

The Acquisition of Japanese Intransitive and Transitive Paired Verbs by English-Speaking Learners: Case Study at the Australian National University

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This study examined how the acquisition of Japanese intransitive-transitive paired verbs by students of Japanese is affected by verb type (intransitive-transitive). The acquisition of the paired verbs across four levels of Japanese proficiency groups (Intermediate I, Intermediate II, Advanced I, and Advanced II) was also explored. The study analysed the performance of native English speaking students of different Japanese proficiency levels enrolled at The Australian National University using a written test and a follow-up interview. A Generalised Linear Mixed Model (Schall, 1991) was used for the statistical analysis.

The study found:

- (1) transitive verbs were easier to acquire than intransitive verbs.
- (2) there was no significant difference in results between the test scores for Intermediate I and II groups in spite of the higher general Japanese ability of members of Intermediate II.

Three contributory explanations for finding (1) are put forward: (i) the lexical differences between Japanese and English; (ii) the structural differences of the two languages; and, (iii) the differences in the frequency with which intransitive and transitive verbs occur in the instructions used by language teachers and in language textbooks.

The explanation for finding (2) is that it reflects “U-shaped behavioural development” (Kellerman, 1985) which in this case was attributable to an instructional effect.

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1 Introduction

1-1 Intransitive-Transitive Verb Pairs

A feature of Japanese is the large number of intransitive and transitive verb pairs which share the same root.¹ In addition to their morphological similarities these verbs are also related to one another both syntactically and semantically.² Examples of such verbs are *aku* (intransitive) / *akeru* (transitive) “to open,” and *shimaru* (intransitive) / *shimeru* (transitive) “to close.”

Intransitive-transitive verb pairs are important in Japanese not only because they are highly prevalent, but also because of the significant linguistic roles they play in Japanese grammar. Many scholars including Shibatani (1982) and Nishio (1982) have drawn attention to the fundamental importance of the distinction between intransitive and transitive verbs. They have assumed that a profound relationship exists between intransitive, transitive verbs, and the passive and causative voices of the verbs.³

Also, significantly, the intransitive-transitive distinction is closely related to Japanese aspect markers such as *-teiru* and *-tearu*, as pointed out by many researchers (Sakuma, 1983; Yoshikawa, 1976; Mihara, 1997). The meanings of such aspect markers depend on the type of the carried verb to which they are affixed, i.e., whether it is progressive, resultant, stative, or possibly some other type of verb. In other words, the choice of whether the verb is intransitive or transitive affects the aspectual meaning of entire sentences. Therefore, in Japanese language teaching, the distinction between intransitive and transitive verbs becomes particularly important when students are faced with Japanese aspect markers (Ishikawa, 1991, 45–46; Tomita, 1993, 162).

Further, in terms of semantic relevance, the paired verbs contain a substantial amount of information about the transitive status of the sentence in which they occur. Unlike in English, in Japanese it is possible in most cases to tell from the form of a given verb whether it is intransitive or transitive. This difference in form is important as, often, a description of transitivity in Japanese will require a reference to the verb form rather than just to the number of noun phrases associated with the verb. Indeed, sometimes the form of the verb itself can serve as the sole distinguishing characteristic of the transitive status of a sentence (Jacobsen, 1982: 2). This is perhaps exemplified by two distinct but related verbs corresponding to

¹ There are many studies that provide details on the relatively high occurrence of these paired verbs in Japanese (Nishio, 1982; Shimada, 1979; Hayatsu, 1987a, 1989a, 1989b).

² Only intransitive and transitive verbs which satisfy certain conditions are regarded as comprising verb pairs and therefore included for the purposes of this research. It is generally agreed that a given intransitive verb and transitive verb are a verb pair in Japanese when (i) a morphological, (ii) a syntactic, and (iii) a semantic correspondence exists between the two forms (Okutsu, 1967: 49–50, 1980: 70; Nishio, 1978: 174–175; Suga, 1986: 60–61; Hayatsu, 1987b, 1989a: 231, 1989b: 354).

³ In Japanese, intransitive verbs can also appear in the passive voice. This can occur in the case of adversative passive (e.g., *Taro ga ame ni furareta*. “Taro was caught in the rain.”).

opened and *to open* (transitive) in *John opened the door*. Okutsu (1980, 71, 1989, 278), Jacobsen (1982, 1), and Teramura (1982, 305, 1992, 222) have shown that there are actually only a very few intransitive-transitive verbs which are expressed with different verb forms in English. Familiar examples are *lie-lay*, *rise-raise*, and *sit-seat*. In contrast, as noted earlier, intransitive and transitive verbs are normally expressed in Japanese through the use of different forms. For example, the transitive verb *akeru*, “to open,” has an intransitive counterpart *aku*, “to open.”

This feature of Japanese of having different forms for intransitive and transitive verbs causes many problems for English-speaking learners of the Japanese language (Okutsu, 1980, 71; 1989, 278; Ishikawa, 1991, 36, 50, 76; Moriya, 1993, 144; Tomita, 1993, 162). The difficulties arise because the paired intransitive and transitive verbs in Japanese share a common root and are derived by attaching a suffix to that root. The morphological similarity of the two kinds of verbs is often confusing for language learners, especially when such a formal distinction does not occur in their mother tongue.

(b) Students find it difficult to learn these paired verbs because there are too many morphological patterns to derive. Rules for derivation do exist, but are too numerous to be systematised. Jacobsen (1992, 56) argues that transitivity is marked by what he calls “a series of verbal oppositions cutting across the verb system,” in which the “opposition” refers to derivational suffix pairings. Jacobsen (1992, 57) classified these oppositions into sixteen classes based on the shape of the suffixes attached (Table 1).

Jacobsen (1992, 56) notes that these oppositions are not productive, as one cannot create the intransitive counterpart on the basis of the transitive form, or vice versa. Jacobsen further mentions the difficulty of distinguishing whether a verb is intransitive or transitive by simply looking at the shape of the verb. Shibatani (1990, 235) makes the same point, saying that the intransitivising and transitivity suffixes are irregular and cannot be freely chosen.

In short, intransitive-transitive pairs are characterised as non-productive derivational morphology. These features are significantly different from the productive or inflectional nature of causativisation and passivisation where forms can be derived by rules. Therefore, the pair verbs must be learned as separate lexical items (Jacobsen, 1982, 11, 1992, 56; Yoshikawa, 1989, 71). Okutsu (1989, 278) added that having to memorise different forms is a burden for native English-speaking Japanese-language learners.

1-3 The Purpose of This Study

While many scholars of the Japanese language have mentioned the difficulty of mastering intransitive and transitive pairs in Japanese, to the best of my knowledge none have researched this difficulty in detail.

The main purpose of this study is to examine some aspects of the acquisition of Japanese intransitive-transitive paired verbs by native English speakers. To do this, the study employed a test involving two significant variables, i.e., verb type and Japanese proficiency level. The former variable reflects the relationship between

Table 1 Jacobsen's (1992) Classification According to Derivational Affixes

	Type of Derivational Affixes	Example Verb Pair-intransitive/transitive
I	-e-/- ϕ -	<i>oreru/oru</i> "break/break"
II	- ϕ -/-e-	<i>aku/akeru</i> "open/open"
III	-ar-/-e-	<i>hajimaru/hajimeru</i> "start/start"
IV	-ar-/- ϕ -	<i>tsunagaru/tsunagu</i> "be connected/connect"
V	-r-/-s-	<i>naoru/naosu</i> "be repaired/repair"
VI	-re-/-s-	<i>kowareru/kowasu</i> "break/break"
VII	-ri-/-s-	<i>tariru/tasu</i> "suffice/add, supplement"
VIII	- ϕ -/-as-	<i>waku/wakasu</i> "boil/boil"
IX	-e-/-as-	<i>nigeru/nigasu</i> "run away/let . . . run away"
X	-i-/-as-	<i>ikiru/ikasu</i> "live/bring to life"
XI	-i-/-os-	<i>okiru/okosu</i> "get up/get . . . up"
XII	- ϕ -/-se-	<i>niru/niseru</i> "resemble/imitate"
XIII	-e-/-akas-	<i>amaeru/amayakasu</i> "fawn upon/spoil"
XIV	-or-/-e-	<i>nukumoru/nukumeru</i> "be warmed/warm up"
XV	-are-/-e-	<i>torawareru/toraeru</i> "be caught by/catch"
XVI	Miscellaneous pairs	<i>nakunaru/nakusu</i> "be lost/lose"

whether a verb is intransitive or transitive and the students' progress in acquiring the paired verbs. The latter concerns how students' proficiency level affects the acquisition of these verbs. The current study utilises four groups of different Japanese proficiency levels, of which details will be provided shortly.

2 Methodology

2-1 The Subjects for This Study

In the test for the current study, the subjects are 89 native-English-speaking students chosen at random from students enrolled in the intermediate or higher level Japanese courses at the Japan Centre of the Australian National University (ANU) in the year 2001.⁴ All the data was collected at the ANU from the end of the first semester to the beginning of the second semester in 2001. The age of the participants ranged from 18 to 24, and all of them had been raised and educated in Australia until the age of 17. The average, median, and mode ages were 20, 21, and 22, respectively. There were 30 males and 59 females.

⁴ Beginners were not included for two reasons. First, the beginners' curriculum does not present intransitive-transitive verb pairs as pairs. Second, even if the students had been exposed to intransitive-transitive pairs, it was judged unlikely that they would be familiar with the use of such verb pairs.

The subjects were divided into four groups according to their proficiency in Japanese. These groupings were based on the Japanese units that the subjects had completed and/or were currently enrolled in. I will hereinafter refer to these groups as Intermediate I, Intermediate II, Advanced I, and Advanced II. Intermediate I is the lowest proficiency group and Advanced II is the highest, among these four groups. Intermediate I students have completed the beginner level of Japanese units and have studied Japanese for one and a half years. Students in Intermediate II and more advanced levels have studied Japanese for two years or longer. In general, the Japanese ability of Intermediate I students is equivalent to Level 3 of the Japanese Language Proficiency Test, the Japanese ability of Intermediate II students is equivalent to something between Level 3 and Level 2, the ability of students of Advanced I is equivalent to Level 2, and that of Advanced II is higher than Level 2 and is equivalent to Level 1. The number of subjects in each group was 21 in Intermediate I, 28 in Intermediate II, 19 in Advanced I, and 21 in Advanced II (See Appendix A for basic statistics for each group.).

2-2 Nature and Contents of the Test

In designing the test for this research, I extracted and revised teaching materials on transitivity as well as passive and causative forms of verbs from work by Ford-Niwa et al. (2000, 6–9). Some revisions were needed because Ford-Niwa et al. (2000, 6–9) incorporates tasks involving verbs which have a counterpart intransitive-transitive verb as well as those which do not have such a counterpart. Given that the purpose of the current study is to examine the acquisition of Japanese paired verbs, only verbs that comprise one member of an intransitive-transitive verb pair were used.

As part of this analysis, subjects were required to: (a) write the meaning of a given Japanese verb in English, (b) identify the given verb as either intransitive or transitive, and (c) provide the paired counterpart of the given verb. The instructions were given in English, and English translations for some words and phrases were provided when necessary (See Appendix B for the details of the test and 3–5 for the scoring mechanism of the test.). The rationale behind these requirements is that students can correctly use the paired verbs in terms of grammar and semantics only when they fully understand the meaning and applications of the paired verbs.

After a pilot test was conducted, involving 41 questions comprising 20 intransitive and 21 transitive verbs were selected from Level 4 to Level 2 (mainly from Level 4 and Level 3) of the Test Content Specifications of the Japanese Language Proficiency Test (The Japan Foundation and Association of International Education, 1994).⁵ The tested verbs were selected from these levels to ensure that the body of verbs used for the analysis was appropriate for subjects of the Japanese ability in this study. Table 2 lists these 41 verbs. The underlined verbs are those that were used in the test. Their counterparts are also shown next to these underlined verbs.

⁵ The initial intention was that the test would comprise 46 questions (23 each from intransitive and transitive verbs). Five verbs were left out because it appeared that the students were unfamiliar with them.

The numbers in parentheses indicate question numbers, e.g., (3), (6), (8), on the test sheet. The numbers in square brackets, e.g., [4:4], [2:3], [3:3], show the vocabulary levels specified in the Japanese Language Proficiency Test (1994). For example, the number on the left of [2:3] indicates that the intransitive verb is taken from Level 2

Table 2 The Paired Verbs Based on Intransitive-Transitive Distinction

Selected intransitive verbs (underlined)	Selected transitive verbs (underlined)
(3) <u>narabu</u> / <u>naraberu</u> “line up/line up” [4:4]	(1) <u>waku</u> / <u>wakasu</u> “boil/boil” [3:3]
(6) <u>tatsu</u> / <u>tateru</u> “be built/build” [2:3]	(2) <u>kireru</u> / <u>kiru</u> “be cut/cut” [2:4]
(8) <u>sagaru</u> / <u>sageru</u> “go down/lower” [3:3]	(4) <u>neru</u> / <u>nekasu</u> “sleep/put . . . to sleep” [4:2]
(9) <u>oreru</u> / <u>oru</u> “break/break” [3:2]	(5) <u>hajimaru</u> / <u>hajimeru</u> “start/start” [4:3]
(10) <u>heru</u> / <u>herasu</u> “decrease/decrease” [2:2]	(7) <u>tomaru</u> / <u>tomeru</u> “stop/stop” [4:3]
(14) <u>hairu</u> / <u>ireru</u> “enter/let . . . enter” [4:4]	(11) <u>kimaru</u> / <u>kimeru</u> “be fixed/fix” [3:3]
(16) <u>kawaru</u> / <u>kaeru</u> “change/change” [3:3]	(12) <u>tsuzuku</u> / <u>tsuzukeru</u> “continue/continue” [3:3]
(17) <u>wareru</u> / <u>waru</u> “break/break” [3:2]	(13) <u>tooru</u> / <u>tōsu</u> “go through/let . . . go through” [3:2]
(18) <u>todoku</u> / <u>todokeru</u> “arrive/deliver” [2:3]	(15) <u>ochiru</u> / <u>otosu</u> “fall/drop” [3:3]
(19) <u>naoru</u> / <u>naosu</u> “be repaired/repair” [3:3]	(20) <u>yakeru</u> / <u>yaku</u> “be cooked/cook” [3:3]
(22) <u>tomaru</u> / <u>tomeru</u> “stay/let . . . stay” [3:2]	(21) <u>hieru</u> / <u>hiyasu</u> “be cooled/cool” [3:2]
(23) <u>naru</u> / <u>narasu</u> “ring/ring” [3:2]	(24) <u>nokoru</u> / <u>nokosu</u> “be left/leave” [3:2]
(25) <u>ugoku</u> / <u>ugokasu</u> “move/move” [3:2]	(26) <u>ururu</u> / <u>uru</u> “sell/sell” [2:4]
(29) <u>sugiru</u> / <u>sugosu</u> “pass/spend” [3:2]	(27) <u>aku</u> / <u>akeru</u> “open/open” [4:4]
(31) <u>nakunaru</u> / <u>nakusu</u> “be lost/lose” [3:3]	(34) <u>tsuku</u> / <u>tsukeru</u> “be on/turn . . . on” [3:4]
(32) <u>odoroku</u> / <u>odorokasu</u> “be surprised/surprise” [3:2]	(38) <u>katazuku</u> / <u>katazukeru</u> “be cleaned/clean” [2:3]
(37) <u>deru</u> / <u>dasu</u> “go out of/take . . . out” [4:4]	(28) <u>mitsukaru</u> / <u>mitsukeru</u> “be found/find” [3:3]
(39) <u>okiru</u> / <u>okosu</u> “get up/get . . . up” [4:3]	(30) <u>kowareru</u> / <u>kowasu</u> “break/break” [3:3]
(40) <u>yabureru</u> / <u>yaburu</u> “be torn/tear” [2:2]	(33) <u>agaru</u> / <u>ageru</u> “rise/raise” [3:4]
(41) <u>atsumaru</u> / <u>atsumeru</u> “be gathered/gather” [3:3]	(35) <u>nigeru</u> / <u>nigasu</u> “run away/let . . . run away” [3:2]
	(36) <u>kieru</u> / <u>kesu</u> “go off/turn . . . off” [4:4]
Total 20	21

and the number on the right indicates that the transitive verb is from Level 3.

Follow-up interviews were also conducted at random in order to check the subjects' understanding of Japanese transitivity as well as their understanding of the differences between Japanese and English transitivity (See 3–4 for the results of follow-up interviews.).

2–3 Arrangement of the Data

For each question, the subjects gained one point if they correctly gave the meaning of the verb, identified whether the verb was intransitive or transitive, and provided the correct counterpart. To avoid the possibility that guesswork might affect the results of the analysis, only answers which were correct on all counts were included in this study.

Where subjects gave otherwise correct answers without knowing the meaning of the verbs, the possibility that the subjects might have learned something about intransitive-transitive verbs which might have given their answers some validity for the study was explored. The follow-up interviews revealed only that, in these cases, the subjects did not know anything in particular about the verbs which had allowed them to answer correctly but rather all of them just happened to guess the correct answers. These answers were therefore excluded from the analysis.

After collecting the questionnaires, the number of correct/incorrect answers was counted for the verb type, i.e., intransitive and transitive, per subject, and then the percentages of correct answers were compiled according to the four Japanese proficiency groups.

3 Findings

3–1 The Preliminary Statistical Analysis and the Findings

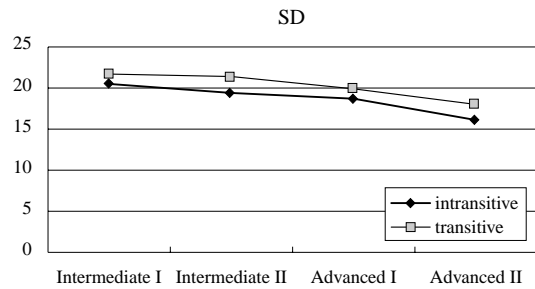
The preliminary analysis is important for providing a first sense of key statistical features and for building the hypotheses for the following inferential statistics. The preliminary statistical analysis and some findings from the analysis of the results are displayed below. Graph 1 and Graph 2 show the means and standard deviations (SD) of the scores in the test for the intransitive-transitive distinction for each Japanese proficiency group.

With respect to verb type, Graph 1 shows that the means of the test scores for transitive verbs were higher than those for intransitive verbs for each of the four Japanese proficiency groups. This means that transitive verbs were easier to acquire than intransitive verbs for the students in this study. From Graph 2, it can be seen that the SDs of intransitive and transitive verbs displayed the same tendencies as the means. That is, the SDs for the test scores for transitive verbs were slightly higher than those for intransitive verbs through all proficiency groups. Graph 2 indicates that the test scores for transitive verbs appeared to differ from those of intransitive verbs. It supports that the acquisition of transitive verbs for the students differ from those of intransitive verbs.

In terms of the Japanese proficiency groups, Graph 1 indicates that, overall, there

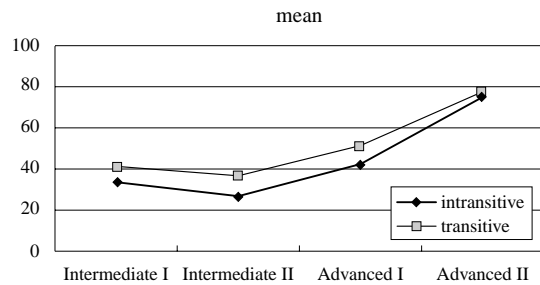
Graph 1 Means of correct answers for intransitive and transitive verbs per Japanese proficiency group (%)

Mean		
	Intransitive	Transitive
Intermediate I	33.6	41.3
Intermediate II	26.8	36.7
Advanced I	42.4	51.4
Advanced II	75.5	77.6



Graph 2 SDs of correct answers for intransitive and transitive verbs per Japanese proficiency group (%)

SD		
	Intransitive	Transitive
Intermediate I	20.5	21.7
Intermediate II	19.4	21.4
Advanced I	18.7	19.9
Advanced II	16.1	18.0



was a correlation between the higher test scores and the more advanced subjects' proficiency groups. In other words, it indicates a general tendency that the higher the Japanese proficiency group, the higher the means of the test scores for both intransitive and transitive verbs. However, the Intermediate II group was an exception to this general tendency. Although Intermediate II is comprised of a higher level proficiency than Intermediate I, the means of the test scores for intransitive and transitive verbs for Intermediate II (26.8 percent and 36.7 percent, respectively) were lower than those for Intermediate I (33.6 percent and 41.3 percent, respectively).

3-2 Hypotheses for the Statistical Test

For the purpose of statistic analysis, the two pairs of null hypotheses and alternative hypotheses are set out as follows, on the basis of the study's findings presented in 3-1:

(i) Hypothesis 1

Null hypothesis 1:

Transitive verbs and intransitive verbs are equally easy to acquire for English native students of Japanese.

Alternative hypothesis 1:

Transitive verbs are easier to acquire than intransitive verbs for English native students of Japanese.

(ii) Hypothesis 2

Null hypothesis 2:

Overall, progress in the acquisition of intransitive and transitive verbs is not correlated with students' overall levels of proficiency.

Alternative hypothesis 2:

Overall, progress in the acquisition of intransitive and transitive verbs is correlated with students' overall levels of proficiency.

3-3 The Statistical Analysis*3-3-1 Method of Analysis*

A Generalised Linear Mixed Model (GLMM) (Schall, 1991) (See Appendix C for an explanation about GLMM and the statistical terminology used in this study.) was used to analyse the test data. This statistical model is suitable for this data where there are two sources of variability, variation from subject to subject, and variation from question to question for each individual subject. The independent factors in the data are (i) verb type: intransitive-transitive, (ii) proficiency group: Intermediate I, Intermediate II, Advanced I, and Advanced II and (iii) subject: 89 subjects.

3-3-2 Results of Hypothesis 1

Alternative Hypothesis 1 was supported, and Null Hypothesis 1 rejected:

(i) Table 3 shows that transitive verbs were easier to acquire than intransitive verbs for students overall (Wald statistic (W) = 23.7, degrees of freedom (df) = 1, critical value (c.v.) = 10.8, $p < 0.001$).

Table 3 Means and Standard Errors for Intransitive and Transitive Verbs on the Linear Predictor Scale

	Intransitive	Transitive
Predicted means (Back-transformed scale)	-0.25 (43.8%)	0.11 (52.7%)
Standard error of differences	0.08	
Wald statistic	23.7	
Critical value	10.8 (0.1%)	
Probability level	***	

Note: *** indicates that the difference was significant at $p < 0.001$.

(ii) Table 4 indicates that for most proficiency groups, the test scores for transitive verbs were significantly higher than those for intransitive verbs [Intermediate I group ($z = 2.49$, $df = 1$, $c.v. = 1.96$, $p = 0.05$), in the Intermediate II group ($z = 3.86$, $df = 1$, $c.v. = 3.29$, $p = 0.001$), and also in the Advanced I group ($z = 2.62$, $df = 1$, $c.v. = 2.57$, $p = 0.01$)]. However, there was no significant difference between the test scores for intransitive and transitive verbs in Advanced II group [$z = 0.76$, $df = 1$, $c.v. = 1.96$, NS]. It was apparent that students in Advanced II, the most advanced group, were equally at ease with both intransitive and transitive verbs.

Table 4 Means and Standard Error of Differences for Intransitive and Transitive Verbs in Each Proficiency Group on the Linear Predictor Scale

Proficiency group	Intermediate I	Intermediate II	Advanced I	Advanced II
Intransitive-transitive				
Predicted means for Intransitive (Back-transformed scale)	- 0.80 (30.9%)	- 1.13 (24.4%)	- 0.33 (41.8%)	1.27 (78.0%)
Predicted means for Transitive (Back-transformed scale)	- 0.43 (39.5%)	- 0.60 (35.5%)	0.07 (51.7%)	1.40 (80.2%)
Standard error of differences	0.15	0.14	0.15	0.17
z statistic	2.49	3.86	2.62	0.76
Critical value	1.96 (5%)	3.29 (0.1%)	2.57 (1%)	1.96 (5%)
Probability level	*	***	**	NS

Note: *** indicates that the difference was significant at $p = 0.001$.

** indicates that the difference was significant at $p = 0.01$.

* indicates that the difference was significant at $p = 0.05$.

NS indicates that the difference was not significant at $p = 0.05$.

3-3-3 Results of Hypothesis 2

Alternative Hypothesis 2 was supported, and Null Hypothesis 2 rejected:

(i) Table 5 shows that the more advanced the students, the higher their test scores

Table 5 Means and Standard Errors for the Four Proficiency Groups on the Linear Predictor Scale

	Intermediate I	Intermediate II	Advanced I	Advanced II
Predicted means (Back-transformed scale)	- 0.62 (35.1%)	- 0.86 (29.6%)	- 0.13 (46.7%)	1.33 (79.1%)
Standard error of differences		0.29		
Wald statistic		70.9		
Critical value		16.3 (0.1%)		
Probability level		***		

Note: *** indicates that the difference was significant at $p = 0.001$.

for intransitive and transitive verbs in general ($W = 70.9$, $df = 3$, $c.v. = 16.3$, $p = 0.001$).

(ii) Table 6 shows where and at which probability level there were significant differences among the four Japanese proficiency groups. There was no significant difference in the means for the test scores between Intermediate I and Intermediate II groups ($z = -0.92$, $df = 1$, $c.v. = 1.96$, NS). In contrast, there was a significant difference between Intermediate II and Advanced I ($z = 2.64$, $df = 1$, $c.v. = 2.58$, $p = 0.01$), and between Advanced I and Advanced II groups ($z = 4.89$, $df = 1$, $c.v. = 3.30$, $p = 0.001$).

Table 6 Results Corresponding to Table 5

	Intermediate I vs. Intermediate II	Intermediate II vs. Advanced I	Advanced I vs. Advanced II
Differences in predicted means	-0.25	0.73	1.46
z statistic	-0.92	2.64	4.89
Critical value	$c.v. = 1.96$ (5%)	$c.v. = 2.58$ (1%)	$c.v. = 3.30$ (0.1%)
Probability level	NS	**	***

Note: *** indicates that the difference was significant at $p = 0.001$.

** indicates that the difference was significant at $p = 0.01$.

NS indicates that the difference was not significant at $p = 0.05$.

The main findings are summarised as follows:

- (i) Overall, transitive verbs were easier to acquire than intransitive verbs.
- (ii) In general, there was a positive correlation between the test scores and students' overall levels of proficiency. However, this was not uniform as there was no significant difference in the test scores for Japanese paired verbs between the two Japanese proficiency groups, Intermediate I and Intermediate II.

3-4 The Results of Follow-up Interviews

As mentioned earlier, follow-up interviews were conducted after the test. The results of follow-up interviews showed that a large proportion of students seemed to learn or memorise intransitive-transitive pairs based on transitive verbs. The main point to emerge was that students felt it was easier to recognise or become familiar with transitive verbs than intransitive verbs. This finding was consistent with the results of their tests (cf. 3-1 and 3-3). Further, the subjects were asked how they identified whether the tested verbs were intransitive or transitive and how they determined what the counterparts of the verbs were. They were also asked whether they understood the concept of Japanese transitivity.

Most students did indeed seem to understand the concept of Japanese paired verbs. However, they emphasised how difficult they found it to provide the paired intransitive verbs of the given transitive verbs. As an explanation for this, some

students noted that intransitive verbs presented more of a learning problem because there are not as many lexical intransitive verbs in English as in Japanese. Also, many students said that they were more familiar with transitive verbs because these are heard and used more frequently than intransitive verbs in the classroom or other language learning environments.

In explaining how they identified whether a given verb was intransitive or transitive, most students said that they tried to recall familiar sentences incorporating that given verb and made a decision based on those sentences. For example, for a given verb *hajimeru* “to start” (transitive), students might recall sentences such as *jugyō o hajimemashō* “let’s start the class,” which they had often heard from their language teachers. This helped them to decide that *hajimeru* was a transitive verb. These students’ responses were useful pointers to the explanations for the results of the analysis.

3–5 The Scoring Mechanism of the Test

The criteria for determining the acquisition rates of different verb types were based on factors including the rate of correct responses, the breakdown of the error types of incorrect responses, and the results of follow-up interviews.

In relation to error types, for both verb categories the most common type of incorrect response was one where students could identify whether a given verb was intransitive or transitive but could not provide the counterpart of that verb correctly (See 1 of Table 7.). The second most common type of incorrect response involved examples where the subjects could neither identify whether a given verb was intransitive or transitive nor provide the counterpart of that verb correctly (See 2 of Chart 7.). The rest of the errors were switching type errors where subjects could provide the intransitive/transitive counterpart of a given verb but they wrongly identified the transitive verb as intransitive and vice versa (See 3 of Table 7.).

Table 7 Breakdown of Error Types (%)

	Intransitive	Transitive
1	8.8	8.6
2	7.5	6.2
3	3.6	4.6

4 Discussion

4–1 Why Are Transitive Verbs Easier to Acquire than Intransitive Verbs?

The current study suggests that transitive verbs are in general easier to acquire than intransitive verbs for English native students of Japanese. There are three explanations for this finding.

4-1-1 *The Lexical Differences*

The fact that students have more difficulty in acquiring intransitive verbs than transitive verbs is partially due to the lexical differences between Japanese and English. That is, English-speaking students of Japanese find it easier to acquire the use of the transitive verb form because they are familiar with transitive verbs and not so familiar with intransitive verbs: the use of intransitive verbs is actually a feature of Japanese and a point of difference between Japanese and English.

As noted earlier, in English, the same form of a verb can in most cases be used both as an intransitive and a transitive verb (e.g., *the door opened* and *John opened the door*). Unlike in Japanese, in English, there are only few intransitive-transitive verb pairs which display a morphological division.

However, it should be noted that even though most English verbs can be used as either intransitive or transitive verbs, their use is nonetheless quite restricted lexically, compared to Japanese paired verbs (Teramura, 1992, 222; Yoshikawa, 1995, 195). Teramura (1992, 222) gives examples, such as the verb *to break* which can be expressed in Japanese not only as *kowasu* or *waru*, which are transitive, but also as *kowareru* or *wareru*, which are intransitive. On the other hand, English verbs, such as *to cut*, can be expressed in Japanese as *kiru* “to cut” (transitive) which cannot be used intransitively. Although the Japanese intransitive counterpart of *to cut*, *kireru* “to cut” (intransitive), can be (e.g., where *to cut* is used as a transitive in the sentence *he cut the string*), the sentence is grammatically correct. However, it cannot be used as an intransitive **the string cut*. It should be *the string was cut*. In Japanese, because the paired verbs *kiru* (transitive) and *kireru* (intransitive) express the transitive and intransitive meanings respectively, the equivalent Japanese sentences of the above English sentences are *kare ga ito o kitta* (transitive) and *ito ga kireta* (intransitive). To generalise, most English transitive verbs correspond to Japanese transitive verbs, but very few of these verbs can actually be used intransitively in a way which corresponds to the intransitive counterpart of the Japanese transitive verbs (Teramura, 1992, 222).

This phenomenon explains why native English-speaking students of Japanese take more time to understand Japanese intransitive verbs than they do to understand the transitive counterparts of those intransitive verbs.

4-1-2 *The Structural Differences*

The second contributory explanation for the relative ease with which English-speaking students acquire transitive verbs in Japanese relates to the different ways of describing situations in Japanese and English. A major difference between the two languages is that “intransitive or spontaneous” expressions are prevalent in Japanese whereas in English “transitive or active” expressions are more prevalent. Put differently, in Japanese, there is a tendency to use intransitive expression in many cases: e.g., *kyūryō ga agatta* “got a raise/got a salary rise” rather than the transitively expressed sentence, *kaisha ga kyūryō o ageta* “the company gave me a raise.”

Many researchers, such as Alfonso (1974), Ikegami (1981), Jacobsen (1992),

Teramura (1992), Inaki et al. (1995), and Yoshikawa (1995), have investigated the possibility that the differences between the languages are not so much incidental but actually relate to the fundamental characteristics of the two languages. For example, Ikegami (1981) differentiates the two languages in terms of the two participants, that is, the agent and the object in an event. English exhibits agent-oriented DO-language (do-type language) that focuses on who or what brought about a certain event, and Japanese exhibits object-oriented BECOME-language (become-type language) that focuses on the change that has been brought about. Likewise, Teramura (1992, 231) characterises English as having a preference for expressions that “do” and “be done (as the reverse direction),” whereas Japanese has a preference for employing “become” expressions. For example, in Japanese, the focus is on the object of a change that has been brought about, i.e., *kyūryō* “salary,” so the equivalent sentence of the Japanese sentence is *kyūryō ga agatta* “got a raise/got a salary rise.” In the English sentence *the company gave me a raise*, the focus is on who, i.e., the agent of the sentence *a company*, and what brought about a certain event, i.e., *gave me a raise*.

Relevant to our analysis is that the viewpoint and reactions that English speakers and Japanese speakers take toward expressing situations differs in the moment of spontaneous expression. That is, these language speakers differ in their habitual approach to situations. English speakers will tend to use a transitive verb, while Japanese will tend to use an intransitive verb to describe the same situations. English-speaking students of Japanese quite often try to form a transitively expressed sentence, such as *kaisha ga kyūryō o ageta* “the company gave me a raise” rather than *kyūryō ga agatta* “got a raise/got a salary rise.”

Similarly, Jacobsen (1992, 80) also comments that, from an English-speaking point of view, it is difficult imagine events expressed by sentences which occur without the presence of outside agency. Consider the example below:

(3) Japanese *Raigetsu* *kare no* *sōbetsukai o*
 next-month his GEN farewell-party ACC
 hiraku koto ni kimatta
 hold COMP DAT be-decided-PAST

- English (a) It has been decided to throw a farewell party for him next month.
 (b) I, we, they, etc., have decided to throw a farewell party for him next month. Jacobsen (1992, 80)

In the Japanese example, sentence (3) above, an event was expressed as a natural consequence of something. Intransitive verb *kimaru* “to be decided” is used, in the place of the transitive verb *kimeru* “to decide.” In contrast, English is a language that explicates the subject of an action or the subject of its effect and their causes (Yoshikawa, 1995). Therefore, when the Japanese example sentence (3) is translated into English, English sentence (3b), where the doer is explicitly referenced, is preferable to English sentence (3a) where the doer is not explicitly referenced.

4-1-3 The Frequency Differences

A final explanation for the result that students find transitive verbs easier to acquire than intransitive verbs is that transitive verbs comprise the great majority of verbs which appear in the instructions used by Japanese-language teachers and in Japanese-language textbooks. That is, students encounter transitive verbs more frequently than they encounter intransitive verbs, and they therefore naturally become more accustomed to transitive verbs.

In class, when Japanese-language teachers give instructions, they often use sentences with volitional sentence-ending expressions such as, *-mashō* “let us do . . . ,” *-nasai* “do, will,” and *-kudasai* “please do” Such instructional expressions are also often found in language textbooks when students are instructed to do some exercises. It is important to note here that transitive verbs have a profound relationship to the nature of the volitionality. Of course, it cannot be said that all transitive verbs are volitional verbs and that all intransitive verbs are non-volitional verbs.⁶ Nonetheless, it does appear that most transitive verbs are volitional, as pointed out by Kindaichi (1976). Furthermore, most intransitive verbs with their paired transitive verbs do not have a volitional sense, therefore they only can take non-volitional sentence-ending expressions (Otsuka et al., 1988, 13).

The logical conclusion that students’ language learning environments include a high proportion of transitive verbs is supported by my primary analysis of Japanese textbooks. Seven Japanese textbooks⁷ ranging from beginner to intermediate levels, including *Japanese For You* (Ohso and Koyama, 1988), which is used by intermediate level classes at the ANU, were examined. The rationale behind the selection of these textbooks was that they all have instructional sentences for drills or exercises in Japanese. A national language dictionary, *Gakken Kokugo Daijiten* [Gakken Large Dictionary of the National Language] (Kindaichi and Ikeda, 1997) and a web site run by The Japan Foundation Japanese-language Institute (2002) were used to confirm whether verbs in instructions in these textbooks were intransitive or transitive. As a result, it was found that in these textbooks, huge numbers of transitive verbs were used in instructional sentences. In all, 743 verbs were found. There were 611 (82.2 percent) transitive verbs with no paired intransitive verbs, 78 (10.5 percent) transitive verbs with paired intransitive verbs, and only 54 (7.3 percent) intransitive verbs with no paired transitive verbs. Together, these transitive verbs with/without paired intransitive verbs accounted for 92.7 percent of the total number of verbs.

Thus, it is most likely that the high frequency of transitive verbs in instructions in Japanese-language textbooks and the frequent use of transitive expressions in the

⁶ For example, intransitive verb *okiru* “to get up” is a volitional verb, and transitive verb *otosu* “to lose” can be either non-volitional or volitional verb depending on the context.

⁷ They are *Nihongo hyōgen bunkei chūkyū I* (1983), *Bunka shokyū Nihongo I* (1987a), *Bunka shokyū Nihongo II* (1987b), *Current Japanese* (1987), *Gendai Nihongo kōsu chūkyū I* (1988), *Japanese For You* (1988), *Chūkyū kara manabu Nihongo* (1991).

language used by teachers in the classroom context and the fact that students consequently have a higher exposure to transitive verbs than they do to intransitive verbs is one significant factor underlying the finding that transitive verbs are easier to acquire than intransitive verbs.

4-2 An Explanation for the Findings of Uneven Progress

With respect to the four Japanese proficiency groups, overall the analysis supported the general expectation that students of more advanced Japanese ability performed better than students with less Japanese ability. However, as mentioned in 3-3-3, there was an exception to this general expectation in the finding that test scores of Intermediate I were higher than those of Intermediate II, despite the higher general Japanese proficiency level of Intermediate II. This finding reflects “U-shaped behavioural development” (Kellerman, 1985).

4-2-1 The Instructional Effect in the “U-shaped Behavioural Development”

Ishida (1991) notes that one year’s study at either beginner or intermediate level does not necessarily reduce the students’ error rates. Tamaru et al. (1993) also suggest that the relationship between the developmental stages of interlanguage and errors is not as simple as a natural decline of errors correlated to more advanced levels of acquisition. They further point out that diminished accuracy at more advanced stages of language proficiency can be associated with U-shaped behaviour.

The term “U-shaped behavioural development” is a name given by Kellerman (1985) to a certain feature of the acquisitional development of language learning in SLA, which involves three stages. According to Kellerman (1985), at stage 1, an early stage of language learning, second language (L2) learners perform quite successfully. At stage 2, they produce forms which deviate from the target language. Finally, at stage 3, they again begin to perform well. The term “U-shaped behavioural development” was derived from the shape of this sequence of tripartite students’ performance which looks like the letter “U.” This phenomenon has been observed in many SLA studies; for example, L2 lexico-semantic development (Kellerman, 1979; Jordens, 1977; Ijaz, 1986), and L2 morphological development (Wode et al., 1978).

Shirai (1990, 691–695) divided SLA studies involving the U-shaped behaviour into three categories: they are (i) task-specific, (ii) instructional effect, and (iii) three-phase model. These three categories are not mutually exclusive as sometimes the U-shape of language learning development may be influenced by more than one factor.

Task-specific U-shaped behaviour reflects the interaction between tasks that test the learner’s knowledge of special areas and changes in the learner’s knowledge. In task-specific U-shape curves, there are three stages, Stage 1 (first language (L1)-dependent), Stage 2 (restructuring), and Stage 3 (L1-independent). Shirai (1990) tests the learner’s knowledge with tasks from two areas, i.e., lexical semantics (judgmental data) and morphemes (production data). In such tasks, when positive transfer items that are the same as learners’ L1 and their L2 equivalent are tested, the learners overuse the items, because they are dependent on their L1 knowledge.

As a result, they perform well. Then their knowledge of L2 diverges from their knowledge of L1 through the restructuring of their L2 knowledge after more input and instruction, so in Stage 2 their performance will be poorer. Finally, if the learners' interlanguage does not fossilise, Stage 3 will see better performance again.

In instructional effect, the U-shaped curves that show learners' acquisition of a grammatical item are caused by instructional factors. Typically, they are related to the structural syllabus in the classroom setting. For example, when only one item is taught in class, L2 learners display high accuracy in dealing with that item for a while. However, when the focus shifts to another item, the learners' performance level with the first item declines as compared with stage 1, but eventually the L2 learners' proficiency becomes high enough so that the item can be handled easily. See Duff (1988), Lightbown (1983), and parts of Shirai (1990) for a review of the instructional effects they identified.

The three-phase model was originally found in the Karmiloff-Smith's (1986) L1 acquisition research, and it can also be seen in child L2 acquisition in naturalistic settings. She prefers the term "phase" to "stage." The three-phase model is comprised of: Phase 1 data-driven, success-oriented; Phase 2 representation-driven, organisation-oriented; and Phase 3 integration of data and representation. The example in Wode et al. (1978) of plural morphemes in child L2 acquisition may be an example of the three-phase model. In Phase 1, children learn plural morphemes as individual cases and perform well, but in Phase 2, they start to find the regularities in the data and show overregularisation. Finally, as representation and data are integrated, they can produce correct forms again.

Of the above three categories of U-shaped behaviour, instructional effect has particular relevance to the results of the current study. That is, the test results of Intermediate I and Intermediate II (i.e., the scores of Intermediate I are higher than those of Intermediate II) have something to do with the relationship between the time the test was administered for this study and the time when intransitive-transitive paired verbs were taught by teachers. To be more specific, a greater time had elapsed since Intermediate II students had studied intransitive-transitive paired verbs in the classroom. The concept of the intransitive-transitive paired verbs had already been introduced at an earlier time (when these students were in a lower Japanese class). Therefore, intransitive-transitive paired verbs were not new grammatical items for either group. However, for the students in the Intermediate I group, the test for this study was conducted shortly after intransitive-transitive paired verbs were reviewed in the class. For the students in Intermediate II group, by the time they took the test, more time had elapsed since they had studied the intransitive-transitive paired verbs. Furthermore, the focus of the syllabus in the unit which students in Intermediate II were taking was on reading and writing, and less attention was given to the concept of the intransitive-transitive verbs, i.e., they are not taken up in the same way as they were in the unit taken by in students in Intermediate I.

Eventually, as students' general Japanese proficiency becomes high enough, i.e., reaches that of Advanced I and Advanced II, they have relatively less difficulty in

handling intransitive-transitive paired verbs (As noted in 3-3-3, the test scores became significantly better in Advanced I and again in Advanced II.). Therefore, Advanced students get better results because the instructional effect has faded as they learnt the verbs much earlier than Intermediate I or Intermediate II students.

CONCLUSION

The main goal of this study was to discuss the acquisition of Japanese intransitive-transitive paired verbs for native English speakers, with a focus on two key variables, verb type and Japanese proficiency level. The statistical results of the study revealed the following significant features. Transitive verbs were significantly easier to acquire than intransitive verbs for students. There are three contributory explanations for this finding: the findings reflect the existence of lexical differences, structural differences, and frequency differences between the two languages. Compared to English, Japanese is a language that has an abundance of lexical intransitive verbs. Japanese exhibits object-oriented BECOME-language (become-type language), therefore in Japanese there are differences in the ways of describing situations that in English would generally be described using transitive expressions. In addition, because students encounter transitive verbs more frequently than intransitive verbs in the instructions used by language teachers and in language textbooks, they become more familiar with transitive verbs.

Second, with respect to the four Japanese proficiency groups in this study, a statistical analysis of the test results gave the finding that the Intermediate II students unexpectedly performed less well than the Intermediate I students. This result reflects the instructional effect that is one of the factors which causes U-shaped behaviour (Kellerman, 1985). The instructional effect in the context of U-shaped behaviour refers to the phenomenon whereby learners perform better with a particular grammar item after having just learnt or been taught it. Their performance then deteriorates before resuming an upward track. Eventually, when students have enough general Japanese ability, they have less difficulty in handling Japanese paired verbs.

The data in this study was based solely on the responses of students from the ANU raising the conceptual possibility that the results may be skewed by the curriculum at the ANU. However, I believe that this study does shed light on certain important aspects of the acquisition of the Japanese paired intransitive/transitive verbs by native speakers of English, which may be applied for more effective learning and teaching of the paired verbs in general. Future research involving subjects from various learning backgrounds would be necessary for a more generalised and comprehensive understanding of the acquisition of the paired verbs.

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Appendix A Basic Statistics for Each Proficiency Group

Intermediate I	intransitive	transitive	Intermediate II	intransitive	transitive
mean	33.6	41.3	mean	26.8	36.7
SE	4.5	4.7	SE	3.7	4.0
median	35.0	42.9	median	20.0	31.0
mode	50.0	42.9	mode	20.0	23.8
SD	20.5	21.7	SD	19.4	21.4
variance	420.4	472.4	variance	378.2	458.3
range	80.0	81.0	range	80.0	81.0
min	0.0	0.0	min	0.0	9.5
max	80.0	81.0	max	80.0	90.5
number of samples	21.0	21.0	number of samples	28.0	28.0

Advanced I	intransitive	transitive	Advanced II	intransitive	transitive
mean	42.4	51.4	mean	75.5	77.6
SE	4.3	4.6	SE	3.5	3.9
median	35.0	47.6	median	80.0	85.7
mode	25.0	38.1	mode	90.0	95.2
SD	18.7	19.9	SD	16.1	18.0
variance	351.0	397.0	variance	259.8	322.3
range	70.0	61.9	range	50.0	52.4
min	15.0	19.0	min	45.0	47.6
max	85.0	81.0	max	95.0	100.0
number of samples	19.0	19.0	number of samples	21.0	21.0

Appendix B The Test in This Study

Name _____

Email Address _____

Age _____

Which Japanese courses are you currently enrolled in?

Which Japanese courses have you completed so far?

Have you been to Japan? If yes, when and for how long?

Instructions

1. Read the list of Japanese verbs on the attached sheets.
2. Write the meaning of the verb in English in the square brackets beside each verb.

e.g. 閉める [close]

3. Identify whether each verb is transitive or intransitive and write the verb in the appropriate parenthesis.

e.g. 閉める [close] 自動詞 (intransitive verb) 他動詞 (transitive verb)
 まどが () まどを (閉める)

4. Next, write the paired verb of the verb in the other parenthesis.

e.g. 閉める [close] 自動詞 (intransitive verb) 他動詞 (transitive verb)
 まどが (閉まる) まどを (閉める)

Please try to **complete all blanks**, even if you are not sure of the answers.

	意味 (meaning)	自動詞 (intransitive verb)	他動詞 (transitive verb)
(1)	沸かす []	お湯が ()	お湯を () お湯 = hot water
(2)	切る []	糸が ()	糸を () 糸 = string
(3)	並ぶ []	人が ()	人を ()
(4)	寝かす []	子供が ()	子供を ()
(5)	始める []	授業が ()	授業を ()
(6)	建つ []	ビルが ()	ビルを () ビル = building
(7)	止める []	車が ()	車を ()
(8)	下がる []	薬で熱が ()	薬で熱を () 薬 = medicine, 熱 = fever
(9)	折れる []	スキーで骨が ()	スキーで骨を () 骨 = bone
(10)	減る []	体重が ()	体重を () 体重 = weight
(11)	決める []	予定が ()	予定を () 予定 = schedule
(12)	続ける []	仕事が ()	仕事を ()
(13)	通す []	車が ()	車を ()
(14)	入る []	ジョンが部屋に ()	ジョンを部屋に ()
(15)	落とす []	財布が ()	財布を () 財布 = purse
(16)	変わる []	髪型が ()	髪型を () 髪型 = hair style
(17)	割れる []	皿が ()	皿を () 皿 = dish
(18)	届く []	手紙が ()	手紙を ()
(19)	直る []	時計が ()	時計を ()
(20)	焼く []	魚が ()	魚を () 魚 = fish

	意味 (meaning)	自動詞 (intransitive verb)	他動詞 (transitive verb)
(21)	冷やす []	冷蔵庫でビールが()	冷蔵庫でビールを() 冷蔵庫 = refrigerator
(22)	泊まる []	ジョンが私の家に()	ジョンを私の家に()
(23)	鳴る []	ベルが ()	ベルを ()
(24)	残す []	ごはんが少し ()	ごはんを少し ()
(25)	動く []	車が ()	車を ()
(26)	売る []	本が ()	本を ()
(27)	開ける []	ドアが ()	ドアを ()
(28)	見つける []	落としした財布が()	落としした財布を() 落としした財布 = lost purse
(29)	過ぎる []	時間が ()	時間を ()
(30)	壊す []	機械が ()	機械を () 機械 = machine
(31)	無くなる []	お金が ()	お金を ()
(32)	驚く []	ジョンが ()	友達がジョンを()
(33)	上げる []	部屋の温度が ()	部屋の温度を () 部屋の温度 = room temperature
(34)	つける []	電気が ()	電気を () 電気 = lights
(35)	逃がす []	かごから鳥が ()	かごから鳥を () かご = cage, 鳥 = bird
(36)	消す []	ランプが ()	ランプを () ランプ = lamp
(37)	出る []	部屋からジョンが()	部屋からジョンを()
(38)	片付ける []	汚い部屋が ()	汚い部屋を ()
(39)	起きる []	ジョンが ()	ジョンを ()
(40)	破れる []	紙が ()	紙を () 紙 = paper
(41)	集まる []	資料が ()	資料を () 資料 = document

Appendix C The Explanation of the Statistics in This Study

Generalised Linear Mixed Models (GLMMs) are used to model various sorts of data, including binary data (yes/no), such as is considered here. For more details on GLMMs see Schall (1991).

The GLMM was fitted to the data with verb type and proficiency group as fixed effects, and subjects as a random effect, using a binomial model with a logit link function. For the GLMM, the dependent variable was the number of correct answers in a verb type for a particular subject, considered as a binomial response. A binomial model is commonly used for data where the outcome is the number of successes in a set of trials, such as in this study where the outcome is the number of correct answers to a set of questions.

Predicted means, which could also be called estimated means, indicate the average value expected in a very large experiment. Standard error of differences is the uncertainty in the estimation of a difference, and it is used to calculate Wald statistics and Z statistics.

Wald statistics were used to test the hypotheses about differences between verb types and between proficiency groups (See Tables 3 and 5.). For more details about the Wald statistics see Harrell (2001). Z statistics are special cases of Wald statistics used to test the hypotheses about the difference between transitive and intransitive verbs (See Tables 4 and 6.). For more details about the z statistics, see Steel and Torrie (1960).

Back-transformed scale means converting from the linear predictor scale as if doing a transformation, then converting back to where one started. Critical value is the value that must be met or exceeded in order to reject the null hypothesis. Critical values for appropriate significant levels were obtained from the standard normal distribution.