedded clause after the embedded subject NP.

The theoretical account and results of the experiments in this study posit the hypothesis that the external factor, which will be the semantic complexity (the specificity or modifiability) of antecedent, can be also the one of the factors to increase production difficulty besides the internal factors;

(10) The Specificity of Antecedents

The more modified antecedents vs. the less modified antecedents

The semantic complexity of antecedent (the specificity of

antecedent) decreases its modifiability.

(11) The Modifiability of Antecedent

The necessity of relative clause affects the production difficulty of the relative clause. (The less modifiability of the antecedent, the less burden to the relative clause per se)

According to the results from the experiments conducted in this paper, the specificity of antecedents as an external factor to ORC also can create the modulation on insertion and omission of object relative pronoun in production and comprehension process.

By combining the results of Macdonald et al's previous experiments with this paper, the production-constraint approach (Macdonald et al, 2003) to the interaction between the production and comprehension systems can be more persuasive over the comprehension oriented account.

There have been diverse theories to adequately explain relative pronoun omission phenomena, some theories made their points, but do not explain thoroughly every aspect of the phenomena. To add just a fraction of what should continue to be investigated, the other aspects of antecedents would be the first. As mentioned previously in subchapter 2.1 (incremental nature of production) if the production of natural language follows the incremental nature of itself, the parser should dictate that the production

difficulty of antecedent is introducing beforehand rather than the production difficulty of following object-relative clause. Therefore, if the parser in production process is virtually parsing down in the-top-to-bottom fashion, the suggestion here should be the first course of action to take for future investigations.

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# Appendix

**The Result for "a/an/the [NN0] [PNP]" Query**

| DISTRIB | WORD/PHRASE | TOKEN/REG1 | RER MIL/REG1 |
|---|---|---|---|
| 1 | THE PEOPLE I | 146 | 1.46 |
| 2 | THE PEOPLE YOU | 106 | 1.06 |
| 3 | THE PEOPLE HE | 105 | 1.05 |
| 4 | THE PEOPLE THEY | 88 | 0.88 |
| 5 | THE PEOPLE WE | 85 | 0.85 |
| 6 | THE PEOPLE SHE | 48 | 0.48 |
| 7 | THE PEOPLE IT | 29 | 0.29 |
| 8 | THE DATA THEY | 15 | 0.15 |
| 9 | THE FISH YOU | 13 | 0.13 |
| 10 | THE DATA WE | 12 | 0.12 |
| 11 | THE DATA IT | 11 | 0.11 |
| 12 | THE WORKS HE | 9 | 0.09 |
| 13 | THE FISH THEY | 7 | 0.07 |
| 14 | THE DATA HE | 7 | 0.07 |
| 15 | THE FISH I | 6 | 0.06 |
| 16 | THE DATA I | 6 | 0.06 |
| 17 | THE DATA YOU | 6 | 0.06 |
| 18 | THE AIRCRAFT YOU | 5 | 0.05 |
| 19 | THE STAFF IT | 5 | 0.05 |
| 20 | THE MEANS THEY | 5 | 0.05 |
| 21 | THE MEANS HE | 5 | 0.05 |
| 22 | THE WORKS I | 4 | 0.04 |
| 23 | THE STAFF WE | 4 | 0.04 |
| 24 | THE SPECIES WE | 4 | 0.04 |
| 25 | THE AIRCRAFT HE | 4 | 0.04 |

| | | | |
|---|---|---|---|
| 26 | THE WORKS YOU | 4 | 0.04 |
| 27 | THE STAFF I | 4 | 0.04 |
| 28 | THE FISH HE | 4 | 0.04 |
| 29 | A PAIR YOU | 4 | 0.04 |
| 30 | A SERIES HE | 4 | 0.04 |
| 31 | THE OFFSPRING THEY | 3 | 0.03 |
| 32 | THE SPECIES I | 3 | 0.03 |
| 33 | THE STATISTICS WE | 3 | 0.03 |
| 34 | THE WORKS WE | 3 | 0.03 |
| 35 | THE MEDIA IT | 3 | 0.03 |
| 36 | THE AIRCRAFT WE | 3 | 0.03 |
| 37 | THE MEDIA YOU | 3 | 0.03 |
| 38 | THE SPECIES IT | 3 | 0.03 |
| 39 | THE SALES IT | 3 | 0.03 |
| 40 | THE MEANS WE | 3 | 0.03 |
| 41 | A CEMETERY.THEN I | 3 | 0.03 |
| 42 | A DUCK I | 3 | 0.03 |
| 43 | THE FISH WE | 3 | 0.03 |
| 44 | THE AIRCRAFT THEY | 3 | 0.03 |
| 45 | THE MEDIA THEY | 3 | 0.03 |
| 46 | THE TROPICS HE | 2 | 0.02 |
| 47 | A FISH I | 2 | 0.02 |
| 48 | A STAFF HE | 2 | 0.02 |
| 49 | A FISH IT | 2 | 0.02 |
| 50 | A SPECIES IT | 2 | 0.02 |
| 51 | A FISH HE | 2 | 0.02 |
| 52 | A DICE YOU | 2 | 0.02 |
| 53 | THE MINK I | 2 | 0.02 |
| 54 | THE SPACECRAFT SHE | 2 | 0.02 |

| | | | |
|---|---|---|---|
| 55 | THE SERIES I | 2 | 0.02 |
| 56 | THE SPECIES THEY | 2 | 0.02 |
| 57 | THE STATISTICS I | 2 | 0.02 |
| 58 | THE BARRACKS I | 2 | 0.02 |
| 59 | THE &POUND;1,500 I | 2 | 0.02 |
| 60 | THE SPECIES YOU | 2 | 0.02 |
| 61 | THE SERIES IT | 2 | 0.02 |
| 62 | THE BURMESE HE | 2 | 0.02 |
| 63 | THE FRUIT IT | 2 | 0.02 |
| 64 | THE &POUND;6 YOU | 2 | 0.02 |
| 65 | THE &POUND;125 HE | 2 | 0.02 |
| 66 | THE &POUND;150 THEY | 2 | 0.02 |
| 67 | THE STAFF YOU | 2 | 0.02 |
| 68 | THE FRUIT HE | 2 | 0.02 |
| 69 | THE PERCH I | 2 | 0.02 |
| 70 | THE PAIR THEY | 2 | 0.02 |
| 71 | THE PAIR YOU | 2 | 0.02 |
| 72 | THE BARRACKS SHE | 2 | 0.02 |
| 73 | THE FRUIT THEY | 2 | 0.02 |
| 74 | THE &POUND;40 HE | 2 | 0.02 |
| 75 | THE &POUND;21M IT | 2 | 0.02 |
| 76 | THE MEANS SHE | 2 | 0.02 |
| 77 | THE MEDIA I | 2 | 0.02 |
| 78 | THE WORKS IT | 2 | 0.02 |
| | **Total** | **866** | **8.66** |