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Longitudinal Measurements and
Developmental Patterns
of Receptive Vocabulary Size:
A Study of Japanese University EFL Students

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Abstract

The purposes of this study are (1) to longitudinally investigate the percentages of Japanese university English majors who make (a) good progress, (b) little progress, and (c) negative progress in vocabulary learning during specific years in their university studies; and (2) to describe the longitudinal developmental patterns of the students' vocabulary sizes during their first two years of university.

At the beginning of their freshman year (1st year), sophomore year (2nd year), and junior year (3rd year), 109 university students took one of the three parallel forms of Mochizuki's (1998) Vocabulary Size Test (VST). The tests were always administered in April, when the academic year begins in Japan. By comparing the standard errors of difference (*SEdiffs*) across years, the author examined the progress of students in each year to investigate what percentage of the participants had made good progress, little progress, or negative progress in vocabulary learning. The author also sought to identify developmental patterns in the first half (i.e., the first two years) of students' time at the university.

The results showed that 38.5% of the participants made good progress, 51.4% little progress, and 10.1% negative progress in their vocabulary size during their freshman year. These numbers were 57.8%, 26.6%, and 15.6%, respectively, for the sophomore year. Nine longitudinal developmental patterns were found. The most frequent pattern (31.2%) is Type ($\rightarrow\uparrow$), in which students made no progress as freshmen but successfully increased their vocabulary size as sophomores. The other patterns are also described in detail. The study revealed that even English majors did not always increase their vocabulary size in the course of one year.

1. Introduction

Various kinds of vocabulary tests have been developed and studied (Read, 2000; Nation, 2001). Many focus on breadth of vocabulary knowledge, while others aim at studying the depth of such knowledge, and a few focus on access time. Most vocabulary tests that focus on breadth of vocabulary knowledge measure receptive knowledge;

others measure productive knowledge. However, despite the range of vocabulary tests available, few studies have utilized them to measure learners' vocabulary knowledge longitudinally.

Longitudinal measurements provide important insights into learners' development of language knowledge and proficiency (e.g., Ortega & Byrnes [Eds.], 2008). Numerical data on the development of vocabulary size can yield fundamental data on the development of language ability.

Vocabulary size (or receptive knowledge of vocabulary) moderately correlates with English ability among Japanese EFL learners (junior high school students, senior high school [SHS] students, and university students) (Katagiri, 2001). Only a few studies have conducted longitudinal measurements of the receptive knowledge of vocabulary, although some have performed cross-sectional measurements of it (e.g., Yashima, 2002).

Kosuge (2003) measured the vocabulary sizes of Japanese junior high school students longitudinally, utilizing Mochizuki's (1998) Vocabulary Size Tests (VSTs). She showed that most junior high school students increased their receptive knowledge of vocabulary every year.

Katagiri (2009) measured the receptive vocabulary sizes of Japanese SHSs over a period of approximately three years, also utilizing Mochizuki's (1998) VSTs. The results showed that students in the regular course increased their vocabulary sizes in their 1st and 3rd years, but not in their 2nd year, and that students in the English course increased their vocabulary size every year. In addition, in a regular course even at a top-ranking senior high school in the prefecture, 63.9% of the students made little or negative progress in their 2nd year, and 42.2% made little or negative progress in their 3rd year. Katagiri noted various longitudinal developmental patterns, including 14 types for students in the regular course and 6 types for those in the English course. In the regular course, the most frequent pattern (22.5%) was Type (↑ → ↑), which indicates that the students made good progress in vocabulary size as 1st and 3rd years, but made little progress during their 2nd year. The second most frequent pattern (18.3%) in the regular course was Type (↑ ↓ ↑), which implies the students made progress in vocabulary size as 1st and 3rd years, but their learning deteriorated in the 2nd year. The third most frequent pattern (15.5%) in the regular course was Type (↑ ↑ ↑), which describes that students made good progress in their vocabulary size during all the three years of high school. In the English course, the most frequent pattern (71.8%) was Type (↑ ↑ ↑), and the second most frequent pattern (15.4%), Type (↑ → ↑).

Katagiri (2005) cross-sectionally and longitudinally measured the vocabulary sizes of Japanese university students whose major is English, utilizing Mochizuki's (1998) VSTs. Descriptive statistics and estimates of vocabulary size were given for freshmen, sophomores, and juniors; they indicated that, as a whole, higher-grade students had larger vocabulary sizes. Katagiri further reported that 17% of the university

students did not make any progress in their vocabulary size and 18% made negative progress after studying for the two years while freshmen and sophomores.

However, Katagiri's (2005) purpose was not to analyze longitudinal data in detail, and it left room for improvements in the longitudinal analyses. Taking into account the standard error of measurement (*SEM*) (*SEM* of Form 2 in the VST that the participants took as freshmen is 157; *SEM* of Form 3 that the participants took as sophomores is 213; *SEM* of Form 1 that the participants took as juniors is 171), Katagiri temporarily regarded the progress of -249 words to 0 words and 0 words to +249 words as no progress for the sake of convenience. However, the standard error of difference (*SEdiff*) should have been utilized to strictly judge whether each participant increased his or her vocabulary size.

By reanalyzing the data from Katagiri (2005), this study will (1) longitudinally investigate what percentage of the students made (a) good progress, (b) little progress, and (c) negative progress in their vocabulary learning during specific years; and (2) describe the longitudinal developmental patterns of students' vocabulary sizes during the first two years of their university study.

2. Method

2.1. Participants

The participants were 109 students majoring in English at a university in Japan. They had been learning English as a foreign language (EFL) since junior high school. As freshmen, they took five university English classes per week; this number increased to six when they became sophomores. Each class consisted of 15 sessions per semester, each 90 minutes long. There were two semesters in the academic year. The investigation took place over two academic years (or four semesters). Thus, the participants spent approximately 495 hours ($1.5 \text{ hours} \times 15 \text{ lessons} \times 5 \text{ classes} \times 2 \text{ semesters} + 1.5 \text{ hours} \times 15 \text{ lessons} \times 6 \text{ classes} \times 2 \text{ semesters}$) attending English lessons at the university. The same students had also participated in Katagiri (2005), which showed selected results of macro-analyses of their vocabulary sizes.

2.2. Materials

Mochizuki's (1998) VSTs were utilized to measure the participants' receptive knowledge of vocabulary. The VSTs have three forms, labeled as Forms 1, 2, and 3. The forms are confirmed as parallel tests with one another (Katagiri & Mochizuki, 2002).

Each form has 1,000 – 7,000 word-frequency levels, but test items in the 1,000 word-frequency level were not utilized because a previous study showed that they were too easy for university students (Katagiri, 2000). The test items in the 2,000 – 7,000 word-frequency levels in the VSTs were utilized in this study.

Mochizuki's original VSTs include 30 test items in each word-frequency level.

However, the VSTs utilized in this study are revised ones (i.e., simplified versions), which have 26 test items in each word-frequency level for convenience. A sample of the VSTs used in this study is shown in Appendix 1.

Katagiri (2007) examined whether the rationale of estimating receptive vocabulary sizes of Japanese EFL learners through each word-frequency level is appropriate from a psychometrical viewpoint, and it was empirically demonstrated that the rationale is appropriate.

2.3. Procedure

The 109 university students took one of the three forms of Mochizuki's VSTs every April at the start of their freshman, sophomore, and junior years as follows: Freshman: Form 2, Sophomore: Form 3, and Junior: Form 1.

The test results were given to the students as feedback in May of each year, with the expectation that they might motivate the students to learn more vocabulary. A sample of such feedback is shown in Appendix 2. The results were also given to the students' teachers as for their reference or to be applied toward teaching.

3. Results and Discussion

3.1. Descriptive Statistics and Test Reliability

Table 1 shows the means, standard deviations (*SDs*), maximums, and minimums of the total scores of the 1,000 – 7,000 word-frequency levels in the VSTs. It also shows reliability indices produced by *FACETS* (a Rasch measurement computer program), and *SEMs*¹ for each grade. High reliability indices were confirmed.

Utilizing the *SEM* values, the *SEdiffs*² among the three forms are calculated and shown in Table 2.

The mean difference in students' vocabulary size in April of the first and second years ($4650.7 - 4501.4 = 149.3$) is within the *SEdiff* (257.0). Thus, as a whole, the students did not increase their vocabulary size during their freshman year³. Notably, all of them were English majors. The mean difference in April of the second and third years ($5018.7 - 4650.7 = 368$), however, is larger than the *SEdiff* (270.8). Therefore, as a whole, the students increased their vocabulary size as sophomores.

Generally speaking, variation in learner ability tends to increase after the learners have taken lessons at school or university and studied for a longer period; however, Table 1 shows that the variations (i.e., *SDs*) of vocabulary size became smaller as the students took more English classes and studied English for a longer period of time. To look into this phenomenon more in detail, the participants' data were divided into three groups (higher, middle, and lower groups) according to the VST scores they obtained when they were freshmen, and the descriptive statistics of their vocabulary sizes of the three groups are calculated and shown in Table 3. We can see from Table 3 that the

Table 1: *VST Scores by University Year*

Month Year	VST	University Year	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Max.</i>	<i>Min.</i>	Reliab -ility	<i>SEM</i>
April 2002	Form 2	Freshman (1 st year)	109	4,501.4	679.2	5,808	3,077	0.95	151.9
April 2003	Form 3	Sophomore (2 nd year)	109	4,650.7	598.3	6,500	3,423	0.88	207.3
April 2004	Form 1	Junior (3 rd year)	109	5,018.7	551.1	6,692	3,577	0.90	174.3

Note. VST = Vocabulary Size Test; *N* = Number of students; *SD* = standard deviation;

Max. = maximum; *Min.* = minimum; *SEM* = Standard error of measurement.

Table 2: *Standard Error of Difference (SEdiff) by Forms*

	Between Forms 2 and 3	Between Forms 3 and 1	Between Forms 1 and 2
<i>SEdiff</i>	257.0	270.8	231.2

Table 3: *VST Scores by University Year Among Higher, Middle, and Lower Groups*

	<i>N</i>		April 2002	April 2003	April 2004
			Freshman	Sophomore	Junior
A Whole	109	<i>Mean</i>	4,501.4	4,650.7	5,018.7
		<i>SD</i>	679.2	598.3	551.1
		<i>Max.</i>	5,808	6,500	6,692
		<i>Min.</i>	3,077	3,423	3,577
A higher group	36	<i>Mean</i>	5,254.2	5,251.1	5,076.9
		<i>SD</i>	264.7	392.4	514.9
		<i>Max.</i>	5,808	6,500	6,000
		<i>Min.</i>	4,923	4,346	3,577
A middle group	37	<i>Mean</i>	4534.3	4637.2	5084.2
		<i>SD</i>	197.8	353.3	544.1
		<i>Max.</i>	4,885	5,577	6,346
		<i>Min.</i>	4,192	3,885	3,885
A lower group	36	<i>Mean</i>	3714.7	4064.2	4893.2
		<i>SD</i>	304.5	311.9	586.1
		<i>Max.</i>	4,115	4,731	6,692
		<i>Min.</i>	3,077	3,423	3,923

Note. The three groups were classified according to the VST scores the students acquired when they were freshmen.

lower group increased their VST scores successively while they were freshmen and sophomores and that the higher group did not increase their VST scores while freshmen and sophomores. This may lead to the more convergence into the average and the smaller variations of VST scores as the students studied English for a longer period of time. The author asked their teachers why the higher-group students did not expand their vocabulary size while freshmen and sophomores, and no plausible reasons were obtained. The teachers were just surprised to see this finding.

3.2. Progress of Each Student Vocabulary Size by University Year

The numbers and percentages of students who made progress over each *SEdiff*, who made little or no progress within each *SEdiff*, and who deteriorated over each *SEdiff* are shown by university year in Table 4. It was found that 38.5% of the participants made good progress, 51.4% made little progress, and 10.1% made negative progress in their vocabulary sizes in their freshman year. These numbers were 57.8%, 26.6%, and 15.6%, respectively, for the sophomore year. The author assumes that the yearly progress of the university students majoring in English is probably not as large as what many university teachers and educational researchers expected and that these objective data are new information to teachers and researchers.

Table 4: *Progress of Student Vocabulary Size by University Year (N = 109)*

Change over <i>SEdiff</i>		Freshman year	Sophomore year	Freshman and sophomore years
Good progress	↑	42 (38.5%)	63 (57.8%)	70 (64.2%)
Little change	→	56 (51.4%)	29 (26.6%)	20 (18.3%)
Deterioration	↓	11 (10.1%)	17 (15.6%)	19 (17.4%)

3.3. Longitudinal Developmental Patterns

Using data of the same participants, analyses were conducted to identify longitudinal developmental patterns in vocabulary size during the first two years of university.

If the difference in a student's vocabulary size as measured in the freshman versus sophomore year is larger than 257.0 points (*SEdiff* between Forms 2 and 3), it is statistically regarded, with a confidence level of 68%, that the student increased his/her vocabulary size while he/she was a freshman. Hereafter, increases of over 257.0 are symbolized as (↑) . If the difference is within ± 257.0 points, it is considered that the student did not make progress in his/her vocabulary size. This is symbolized as (→) . Then, if a difference is less than -257.0 points, the student's vocabulary size is considered to have decreased. This type is symbolized as (↓) .

Table 5: *Longitudinal Developmental Patterns (N = 109)*

Pattern type	Freshman year	Sophomore year	<i>N</i>	%
1	↑	↑	24	22.0%
2	↑	→	11	10.1%
3	↑	↓	7	6.4%
4	→	↑	34	31.2%
5	→	→	14	12.8%
6	→	↓	8	7.3%
7	↓	↑	5	4.6%
8	↓	→	4	3.7%
9	↓	↓	2	1.8%
Total			109	100%

Note. *N* = Number of students.

Similar judgments using a criterion of 270.8 points (*SEdiff* between Forms 3 and 1) were made for each student's development between the sophomore and junior year.

Various developmental patterns emerged, and they were classified into nine pattern types, which is the same as the theoretical maximum number of pattern types. Table 5 lists these types along with the number and percentage of students who displayed each one.

The most frequent pattern (31.2%) is Type 4 (→↑), in which students made no progress in their receptive vocabulary sizes during their freshman year but did make progress as sophomores. The second most frequent pattern (22.0%) is Type 1 (↑↑), which indicates that they made progress in both their freshman and sophomore years. The third most frequent pattern (12.8%), Type 5 (→→), describes that they made no progress in each either year.

3.4. Discussion

Many teachers, students, and educational researchers believe that, in general, students increase their English vocabulary size every year. However, this study shows that the presumption is not true. Only 22.0% of participants in this study increased their vocabulary size favorably each year. This findings accords with Katagiri (2009), which showed that, even at a top-ranking high school, 63.9% of the students in the regular course made little or negative progress in their vocabulary learning during their sophomore year, and 42.2% made little or negative progress in their junior year. Katagiri (2009) also identified as many as 14 longitudinal developmental patterns in the vocabulary learning of SHSs in the regular course. The results of this study also accord with Katagiri (2010). Part of the results of Katagiri (2010) are shown in Table 6, which

Table 6: *Examining the Progress of Each Student of SHS students in Each Year*

(Katagiri 2010, p. 225)

				During the 1 st -year of SHS	During the 2 nd -year of SHS	During the 3 rd -year of SHS	During the 3 years of SHS (1 st to 3 rd)
Regular course N = 213	L	Progress over <i>SEdiff</i>	↑	35 (16.4%)	35 (16.4%)	40 (18.8%)	71 (33.3%)
		Little change within <i>SEdiff</i>	→	163 (76.5%)	162 (76.1%)	138 (64.8%)	123 (57.7%)
		Deterioration over <i>SEdiff</i>	↓	15 (7.0%)	16 (7.5%)	35 (16.4%)	19 (8.9%)
	R	Progress over <i>SEdiff</i>	↑	67 (31.5%)	38 (17.8%)	80 (37.6%)	114 (53.5%)
		Little change within <i>SEdiff</i>	→	123 (57.7%)	132 (62.0%)	104 (48.8%)	68 (31.9%)
		Deterioration over <i>SEdiff</i>	↓	23 (10.8%)	43 (20.2%)	29 (13.6%)	31 (14.6%)

showed that the percentage of students in the regular course who made progress during their 1st year, 2nd year, and 3rd year of senior high school was only 16.4%, 16.4%, and 18.8%, respectively, in listening scores of TOEIC Bridge and 31.5%, 17.8%, and 37.6%, respectively, in reading scores of the same.

Recently, complexity theory, dynamic systems theory, complex adaptive systems theory, and chaos theory have drawn attention in the field of applied linguistics, where attempts have been made to apply them (Larsen-Freeman & Cameron, 2008; Ellis & Larsen-Freeman [Eds.], 2009; Verspoor, de Bot, & Lowie [Eds.], 2011). These theories are similar to one another, but they differ in some regards. “Complexity theory deals with the study of complex, dynamic, non-linear, self-organizing, open, emergent, sometimes chaotic, and adaptive systems” (Larsen-Freeman & Cameron, 2008, p. 4). Dynamic systems theory considers that linguistic skills can grow and decline; its characteristics are following: (a) sensitive dependence on initial conditions, (b) complete interconnectedness, (c) nonlinearity in development, (d) change through internal reorganization and interaction with the environment, (e) dependence on internal and external resources, (f) constant change, with chaotic variation sometimes, in which the systems only temporarily settle into “attractor states,” (g) iteration, which means that the present level of development depends critically on the previous level, (h) change caused by interaction with the environment and internal reorganization, and (i) emergent properties (de Bot & Larsen-Freeman, 2011). Meara (1997, 2004, 2006) used a complex systems approach or dynamic modeling to describe vocabulary development or loss. Complex adaptive system approaches consider, “The system is adaptive; that is, speakers’ behavior is based on their past interactions, and current and past interactions together feed forward into future behavior” (Beckner et al., 2009, p. 2). “Chaos theory is the study of non-linear dynamical systems, i.e. systems that do not unfold over time in a linearly predictable manner” (Larsen-Freeman & Cameron, 2008, p. 4). From the viewpoints of complexity theory, dynamic systems theory, complex adaptive systems theory, or chaos theory, the results of this study and Katagiri (2009) might support that

vocabulary learning and learners' longitudinal development in vocabulary size are complex, dynamic, and non-linear.

Longitudinal measurements of each EFL learners' vocabulary sizes seemed to provide the learners and their teachers with fundamental data on their long-term vocabulary development. Curriculum and syllabus design should take into account the various development patterns of vocabulary size. From the viewpoint of the *portfolio* in which learners accumulate learning materials and contents and sometimes review them, it appears helpful for language learning if EFL learners accumulate the data of their longitudinal measurements and review them occasionally to motivate themselves to learn more. Japanese EFL learners, in particular, seem to benefit from confirmations of their English progress through objective numerical data, because they have few opportunities to practice English in their daily lives and, therefore, few opportunities to feel that their English has improved through life experience or communication. Future studies should provide more longitudinal measurements of Japanese junior high school, senior high school, and university students' EFL vocabulary knowledge.

3.5. Limitations and Suggestions for Future Research

Only university students majoring in English participated in this study. Further research should explore the same topic with university students majoring in a variety of academic fields, such as the social sciences and natural sciences.

Moreover, Mochizuki's VSTs were utilized in this study because the author considered them appropriate to measure the vocabulary size of Japanese EFL learners (Katagiri, 2001). If other vocabulary size tests had been utilized, the results might have been affected accordingly.

This study focused on the receptive knowledge of vocabulary. Longitudinal measurements of the productive knowledge of vocabulary are expected in future research. Longitudinal measurements of the depth of knowledge of vocabulary are also of interest.

In this study, longitudinal measurements were conducted only for the first two years of university learning. Measurements spanning longer periods may be expected. However, in Japan, university juniors begin searching for jobs in the second half of the academic year. Their job search activities and related preparations often take precedence over studying; therefore, juniors spend much less time learning English than freshman and sophomore students.

Finally, more studies that include longitudinal measurements of vocabulary knowledge are needed to support the findings here. Adding to measurements of vocabulary knowledge, longitudinal quantitative measurements or qualitative observations of other aspects of English language competency (proficiency) and learners' motivations are also expected to be conducted longitudinally.

4. Conclusion

The purposes of this study were (1) to longitudinally investigate what percentage of the students made (a) good progress, (b) little progress, and (c) negative progress in vocabulary learning during specific years in their university studies; and (2) to describe the longitudinal developmental patterns of students' vocabulary size during their first two years of university.

In relation to the first purpose, it was found that 38.5% of the participants made good progress, 51.4% made little progress, and 10.1% made negative progress in their vocabulary sizes in their freshman year. These numbers were 57.8%, 26.6%, and 15.6%, respectively, for the sophomore year.

Regarding the second purpose of the study, nine longitudinal developmental patterns were found. The most frequent pattern (31.2%) is Type 4 ($\rightarrow\uparrow$), which means that the students made no progress in their receptive vocabulary sizes during their freshman year, but they made progress as sophomores. The second most frequent pattern (22.0%) is Type 1 ($\uparrow\uparrow$), which indicates that students made progress in both their freshman and sophomore years. The third frequent pattern (12.8%), Type 5 ($\rightarrow\rightarrow$), describes that they made no progress in either year.

Notes

- * The results of this paper were reported at a poster presentation at the Conference of the American Association for Applied Linguistics in Boston, U.S.A, on March 26, 2012.

1. The mathematical formula of standard error of measurement (*SEM*) is:

$$SD * \sqrt{1-r}.$$

(Note. *SD* = standard deviation; *r* = reliability index)

If one respondent takes the same test twice with an interval of some time and the difference (increase or decrease) of the two scores is over the points of *SEM*, it is statistically regarded that there is a difference (increase or decrease) between the previous test score and the latter with a confidence level of 68%. If the difference is over the double of *SEM*, it is that there is a difference with a confidence level of 95%. (Here, repetition effects are neglected.)

2. The mathematical formula of standard error of difference (*SEdiff*) is:

$$\sqrt{(SEM_1)^2 + (SEM_2)^2}.$$

(Note. *SEM*₁ = *SEM* of the first parallel form of the tests;

*SEM*₂ = *SEM* of the second parallel form.)

If one respondent takes the TWO parallel forms of the tests and the difference (increase or decrease) of the two scores is over the points of *SEdiff*, it is statistically

regarded that there is a difference (increase or decrease) between the previous test score and the latter with a confidence level of 68%. If the difference is over the double of *SEdiff*, it is that there is a difference with a confidence level of 95%.

3. Some researchers use the double of *SEdiff* as a criterion to examine whether there is a difference (increase or decrease) between the previous test score and the latter with a confidence level of 95%. Generally speaking, a higher confidence level should be expected. However, the author adopted the single of *SEdiff* as a criterion to examine whether there is a difference with a confidence level of 68%, because the double of *SEdiff* seemed too strict as the criterion, judging from Tables 1 and 4.

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Appendix 1

A Sample of a Slightly Revised Version of Mochizuki's (1998) Vocabulary Size Tests

7,000 Word Level (Form II)

1. 名詩選集、作品集			2. 生態学		
(1) anthology	(2) antibiotic	(3) donor	(4) ecology	(5) leukemia	(6) pneumonia
3. 平等主義者			4. 恐竜		
(1) analyst	(2) catalyst	(3) dinosaur	(4) egalitarian	(5) mentor	(6) proletarian
⋮					
23. 器用な、巧みな			24. 筋の通った、首尾一貫した		
(1) coherent	(2) competent	(3) deft	(4) eminent	(5) extinct	(6) staunch
⋮					
25. 発明の才がある、利口な			26. 道理のわからない、不合理な		
(1) autonomous	(2) definitive	(3) feasible	(4) illicit	(5) ingenious	(6) irrational

Appendix 2

A Sample of the Feedback to the Students

#	学 年	氏名	1,000 語レ ベル	2,000 語レ ベル	3,000 語レ ベル	4,000 語レ ベル	5,000 語レ ベル	6,000 語レ ベル	7,000 語レ ベル	合計	2002 年 語彙 テ	2003 年 語彙 テ	2004 年 語彙 テ
1	3	太郎	1,000	962	923	692	846	615	231	5,269	4,462	4,769	5,269
2	3	次郎	1,000	1,000	846	808	769	692	308	5,423	4,192	4,846	5,423
3	3	三郎	1,000	1,000	923	885	846	731	385	5,769	5,462	5,731	5,769
4	3	梅子	1,000	1,000	885	808	808	577	385	5,462	4,577	4,500	5,462
5	3	花子	1,000	1,000	692	692	769	615	192	4,962	4,923	4,885	4,962
6	3	五郎	1,000	731	577	462	538	154	115	3,577	5,538	5,192	3,577