Learner Corpus Research: State of the Art and Applications in SLA Research

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The word "corpus" has both positive and negative connotations. It often reminds us of the remark made by Chomsky that corpora, by their very nature, are incomplete and 'skewed' (Chomsky, 1962: 159). Chomsky's comments about corpora made many linguists, especially those who work in the field of theoretical linguistics, stay away from using corpus data as a primary source of evidence and rely heavily on introspection instead. Whilst his comments show some significant facts about corpora which we should take seriously, we should also note that these criticisms did not stop all corpus-based work. In the field of phonetics, for example, naturally observed data remained the dominant source of evidence. In the field of language acquisition also, the observation of naturally occurring evidence remained dominant. Chomsky himself (1964) cautioned that his rejection of performance data as a source of evidence was inappropriate for language acquisition studies.

Recently, corpora have been in the spotlight in the field of applied as well as theoretical linguistics. In applied linguistics, there is a growing interest in the use of corpora for the study of language use. The primary reason for this move is the dramatically improved availability and accessibility of corpora. Such mega-corpora as BNC[1] or Bank of English[2] have improved the description of English by providing statistics about language use which could not otherwise have been obtained. Major pedagogical dictionaries are now based on large corpora. *Longman Grammar of Spoken and Written English* by Biber *et al.*

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[1] http://www.hcu.ox.ac.uk/BNC/
[2] http://titania.cobuild.collins.co.uk/

(1999) shows that a corpus has some intriguing possibilities for describing an English grammar from the viewpoint of how a language is really used. The detailed bibliographical and demographic descriptions of the corpus data in the BNC have become extremely useful research tools for those who work in sociolinguistics and language variation studies. The spoken parts of the BNC or ICE-GB[3] provide researchers analyzing a spoken language with the opportunity to compare spoken data with written data. The on-going corpus compilation projects such as the American National Corpus[4] will facilitate the collection of major varieties of English with up to 100 million words.

The use of corpora has been regaining ground in the field of theoretical linguistics as well. The most notable area is a shift towards a greater preoccupation with the lexicon. Many aspects of language that earlier Chomskyan models dealt with as 'syntax' are now handled as idiosyncrasies of lexical items. The syntax itself is considerably simplified by the omission of many rules, at the cost of greatly increased lexical information. This leads to a revealing insight into the usefulness of corpus data for the description of the lexicon. There is another perspective called a 'usage-based' approach (*cf.* Barlow and Kemmer, 2000). Psycholinguistic and cognitive linguistic theories of language acquisition hold that all linguistic units are abstracted from language use. In these usage-based perspectives, the acquisition of grammar is the piecemeal learning of many thousands of constructions and the frequency-biased abstraction of regularities within them. Language learning is the associative learning of representations that reflect the probabilities of occurrence of form-function mappings. Frequency is thus a key determinant of acquisition. Frequency underpins regularity effects in the acquisition of orthographic, phonological and morphological form, and learning accords to the power law of practice (Ellis 2002). In order to construct such a theory, it is essential that one can obtain frequency information of given linguistic features, and the principal source of such data comes from properly sampled corpora.

Despite the popularity of corpus data in the field of language sciences in the last decade, there seems to be little discussion about how corpora should be best compiled or fully exploited, one of the main issues in corpus linguistics.

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[3] http://www.ucl.ac.uk/english-usage/ice-gb/
[4] http://americannationalcorpus.org/

In this paper, I will first present some fundamental concepts about a corpus, and then review interlanguage (IL) studies from a historical viewpoint in order to show the need of good learner corpora for research in SLA and TEFL. Secondly, I will summarise on-going projects on learner corpora around the world. Finally, I will demonstrate how learner corpus data can be exploited by comparing an IL corpus with L1 and TL corpora.

Fundamental Concepts

The word "corpus" is a cover term for all sorts of collections of text, but it has been increasingly used to refer to only those which are specially assembled for the purpose of linguistic analysis and/or natural language processing. The new generation of corpus linguistics is characterised by the systematic compilation of representative samples of a particular variety of language for analysis by computer (Leech, 1991). Leech (1992) describes five key characteristics of 'the scientific method' and evaluates the extent to which the corpus-based methodology conforms to these scientific norms: (a) falsifiability, (b) completeness, (c) simplicity, (d) strength, and (e) objectivity. I will not go into the detail of evaluation of his claim here, but I argue that the first norm "falsifiability" as well as verifiability will be greatly enhanced as more researchers share corpus data with each other.

Another important definition of corpus is the one made by McEnery and Wilson (2001). Corpus linguistics is not an aspect of language requiring explanation or description such as syntax, semantics, pragmatics and so on, but a *methodology*. "Corpus linguistics is a methodology that may be used in almost any area of linguistics, but it does not truly delimit an area of linguistics itself." (ibid: 2) This understanding is crucial as we see more and more people use corpora as testbeds for verifying their theoretical claims.

Use of Corpora for IL Studies: Historical Perspectives

Contrastive Analysis and Error Analysis. The idea of using learner data in SLA research is not new. In fact it has been around for more than 30 years. The treatment of learner data in most studies to date has been, however, rather haphazard. In the late 1950s and early 1960s, when a major concern was to

determine L1 influence on L2 learning and use, the predominant method used was Contrastive Analysis (CA). CA made no use of learner language data. Instead, analysts compared the target language with the first language to identify the similarities and differences, which they believed would predict the relative difficulty of learning (Fries, 1957; Lado, 1957). Their comparisons between the L1 and the TL, however, were largely based upon expert knowledge and not corpus-based.

Following on from a focus on CA in the 1960s, Error Analysis (EA) became an important paradigm in the 1970s. Researchers began to examine L2 learners' errors, not as something unwanted, but as evidence of the development of the IL system (Corder 1967; Richards, 1971). The difference in approach towards the language data between CA and EA is noteworthy. While in CA only the first language (L1) and the target language (TL) were compared, resulting in total neglect of learner language data, in EA a comparison was made between different stages of the IL system only and no attention was paid to the L1 or the TL. Most EA studies concur that the majority of errors are intralingual (Ellis, 1994: 69) and thus there was no use for L1 source language data. There were many studies in which learner performance data were actually obtained but were only accessed through audiotapes and never transcribed as text (see, for example, Selinker, Swain and Dumas, 1975; Tarone, Frauenfelder and Selinker, 1976; Hendrickson, 1976). There is considerable evidence that the idea of analysing learner performance data started to be accepted in the late 1960s, when people began to collect learner language samples in order to better understand IL development. However, learner performance data were not fully . exploited in their own right because researchers of the day were interested only in the errors themselves. Thus, after error patterns were extracted from the data, the transcription was either discarded or did not undergo further processing. Frequency information concerning the errors was often missing or lacked precision, which gave rise to concern among SLA researchers with regard to the empirical value of such error data.

Performance Analysis. Performance Analysis (PA) emerged in the early 1970s. The difference between EA and PA is that the former attempts to reconstruct learners' acquisition processes on the basis of errors alone while the latter makes use of the whole of their performance, both correct and erroneous. PA was considered to be superior to EA because EA depended only

on the analysis of learners' errors and did not take into account what learners had already acquired. This notion of studying the entire performance of language learners, both errors and correct forms, facilitated a more careful treatment of learner production data. Although they did not call it a "learner corpus" and did not pay attention to the format or nature of the data itself, researchers in the 70s surely had a collection of learner language, sometimes quite copious amounts, thus showing that a primitive form of learner corpora was available at that time. For example, Dulay and Burt (1975) claimed that they examined more than 800 learners with the instrument called the Bilingual Syntax Measure, an elicitation device using picture retelling tasks (Dulay and Burt, 1975). If this is true, they had a database of 800 learners' spontaneous speech although it was not very clear whether the data were actually transcribed. Hakuta's (1976) study on child L2 acquisition collected 30 sessions of 2 hour spontaneous speech data with a 5-year-old Japanese girl, once a fortnight for over a period of 60 weeks. The data were recorded and later orthographically transcribed. He referred to the data as "30 bulky looseleaf notebooks filled with transcriptions." This corpus, however, was never converted into an electronic form[5].

Classroom Process Research. In the 1980s, interest in investigating the classroom interaction between a foreign language teacher and learners grew. This was partly due to the recognition that systematic observation was necessary in order to fully understand how instruction and learning take place. There was also a growing interest in classroom SLA. After the debate over the effect of formal instruction (*cf.* Long, 1983), people came to realize that formal instruction is indeed valuable for IL development and that its effect needs to be investigated more systematically. Since the L2 acquisition process was found to be closely related to classroom input and interaction, L2 researchers felt the need for more careful research in order to identify the effect of classroom activities on IL development. Compared with EA and PA, classroom process research focuses more on the interaction between teachers and learners in the classroom context. In early classroom process research, most of the data consisted of frequencies of events in pre-defined categories, such as how many times the teacher asked questions/ accepted feelings or how often pupils responded (Moskowitz, 1967, Fanselow, 1977; Allwright, 1980). Therefore,

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[5] Hakuta (personal communication).

from the viewpoint of learner language data, very little was available for further processing as a corpus. In later classroom process research, however, there seemed to be more and more data available, at least in audio- or video-recording format. For instance, Sinclair and Coulthard (1975) tried to take account of the findings of more theoretical analyses of classroom discourse and the observation schedule they used attempted to preserve the discourse structure of a lesson. Later schedules were designed for use with recorded or transcribed data, but, with only a few exceptions such as the written protocol printed in Sinclair and Coulthard (1975) or the sample transcriptions in Fanselow (1977), Allwright (1980), and Van Lier (1982), there were no published databases or transcriptions of classroom observations. The reason for this lack of published transcriptions or recordings is that the researchers had no plan to make their data public and usually received consent from teachers to make observations for private research purposes only[6]. Unfortunately, therefore, very little data seems to have been actually transcribed and exploited as a corpus.

The prototype of learner corpora. The idea of ensuring that the data maximally represents the target group has been often mentioned among L2 researchers, but in reality, without sufficient time and money, it has always been difficult to gather attested language use data that meets this demand. Thus most studies in the 1970s and 1980s failed to achieve this goal. Two projects, the ZISA Project in Germany and the ESF Database in European nations, however, are worth mentioning because they are among the few projects that generated corpora which approximate closely to modern-day learner corpora.

The ZISA Project

The ZISA Project has been reported in a series of papers by Meisel, Clahsen, and Pienemann (for example, Meisel, Clahsen and Pienemann, 1981; Clahsen 1980; Clahsen, Meisel and Pienemann, 1983; Pienemann, 1980). They found that there was a clear development pattern in the acquisition of German word order rules by L2 German learners. There were two phases of data collection by the research team ZISA: first, a cross-sectional study with 45 adult workers

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[6] Allwright (personal communication).

from Italy, Spain and Portugal, was conducted from 1977 to 1978 via interviews conducted in the manner of unguided conversations (Clahsen 1980: 59). The results of this study were then tested in a longitudinal study with 12 adult learners of the same origin for three years (2 years of observation) (Meisel 1980:27). In both forms of investigation all of the interviews were audio-taped and transcribed afterwards (Clahsen, 1980:59). Thus, there was a corpus of L2 German learners in a naturalistic acquisition context, sampled both cross-sectionally and longitudinally, which is a well-planned overall design even by current standards. However, available reports show that the use of the corpus data was rather fragmented in nature. Since their primary focus was on the development of word order rules, they omitted repetitions and fillers from transcripts. Also they did not analyse the whole corpus, using only a selective transcription consisting, for each learner, of at least 50 utterances from each session (ibid.). The corpus has not been made available which makes it difficult to verify their findings.

ESF Database

The other project I would like to comment on is the European Science Foundation Second Language Database (the ESF Database)[7]. This project was initiated by Clive Perdue and her team, supported by the European Science Foundation. It is a text database collected by research groups within the ESF-project in five European countries: France, Germany, Great Britain, The Netherlands and Sweden. Immigrants of five different source languages (Arabic, Finnish, Italian, Punjabi, Turkish) were observed during a period of 3 years acquiring a target language to which they were exposed (Dutch, English, French, German, Swedish). For each target language, two source languages were selected so that a cross-linguistic analysis could be made between two source languages and one target language. The project concentrated on spontaneous second language acquisition by 40 adult immigrant workers living in Western Europe, and their communication with native speakers in the respective host countries. The database consists of transcribed recordings of those migrant workers learning the language of their resident country, which includes several types of

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[7] http://www.mpi.nl/world/tg/lapp/esf/esf.html

language use gathered in three data cycles over 2.5 years. The design of the database shows that approximately four to eight subjects were selected from each L1 group. Since the corpus is longitudinal in nature, the database is an invaluable resource despite the small sample size. The ESF database has been available in the CHAT format since 1993 and consequently tools designed for the CHILDES Project can also be used on this database (for CHAT and CHILDES, see MacWhinney (1995)). See Perdue (1984; 1993) for more details.

Summary. In this section, I examined how L2 researchers treated learner performance data in the past research paradigm. The review reveals that the idea of using learner data is not new. In fact it has been around for more than 30 years. The treatment of learner data in most studies to date has been, however, rather haphazard. Often only a fragment of the data is analysed and the rest simply ignored. Although there had been a growing awareness that learner data should be investigated in its entirety, it was not until about a decade ago that a systematic collection of learner production data in the framework of corpus linguistics actually started.

It is also the case that in most past approaches to IL studies, very little attention was paid to the IL development in its entirety, especially in relation to learners' L1 knowledge and the status of the target language. Having said that, I would like to move on to the description of present-day learner corpora to show how different they are from their predecessors.

JEFLL Corpus and Multiple Comparison Approach

Before introducing major projects of learner corpora, let me briefly describe my project. This will, I hope, show how present-day learner corpora are designed and compiled. The project is called the Japanese EFL Learner (JEFLL) Corpus. It aims to compile a corpus of Japanese EFL learners from Year 7 to university levels. The strength of the JEFLL Corpus is that it contains L1 and TL corpora as an integral part of its design. As was shown in the last section, very few studies have made use of both attested L2 learner data and L1/TL data to identify features of interlanguage development, let alone a corpus-based analysis of these data. Most learner corpus studies to date have made use of NS corpora because the studies are typically focused on learning English, and many native English corpora are readily available as a standard reference, whereas very few

studies (except for PELCRA[8] and JEFLL) collect L1 source corpora for comparison.

Table 1 shows the overall structure of the JEFLL Corpus. The total size of the L2 corpus is approximately 400,000 running words of written texts and 50,000 words of the orthographically transcribed spoken data. The L1 corpus consists of a corpus of Japanese newspaper texts (approximately 11 million words) plus a corpus of student compositions written in Japanese. These L2 essays were written on the same topics as the ones given to the L1 English writing.

Table 1: The JEFLL Corpus project: the overall structure

Part 1: L2 learner corpora
- Written corpus (composition): c. 400,000 words
- Spoken corpus (picture description): c. 50,000 words

Part 2: L1 corpora
- Japanese written corpus (composition): 50,000 word texts on the same tasks as English
- Japanese newspaper corpus: c. 11,000,000 words

Part 3: TL corpus
- EFL textbook corpus: 650,000 running words (Y7-9: 150,000; Y10-12; 500,000)

The third part of the JEFLL Corpus comprises the TL corpus. It is a corpus of EFL junior and senior high school textbooks. The junior high school textbooks are used officially at every junior high school in Japan. There are seven competing publishers producing such textbooks. Irrespective of which publisher one chooses, each publishes three books corresponding to the three recognised proficiency grades for years 7-9. Senior high school textbooks are more diversified and more than 50 titles have been published. This corpus contains mainly of the textbooks for English I and II (general English).

I argue that textbook English is a useful target corpus to use in the study of learner language. As this claim runs counter to that of other researchers (Ljung,

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[8] See Table 3 for details.

Mindt, Granger etc.), it is important to examine the basis of this claim in some detail. Firstly, the target language which learners are measured by should reflect the learning environment of learners. It is not always appropriate to use a general corpus such as BNC or the Bank of English to make comparisons with non-native-speaker corpora. The difference you will find between L2 corpora and those general corpora will be the one between learner English and the English produced by professional native-speaker writers. This comparison could be meaningful for highly advanced learners of English or professional non-native translators. The output of such highly advanced learners, however, is something which the vast majority of L2 learners in Japan never aspire to. We have to consider very seriously what the target norm should be for the learners we have in mind. In the present case, it is certainly not the language of BNC, but, rather, a modified English which represents what they are more exposed to in EFL settings in Japan. I am fully aware of the fact that the language used in ELT textbooks themselves is unnatural in comparison to the native speaker usage (see, for instance, Ljung, 1990; 1991). Pedagogically, however, beginning-or intermediate-level texts should contain such modified features of English in order to promote students' learning. Given that textbooks, with all of their peculiarities with comparison to L1 corpora, represent the primary source of input for L2 learners in Japan, their use in explaining and assessing L2 attainment is surely crucial.

The textbook is the primary source of input in Japan. Inside the classroom, some teachers will use classroom English, and others do not use English at all as a medium of instruction. Even if they do use English in the classroom, they usually limit their expressions to the structures and vocabulary that had previously appeared in the textbook. Outside the classroom, those who go to cram schools will receive extra input, but still that input comprises questions borrowed from past entrance exams, or questions based on the contents of the textbooks (Rohlen 1983). Hence, it is fair to say that the English used in the textbooks is the target for most learners of English in Japan. If we exclude textbooks from our investigation, explaining the differences between TL and IL usage may be impossible. However, where textbooks are included in an examination of L2 learning, they can explain differences between NS and NNS usage (McEnery and Kifle, 2001).

While the above argument presents the basis for my inclusion of textbooks in my model of the study of learner language, more evidence is required to substantiate this claim. Later in the description of some of my studies, the textbook corpus will be called upon to provide explanation of differences between IL and TL, substantiating my claim further. For the moment I will take the argument presented so far as sufficient evidence to warrant the inclusion of textbook material in my learner corpus exploitation model. My proposal, therefore, is that standard reference (e.g. BNC), textbook and learner corpora all have roles to play in its exploration of learner language. Figure 1 illustrates this point diagrammatically.
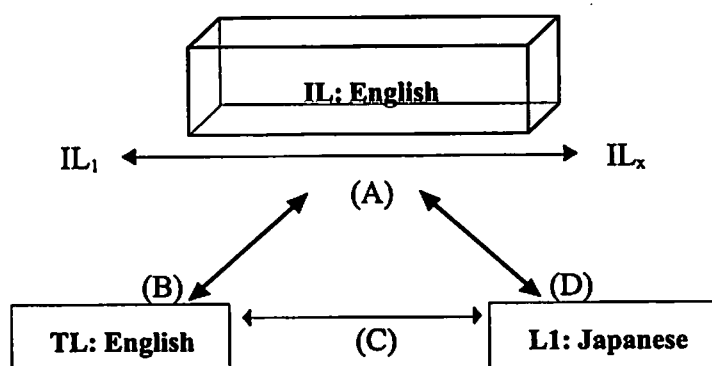

Figure 1: Multiple comparison of L1, TL and IL corpora

"IL_1 ... IL_x" in 1 shows that the L2 learner texts may be divided into subcorpora according to the subjects' academic year. Studies based on such learner subcorpora can be referred to as *IL-IL comparison*. IL-IL comparison can be of several different types, depending on the learner variables. For instance, if the independent variable is age or the academic year of the learners, with all other variables constant, one can make a comparison of different IL corpora from different age groups. In the ICLE[9], on the other hand, the age (or proficiency level) factor is held constant, and research using the ICLE centres on the IL characteristics of different L1 groups.

A comparison between L2 corpora and TL corpora can also be made (see

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[9] International Corpus of Learner English. See Table 3.

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B in Figure 1). One can use either a general standard corpus such as the British National Corpus to look at differences in, for example, lexicogrammar, between native speakers and L2 learners, or use a more comparable corpus of native-speaker texts, e.g. LOCNESS in ICLE, to compare like with like. Let me call this type of comparison an *IL-TL comparison*.

If TL corpora are compared with L1 corpora, it is called a *TL-L1 comparison* (see (C) in Figure 1). This kind of comparison can be used for describing the target adult grammar system and identifying potential causes of L1 transfer. This analysis should be combined with L2 corpus analysis. TL-L1 comparison could provide significant information on the influence of the source language on the acquisition of the target language.

The final type of comparison, the L1-IL comparison, is that between IL corpora and L1 mother tongue corpora (see (D) in Figure 1). L1 corpora can provide features of the L2 learners' native language, which can help us understand potential sources of L1-related errors or overuse/underuse phenomena. Despite the sophistication of recent error taxonomies, it is rather difficult to distinguish interlingual errors from intralingual ones unless some empirical data are available on the pattern of a particular linguistic feature in both languages. L1-IL comparisons will provide fundamental data for interlanguage studies. Table 2 summarises each comparison type and its description.

Table 2: Multiple comparison approach

Comparison	Description
IL-IL comparison	Comparisons between different stages of ILs or ILs by learners with different L1 backgrounds.
IL-TL comparison	Comparisons between learner corpora and target language corpora (i.e. ELT textbook corpora in the present study or general native corpora).
TL-L1 comparison	Comparisons between target language corpora and L1 mother tongue corpora to identify potential causes of L1 transfer.

L1-IL comparison	Comparisons between L1 corpora and learner corpora to identify L1-related errors or overuse/ underuse phenomena.
IL-L1-TL comparison	Combination of the above comparisons to identify the complex relationship between IL, L1 and TL corpora on L2 learners' error patterns or overuse/ underuse phenomena.

Current Projects of Learner Corpora

Table 3 summarises the learner corpus projects currently underway around the world. The table focuses on the design criteria, size, annotation, and availability, and lists the relevant references. It also identifies whether each project involves the comparison of different IL corpora (developmental/ different L1s) with L1/TL corpora from the viewpoints of multiple comparison.

Table 3: Learner corpus projects around the world

Project	Subjects/Tasks Size	Annotation Availability	Comparison	References
Europe/America:				
International Corpus of Learner English (ICLE)	- University EFL 3/4 year students - 15 nationalities - Written essays - 3 million	- Error tagged - POS tagged - Available in 2001	- IL – IL (different L1s) - TL – IL	Granger (1993; 1994; 1996; 1998)
Longman Learners' Corpus (LLC)	- All-levels - Written essays - 10 million	- POS tagged - Available for commercial purposes	- IL – IL	Gillard and Gadsby (1998)
Polish-English Language Corpus Research and Applications (PELCRA)	- All-levels - Written/spoken essays - Polish learners	- POS tagged - Not available	- IL – IL (developmental) - L1 – IL - TL – IL	Uzar (1997) Mason & Uzar (2000)

The ISLE Corpus of non -native spoken English	- 20 minute speech
	- German & Italian
	  intermediate
	  learners of
	  English
		- Orthographic
		- Phone-stress
		- Available
		  from ELRA
			- TL - IL	http://nats-www informatik.uni-hamburg.de /~ isle/speech. html

JPU (Janus Pannonius University) Corpus	- University EFL - Written - c.400,000	- Plain text - Will be available	- IL – IL (developmental)	József (1999)
Cambridge Learners Corpus (CLC)	- All-levels - 10 million	- POS tagged - Error-tagged (2.5 million) - Not available	- IL – IL	http://uk. cambri dgeorg/elt/.refe rence/clc.htm
Indianapolis Business Learner Corpus (IBLC)	- US univ. business students - business writing - plain text	- Plain text - Not available	- IL – IL (different L1s)	Connor & Precht (1998)

Asia:

JEFLL Corpus (Japan)	- All levels; EFL
	- Written & spoken
	- 350,000
		- POS-tagged
		- Error-tagged
		  (partial)
		- available in
		  2003
			- IL – IL
			(developmental)
			- L1 – IL
			- TL – IL
				Tono (2002)
				Tono (2000a, b)
				Tono and Aoki
				(1998)

Corpus of English by Japanese Learners	- All levels; EFL
	- Written
	- 1 million
		- Plain text
		- Error tagged
		  (partial)
		- Will be
		  available
			- IL – IL
			(developmental)
				Asao (1998)

Japanese/ English Translation corpus	- junior & senior
	  high EFL students
	- L1/L2 translation
		- Plain text
		- Available via
		  the web
			- TL – IL	http://home. hiroshima -u.ac.jp/d052121 /eigo1.html

TELEC Student Corpus	- Hong Kong
	  learners
	- Univ. exam
	  scripts
	- 3 million
		- Plain text
		- Restricted
		  availability
			- TL – IL	Allan (1998)

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PolyU Corpus	- Postgraduates - thesis drafts, etc. - 282,000	- Plain text - not available	- TL – IL	Farmer and Mead (1998)
NTOU Corpus	- EFL - 53,000	- Plain text	- TL – IL - IL – IL	Chen (1998)
A parallel corpus of Japanese learners of English	- Short English compositions - Paired with Japanese translations & NS's rewritings	- Database format	- TL – IL - IL – L1	Mark (1998a, b)
MET Corpus	- Chinese middle school students - Written - c. 150000	- Plain text	- TL – IL	Anping (1998)
HKUST Corpus of Learner English	- University EFL Chinese students - 10 million - Written essays & exam scripts	- POS tagged (1M) - Error tagged (100,000 words)	- IL – IL	Flowerdew (1996) Flowerdew (1997) Milton and Tsang (1993)
Standard Speaking Test (SST) Corpus	- Oral proficiency interview test corpus - 100M - Japanese EFL learners	- Error tagged - Back translation - Parallel (with Japanese)	- IL – IL - IL – TL - IL –L1	Tono et al. (2001)

An Example of the Multiple Comparison Approach: L2 Acquisition Of Argument Structure

Overview. Let me demonstrate how the multiple comparison approach works. Here I will report on the study of the patterns of misuse of verb subcategorization frames (henceforth SF) by Japanese learners of English. The acquisition of SF patterns is often associated with the broader issue of the acquisition of argument structure (Pinker 1984, 1987, 1989). The development of argument structure can possibly be influenced by several factors. Four main factors (verb semantics,

learning stage, L1 knowledge, and L2 input) were selected and the relationship of these factors on the use/misuse of argument structure was investigated. An L1 corpus was used to define the influence of verb SF patterns in L1 while ELT textbook corpora were used for determining the degree of exposure to certain SF patterns in the classroom. Using the data from these corpora, I compared the SF patterns of a group of high-frequency verbs in the JEFLL corpus.

The relationship between factors and corpora used. Table 4 shows the relationship between the factors to be examined in this study and how corpus data can supply the relevant information. The multiple comparisons of L1, TL, and IL corpora only make this design possible. Note that the primary purpose of this study is not to identify the role of specific UG constraints in L2 acquisition. Rather, the study aims to capture the cause-effect relationship among those variables and to identify their relative effects on the acquisition of argument structure in L2 English.

Table 4: The relationship between the factors in this study and information from the corpora used

Factors	Corpus data
The L1 effects	Frequency of similar/different argument structure properties in L1 corpus
The L2 input	Frequency of subcategorization patterns in ELT textbook corpus
Developmental stages	Frequency of use/misuse of subcategorization patterns from the developmental IL corpus
The L2 internal effects	Frequency of different verb classes and alternations from the IL corpus

Research Design. This study has the following research questions:
1. Which of the following variables affect L2 acquisition of argument structure most?
   • The L1 effects
   • The L2 input effects

- The L2 internal effects
- The developmental effects

2. Are there any interaction effects between the variables? If so, how?

The clarification of the relationship between the above questions will contribute to current SLA research especially in terms of the possible role of L1 knowledge, L2 classroom input, and verb semantics-syntax correspondences in the acquisition of argument structure.

Each variable is operationally defined as follows:

1. L1 effects:

    L1 effects were examined with respect to the following two aspects: the degree of similarities in SF patterns between English and Japanese in terms of (a) the degree of SF matching and (b) frequencies of the similar SF patterns in the L1 Japanese corpus and the COMLEX Lexicon (TL).

2. L2 input effects:

    L2 input effects were defined as "the frequencies of the given SF patterns in the L2 textbook corpus".

3. L2 internal effects:

    These characteristics pertain to the English verb system. They were defined as "the difference in verb classes and alternation types based on Levin's (1993) classification".

4. Developmental effects:

    Developmental effects were simply defined as the three groups of the subjects based on their school years (Year 7-8; 9-10; 11-12).

Extraction of SF Patterns

In this study, I parsed the learner and textbook corpora using the Apple Pie Parser (APP), a statistical parser developed by Satoshi Sekine at New York University (see Sekine 1998 for details). The accuracy rate of the APP is approximately 70%; hence it was not very efficient to extract SF patterns automatically using the APP alone. Consequently, after running the parser over the corpus, I exported concordance lines of verbs with syntactic information

into Excel and categorized them into SF patterns using pattern matching. This proved to be an efficient means of studying verb SFs.

The Comlex Lexicon (Macleod *et al.,* 1996; Grishman *et al.,* 1994) was also referred to for frequency information relating to each subcategorization frame in the TL corpus. The Comlex Lexicon itself does not provide complete frequency data for SF patterns. However, it has frequency information for the subcategorization frames of the first 100 words appearing in the Brown Corpus. I calculated the percentages of each SF pattern in the Comlex database and used the information to supplement the data from the textbook corpora.

For the L1 corpus, a Japanese morphological analyser, *ChaSen* (Matsumoto *et al.,* 2000), was used for tokenization and morphological analysis and the frequencies of SF patterns were detected by using pattern matching. SF extraction was done after extracting all the instances of a particular verb under study, and thus manual postediting was also possible.

Categorisation of Verb Classes

The verb classification of Levin (1993) was used to categorise verbs into groups with similar meanings. Levin divided verb classes into two major categories: (a) a list of diathesis alternations and (b) a list of semantically coherent verb classes. While Levin's classification is very important for the study of lexical knowledge in the human mind, it should also be noted that the actual use of those verb classes is limited to certain verb classes only. For instance, out of 49 verb classes Levin created, only 22 classes were found in the top 40 most frequent verbs in the BNC. Note that a small number of categories which meet essential communication needs (e.g. 'communication', 'motion', and 'change of possession'), dominate the verb usage. This shows that the input consists of only a handful of highly frequent verb classes and the rest of the classes are quite infrequent.

The information on Japanese SFs was provided in the IPAL Electronic Dictionary Project. After making the matching database of corresponding verbs in English and Japanese, the frequency information of SFs was extracted from the Comlex Lexicon. SFs were extracted from the ELT textbook corpus for TL (English) and from the Japanese corpus I made for L1 Japanese.

Log-linear Analysis.

The objective of log-linear analysis is to find the model that gives the most parsimonious description of the data. For each of the different models, the expected cell frequencies are compared to the observed frequencies. A Chi-square test can then be used to determine whether the difference between expected and observed cell frequencies is acceptable. The least economical model, the one that contains the maximal number of effects, is the *saturated* model; it will by definition yield a 'perfect' fit between the expected and observed frequencies. The associated χ^2 is zero. In this study, the procedure called *backward deletion* was employed. This begins with the saturated model and then effects are successively left out of the model and it is checked to see whether the value of χ^2 of the more parsimonious model passes the critical level. When this happens, the effect that was left out last is deemed essential to the model and should be included.

Subcategorization Frame Database

For each high-frequency verb, the following information was gathered and put into the database format:

- Parsed example sentences containing the target verb
- School year categories (year 7-8; 9-10; 11-12)
- Verb name
- Verb class
- Verb meaning
- Alternation type
- SF for each example
- Frequency of SF in COMLEX Lexicon
- TL frequency of the given SF (i.e. textbook corpora)
- Learner errors
- Parsing errors
- Japanese verb equivalents
- L1 frequency of the equivalent SF (i.e. Japanese corpus)

The database was made for each of the high-frequency verbs and the data were exported to the statistical software used for further analysis. In order to

process the data by log-linear analysis, the frequencies of TL and L1 were converted into categorical data ([HIGH]/ [MID]/ [LOW]). In order to study the acquisition of argument structure, ten verbs were selected for the analysis (*bring, buy, eat, get, go, like, make, take, think,* and *want*). While it would be desirable to cover as many verbs as possible from different verb classes for the study, due to the fact that the frequencies of SF patterns become extremely small if I had chosen low frequency verbs, I had to reduce the number of verbs under investigation to the ten most frequent ones in my data. These verbs, allowed a sufficient number of observations to be made for each verb.

The results of log-linear analysis for individual verbs. Log-linear analysis tested the model by the combination of the following six factors (Factors 1 – 6):

▶ L2 learners developmental factor (Factor 1):
  • 3 levels: Year 7-8/ Year 9-10/ Year 11-12
▶ Subcategorization matching between L1 and L2 (Factor 2):
  • 2 levels: Matched/ Unmatched
▶ Subcategorization frequencies of each SF pattern in COMLEX (Factor 3):
  • 3 levels: High/ Mid/ Low
▶ Subcategorization frequencies of each SF pattern in L1 Japanese Corpus (Factor 4):
  • 3 levels: High/ Mid/ Low
▶ Subcategorization frequencies of each SF pattern in Textbook Corpus (Factor 5):
  • 3 levels: High/ Mid/ Low
▶ L2 learner errors (Factor 6):
  • 2 levels: Error/ Non-error

The results of log-linear analysis for each individual verb revealed quite an interesting picture of the relationship between learner errors and a number of relevant factors. Here let me summarise the results by putting all the best fitting models together in a table and examining which factor exerts most influence on learner performance across the ten verbs. Table 5 shows the summary of log-linear analysis for the ten verbs used for the study.

Table 5: Summary of log-linear analysis

Verbs	Factor 1 YEAR	Factor 2 SUBMATCH	Factor 3 COMLEX	Factor 4 L1FRQ	Factor 5 TEXTFRQ	Factor 6 LERR
bring	51	532, 432	643, 543 532, 432	643, 543 432	543, 532 51	643
buy	1	642, 632 542, 532	532, 543 632	642, 543 542,	543, 542 532	642, 632
eat		642, 632 432, 521	632, 531 432	642, 432	531, 521	642, 632
get	1, 61	432, 532	643, 543 432	643, 543 432	543, 532	61, 643
go	1	632, 542 432, 532	632, 543 432, 532	543, 542 432	543, 542 532	632
like	51	652, 542 532	643, 543 532	643, 543 542	51, 652 543, 542 532	652, 643

make	1	642, 632 542, 532	632, 543 532	642, 543 542	543, 542 532	642, 632
take	51	632, 632 532	632, 543 532	642, 543	51, 543, 532	642, 632
think	1	642, 632 542, 532	632, 543 532	642, 543 542	543,542 532	642, 632
want	31 542	642, 632 31	632, 543 542	642, 543	543, 542	642, 632

In order to analyse the interactions, graphical interpretations of higher dimensional log-linear models are sometimes used (e.g. McEnery 1995; Kennedy, 1992). However, as I am dealing with six dimensional models here, attempting to interpret them using graphical models would be extremely complicated. Also, my primary aim is not to interpret individual cases but to capture the overall picture of how factors are related across different verbs. Consequently I will provide a brief narrative outlining the major results.

Distinctive Effects of the School Year

Table 5 shows that the school year factor (YEAR) has a very strong effect across all of the verbs. For five out of the ten verbs (*buy, get, go, make,* and *think*), the main effect of YEAR was observed. The YEAR effect also has two-way interactions with the factor of text frequency (TEXTFRQ) for four verbs (*bring, like, take, want*) and with the learner error/non-error factor (LERR) for the verb *get*. This shows that the school year influences the way L2 learners use the verbs. It involves both the use/misuse and the overuse/underuse of verbs.

Strong Effects of the SF Frequencies in the Textbook Corpus

We can also see from the summary table that there are strong two-way effects between YEAR and TEXTFRQ. Note that there is only one case (652 for the verb *like*) of the interaction of the textbook frequency factor (Factor 5) with the learner error factor (Factor 6). This implies that the factor of SF frequencies in the textbooks mainly affect the overuse/underuse of the verbs, not the use/ misuse.

SF Similarities and Frequencies in L1 and TL

The factors such as the degree of similarity in SF patterns between English and Japanese (SUBMATCH: Factor 2), the frequency from COMLEX (Factor 3), and the frequency of SF patterns in L1 Japanese (L1FRQ: Factor 4) appear many times with the learner error factor (LERR: Factor 6). These factors are different from the factors of school year and textbook frequency, as they represent more inherent linguistic features of the verbs and L1 effects. Each of

the effects, however, is not very strong because none of them survived backward deletion for the one-way or two-way effects. It seems that only the interactions of these factors affect learners' use/misuse of the verbs.

The effects of verb classes and alternation types. In order to analyse the relationship between verb classes/alternation types and the results of log-linear analysis, I used correspondence analysis. Instead of looking at each verb, I labelled each verb with its verb semantic classes and alternation types. I then gave scores to each factor according to the significance of its effects as shown in Table 5; for instance, if a certain factor had a one-way interaction, which is the strongest, I gave 10 points; if it had a two-way interaction, I gave 5 points for each of the factors involved. Only 1 point was given for each of the three-way effects. In this way, I quantified each of the effects in the best model for each verb in Table 5 and used correspondence analysis to see the relationship between the six factors and verb classes and alternation types.
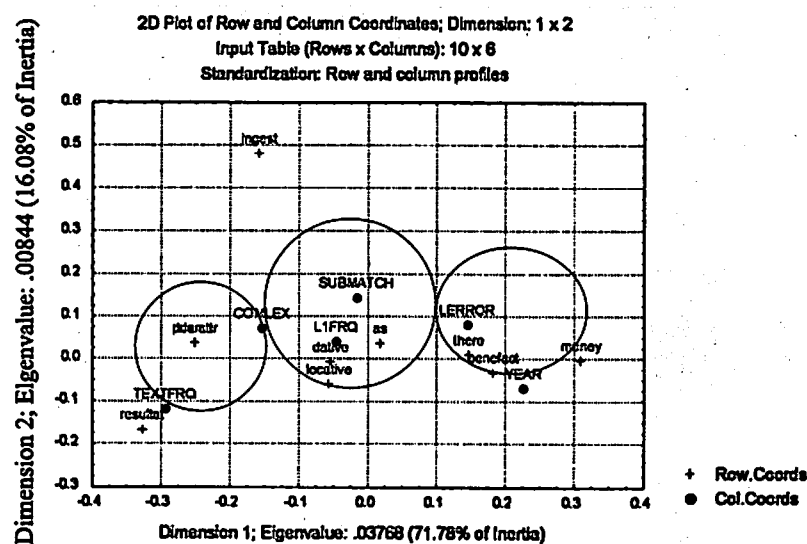

Figure 2: Correspondence analysis (alternations x effects)

Figure 2 shows the results of re-classification of the effects found by log-linear analysis for each verb according to verb alternation types. Correspondence analysis plots the variables based on the total Chi-square values (i.e. inertia) and the more the variables cluster together, the stronger the relationship is. Dimension 1 explains 71% of inertia, so we should mainly

consider Dimension 1 as a primary source of interpretation. The figure shows clearly that there are three major groups of effects: the factor of SF patterns in the textbook corpus (TEXTFRQ) in the left corner, three effects (SF frequencies in L1 corpus, the degree of matching between English and Japanese SFs, the SF frequencies in COMLEX) in the centre, and the learner error effect and the school year effect toward the right side. As was discussed above, the school year represents the developmental aspect of verb learning while the three factors in the middle represent linguistic features in each verb, and the textbook frequency represents L2 input effects.

There is a tendency for verbs involving benefactive alternations (*buy, get, make*, and *take*), sum of money alternations (*buy, get,* and *make*), and *there* insertions (*go*) to cluster around the school year factor and the error factor. Thus these verb alternation classes seem to be sensitive to the developmental factor of acquisition.

Dative (*bring, make, take, think,* and *want*), locative (*take, go*) and alternations (*make, take* and *think*) cluster around inherent linguistic factors such as the degree of SF matching and SF frequencies in L1 and TL.

The verbs involving resultative alternations (*bring* and *take*) cluster around the SF frequencies factor in the textbook corpus. Post-attributive and *blame* alternations are both features of the verbs *like* and *want*. These two alternation types also cluster together close to the textbook frequency effect. These are the verbs showing a strong relationship with L2 input effects.

There is only one alternation type that did not cluster with any other groups; ingestion (*eat*). The verb *eat* was very frequent in learner data and was thus included in the analysis, but it turned out that there were neither very many errors nor many varieties of alternations for this verb. The results look very different from those for the other nine verbs.

Conclusion

The study shows some interesting findings about the developmental effect on learner errors, L2 input effects on the overuse/underuse of SF patterns, L1 effects on some SF errors and L2 internal effects (i.e. verb classes and alternations) on the overall use of verbs. This paper has demonstrated the effectiveness of the multiple comparison approach of IL, L1 and TL corpora.

A large body of L2 learner corpora will become an indispensable resource for SLA researchers in the near future. Also, as we work together with researchers in Artificial Intelligence or Natural Language Processing, there will be very intriguing possibilities for developing a computational model of L2 acquisition. Machine learning techniques will facilitate the testing of prototypical acquisition models or a collection of probabilistic information of IL based on corpora. Computational analyses of IL data will shed light on the process of IL development in a way we never thought possible. For this to happen, there will be a genuine need for well-balanced representative corpora of L2 learners.

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