ACQUIRING LISTENING ABILITY IN SCIENTIFIC ENGLISH IN A JAPANESE UNIVERSITY: EFFECTIVE TEACHING OF BASICS WITH ENUNCIATION
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ABSTRACT
Attention has long been focused on the importance of scientific English (SE) listening ability (SELA) in many Japanese universities, because tertiary/graduate students find it difficult to follow presentations in international conferences and/or perform collaborative R&D communication. In this study, pharmacy students (n=83) without previous systematic teaching of SE basics in coeducational University C were given a set of similar questions before and after lecture to investigate whether SELA acquirement could be established with teaching. A 10-min listening session (30 questions) was given to students without prior notification; the test demanded written (Section A: 5 questions) and multiple-choice answers (Section B: 25 questions). The questions were played on tape once for each test session: before and after lecture. Contents tested included numerals (in ratios, volume, distance, size, etc.), symbols, units (e.g. concentrations, etc.), times (twenty-hour clock system, etc.), and calculations based on collective numbers related to sciences. Teaching involved only explanations, elaborations and enunciations of SE basics written on blackboard and power point displays without the use of listening devices. The man scores of students before and after lecture were analyzed with the Wilcoxon signed-rank test, and differences where P<0.01 were considered significant. The results revealed that the post-lecture mean scores for Sections A (1.0±0.92%) and B (20.4±2.07%) were significantly higher than pre-lecture scores (A=0.3±0.50%; B=18.3±2.90%), suggesting that teaching was useful in helping students to acquire SELA (similar significant improvements were established for pooled A/B sections). Based on our findings, it is constructive and useful to provide content-enunciation teaching to students (with no or little exposure to SE learning in secondary schools) in their attempts to acquire SELA at the tertiary level. Additionally, given the proper
content-enunciation teaching approach, students will and can acquire SELA to prepare for future science-related endeavors.

**Field of research:** listening comprehension, scientific English basics, numerals with units

1. Introduction

English for science or scientific English (SE) - learning resembles, in many aspects, learning a new version of the English language, and it involves language development and conceptual development in sciences (The National Curriculum for England, 1999). In SE, we rely on a combination and interactive use of words, pictures, diagrams, images, animations, chemical element/compounds, mathematical equations, graphs, tables and charts in describing findings, observations, concept and discoveries. In tandem with reading, listening, grammars, and writing, SE is acquired in a gradual and spontaneous manner by first learning the basics and thereafter developing the relevant contents to higher levels and forms of functional communication (Fang & Schleppegrell, 2008; de Oliveira & Dodds, 2010).

In English-speaking schools, SE is acquired through a gradual and continuous time-related exposure and daily use of the medium through reading, listening, writing and doing sciences via instructions, teaching/learning tools and verbal/written communication in primary, secondary and tertiary educational systems, such as those of the United States (U.S.), United Kingdom (U.K.) and former British colonies, as well as international school system tailored by the U.S. authorities. However, this is not the case in Japan, where Japanese students (JSs) are probably first exposed to SE at the tertiary level (except for limited number of schools that incorporate basic SE-learning at the secondary level). Apart from reading, writing and certain atypical grammars used in SE, JSs find listening as one of the most difficult aspects in learning SE. This is only obvious because listening comprehension is probably the most difficult task for almost all learners of English – even literary English - as a foreign language (Beare, K. [http://eslabout.com/od/englishlistening/a/listen_tip.htm]). SE-listening is frustrating for JSs because there are no rules as in grammar-learning; however, constant practice and repeated exposure over time could be a useful approach to improve their listening ability (LA) in SE. In recent years, useful and systematic teaching materials with listening tools incorporating juxtaposition and
visual/structural learning (The problem with textbook learning; http://www.flowofhistory.com/theory/textbook_learning) have been developed to assist and facilitate JSs in SE-learning (Foong, 2010).

Attention has long been focused on the importance of SE-listening ability (SELA) in many Japanese universities, because tertiary/graduate students find it difficult to present/follow presentations in international conferences, and/or feel incompetent in performing interactive and functional communication in collaborative research & development (R&D) projects. However, research has not been conducted in the listening ability (LA) of JSs in SE-learning to date. Therefore, we investigated the SELA of SE basics in fourth-year (Yr-4) JSs, who were following a 6-year pharmacy course at the Faculty of Pharmaceutical Sciences of University C. Our results revealed that SE-teaching was useful, as means scores of given tests showed significant improvement in LA after lecture.

2. Subjects and Method

2.1 Subjects
Yr-4 pharmacy undergraduate JSs (n=83) of either gender (age range: 21-22) following the 6-year course at the faculty of Pharmaceutical Sciences of University C participated in the present study. These participating JSs have 3 previous years of literary English of tertiary level, and have acquired scores of more than 800 (full score: 990) in one of the several Tests of English for International Communication (TOIEC) given in 2012 in Japan (personal communication). Although well-equipped with literary English, they had no previous systematic teaching/learning of SE basics, and were tested for their SELA for the first time.

2.2 Measurement of SELA: written and multiple-choice answers
LA of Yr-4 JSs on SE was examined before and after lecture to investigate if SELA acquisition could be improved and established with teaching. A 10-minute test (30 questions) was first given to participating JSs before conducting a lecture containing the test-relevant contents, and the same test (with similar contents) was given to JSs after the 60-minute lecture within the same test-time. Teaching involved explanations, elaborations and enunciations of SE basics written on blackboard and power point displays with occasional participation from JSs, and without the use of listening devices. The lecture emphasized on the verbal characteristics of numerals, units, and other aspects relevant to the test-content, and
different regional enunciations/intonations of certain numerals (e.g. naught vs oh vs zero for ‘0’) and some relevant words (e.g. schedule, etc.) for JSs to understand the spoken contents. JSs were occasionally asked to pronounce certain numerals, units, mathematical expressions (e.g. fractions, etc.), and certain technical terms.

JSs were asked to either write the appropriate answers after listening to the questions (Section A) or just marked the right answers after listening to the multiple-choice questions (Section B), respectively. Section A (5 questions) contained questions on numerals of 3 - 11 digits with or without decimals and units, codenames with alphabets and numerals, 24-hour clock time, and science-related collective nouns with simple calculations. Apart from contents relevant to Section A, Section B (25 questions) included fractions, ratios, volume, distance, size, abbreviations, and mathematical expressions/equations as well.

The questions on tape/compact disc (CD) were read once by three narrators from different regions (U.S., U.K., and Malaysia). This was to test on their LA in terms of versatility and their ability to differentiate and accommodate slight regional differences in SE enunciation.

Answers were scored before and after lecture, and the scores were expressed as mean values of Sections A (total score: 5) and B (total score: 25) were determined accordingly. JSs who participated in either pre-lecture or post-lecture test, those who arrived 1 min after the test had started, and those who did not feel well during either test were excluded from the study analysis. Talking was strictly prohibited during the tests.

2.3 Statistical analysis

All values were expressed as the mean plus/or standard deviation (mean ± S.D.). Statistical analysis of the differences (mean pre-lecture vs mean post-lecture scores) was performed using the Wilcoxon signed-rank test (R 2.15.1 for Mac OS X; The R Foundation for Statistical Computing, Vienna, Austria), and where those with p <0.001 were considered significant.
3. Results

The results revealed that the mean post-lecture scores for Sections A (1.0 ± 0.92%) were significantly higher than the mean pre-lecture scores (0.3 ± 0.50%) (Fig. 1), and a similar significant improvement of the mean post-lecture vs mean pre-lecture scores (i.e. 20.4±2.07% vs 18.3±2.90%) was demonstrated in Section B (Fig. 2).

When the results of Sections A and B were pooled and compared using the same statistical test, significant (P <0.001) improvements were similarly established (data not shown). Although the scores were not perfect, these findings suggest that teaching was useful in helping students to, at least in part, improve their SELA.

![Figure 1: Mean pre-lecture (1.0 ± 0.92%) and mean post-lecture (0.3 ± 0.50%) scores in Section A (5 questions) indicated that scores were of participating JSs were significantly (p <0.001: *) improved after lecture when analyzed with the Wilcoxon signed-rank test.](image1)

![Figure 1: Mean pre-lecture (18.3±2.90%) and mean post-lecture (20.4±2.07%) scores in Section B (25 questions) demonstrated that scores were of participating JSs were significantly (p <0.001: *) improved after lecture when analyzed with the Wilcoxon signed-rank test.](image2)
4. Discussions

Apart from its use to name, describe, record, compare, explain, analyze, design, evaluate, and theorize the natural world around us (Wellington & Osborne, 2001), SE is a form of English that is required for expressing observations, reasoning, valuation, analysis data, and common communication in science-orientated disciplines. SE, which is different from literary or everyday English (Barnes, 1969; Gardner, 1974; White, 1988; Muralidhar, 1991), requires understanding, learning and acquirement of various technical terms relevant to different specialties in transmitting and disseminating scientific concepts and discoveries (Lemke, 1990; Foong, 2010).

The current trend of SE-learning in Japanese tertiary institutions is brief, opportunistic, randomized, inadequate and limited in terms of exposure, time and content at the tertiary level, not to mention the near-complete non-exposure of JSs to SE in primary or secondary schools. Despite keen efforts to improve SE-learning by many in the science-orientated academic community of Japan, this inadequate and limited approach in Japan appeared to have changed little over the past decades, probably due to insufficient educational funds, unavailable time-slots in educational curricula, non-systematic teaching materials/tools, a limited number of competent and well-trained SE-teaching staff, and lack of a reliable and productive educational system for SE-learning per se, and other miscellaneous factors. In addition to repetition/memory in SE-learning (or any discipline), Scientific English-listening ability (SELA) is especially important, as it is the first barrier that needs to overcome in order to continue and build up interactive and functional communication. Similar to literary English, many JSs just turn off listening when he or she does not understand a technical word or cannot catch a numeral/unit spoken in SE: i.e. making of a mental block (Beare, http://eslabout.com/cs/teaching:listening/a/a_tlisten.htm). When listening is blocked, students tend to search for missed numerals/words or other details by i) making a pause in writing, ii) turn their heads looking elsewhere for answers, and iii) trying hard to remember/recollect of what has been learned by apparent writing/thinking and/or head-scratching.

In addition to attitude adjustment (Beare, http://eslabout.com/cs/teaching:listening/a/a_tlisten.htm) for improvement in LA for literary English, SE-listening demands another element: viz., understanding of SE
basics. Enunciation of numerals and technical terms and terminology (i.e. SE basics) during the lecture could have helped the JSs to appreciate the various aspects of SE being tested, as shown in the significantly improved scores after the lecture. It is therefore not surprising to find that JSs with high TOEIC scores (i.e. >800 of 990) could not score well before lecture and after lecture, although improvement in SELA was obtained, emphasizing the specific forms and characteristics of SE, or its difference from literary English. The mean scores after lecture reflected significant but not perfect improvements. JSs might have scored better if enough time and exposure were given to them to do listening practice, as constant practice and frequent exposure to SE are more likely to have orientated their acoustic acuity and mental accommodation for the various items tested in this study. If JSs did ca. 30 minutes of listening practice and exposure daily, they might have shown better than significant results in their tests: a logical phenomenon that is most likely expected, and which also requires future investigation for confirmation. LA is commonly believed to improve with time, constant practice and repeated exposures to tape- or CD-based narrations (Beare, http://eslabout.com/od/ englishlisteninga/listen_tips.htm). This tendency for SE-listening is therefore expected to surely improve SELA of JSs if they were subjected to similar conditions for practice. In fact, despite the very brief exposure and practice during the lecture in this study, JSs managed to score higher marks for SELA, advocating that the lecture was play an effective role in improving SELA. Some might believe that the SELA improvement was effected due to same questions being tested. However, JSs could most likely not recalled what was heard before when doing the test after lecture, as it was the first experience for them to do SE-listening, where many of the tested items were new (or unheard of) to them. Of course, a test with similar context and volume but with slight variations in the answers would be better for comparison. Another intriguing tendency observed was the answers to questions in written and multiple-choice form: the former was consistent in terms of improvement in answers of all JSs, where questions non-attempted or wrongly answered were appropriately rectified after lecture, while the latter indicated answers of several JSs which were correct before lecture were wrongly answered after lecture. This inconsistency implies that ‘guesswork’ may be at play in the multiple-choice questions. Further investigation is warranted on SE-testing with regard to the test methods.

All in all, our present study revealed that SELA of JSs was significantly improved after lecture. They were probably able to appreciate after learning all the
SE-relevant items and contents during the lecture, thus building a basic foundation for them to subsequently understand what were read. In terms of regional difference in enunciations, JSs were probably more familiarized with the discrepancies when taught. The improved scores after lecture could have cumulatively due to acquirement of SE basics and the ability to differentiate regional enunciation differences in SE. However, further studies on this aspect are warranted to confirm the outcome.

5. Conclusion

Based on our findings, it is constructive and useful to provide content-enunciation teaching to JSs (with no or little exposure to SE-learning/listening in secondary schools) in their attempts to acquire SELA at the tertiary level. Additionally, given the proper content-enunciation teaching approach, students will and can acquire SELA to prepare for future science-related endeavors.

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