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シリアスゲームの設計と実施による、L/Rを識別する聞取りの改善について

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〈論 文〉

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「シリアスゲームの設計と実施による、L/Rを識別する聞き取りの改善について」

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Abstract

The language learner faces many challenges in mastering a new language. New grammatical forms and a new vocabulary offer unique challenges, but can be surmounted by earnest study on the part of the learner. The ability to discriminate between and/or articulate new sounds, on the other hand, requires a completely different set of skills, which are difficult to practice or acquire without a competent bilingual or native teacher as instructor. For the individual learner, it is inordinately difficult to improve auditory discriminatory skills, especially where the sounds are new to the learner.

The purpose of this study is to investigate the feasibility of developing a game-based learning system which focuses on improving L/R discrimination through the design and implementation of a serious game. The game itself uses an adventure format, and provides a series of simple challenges where the player is orally instructed to perform a simple task in a virtual adventure. The learner chooses among several items with similar pronunciations (minimal pairs), which appear on the screen. As the player progresses, the level of difficulty increases, further challenging the learner and refining listening skills. Testing is also an integral part of the process, as the player is unable to proceed further in the adventure unless the oral command is correctly understood and acted upon. Elements of John Keller's ARCS model for learner motivation are considered in developing and creating a suitable learning environment to enable the learning objective to be effectively realized as a serious game.

言語学習者は新しい言語を習得するにあたり数多くの挑戦に直面する。新しい文型や語彙は彼らにとってユニークな挑戦となるが、それは学習者自身が熱心に学ぶことにより克服できる。一方で、新しい音を識別したり発音することは、それとは完全に異なる一連のスキルを必要とするが、それは力量のあるバイリンガル話者やネイティブ話者を指導者とするこなしでは、練習・習得が難しい。特にその音が初めて聞く音で聞き慣れていない場合は、個人学習者にとって聴解力を向上させることは至極困難である。

本稿は、シリアスゲームのデザインと導入を通して、L/Rの識別を向上させることに着目したゲームベースの学習システムを開発する可能性を研究する。ゲーム自体は「冒険もの」のフォーマットを用い、プレイヤーは仮定の冒険のなかで一連の単純な問題を提供され、口頭でそれを解くことを指示される。学習者はスクリーンに現れるいくつかの類似する発音のアイテムから適切なものを選ぶのである。プレイヤーが進むにつれ、難易度が上がり、学習者は更なる挑戦が与えられ、リスニング・スキルは洗練されていく。また、口頭の指示を正しく理解し、行動をとらなければ冒険で先に進むことができないため、テストングもプロセスの一部となる。学習目標を効果的にシリアスゲーム化し達成するために適切な学習環境を開発・創造するためには、John Kellerの学習者のモチベーションに関するARCSモデルの要素が考慮される。

Key Words:

auditory discrimination, listening skills, /l/ and /r/ phonemes, language study, minimal pairs, serious games,

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1 Introduction

Learning a new language provides multifarious difficulties and challenges to the learner. Unfamiliar grammatical forms and a new vocabulary offer unique challenges, but can generally be surmounted by earnest study on the part of the learner. Discriminatory phonemic listening competence, on the other hand, requires a completely different set of skills, which are difficult to acquire without a capable bilingual or native teacher as instructor. As English has a much larger phonemic inventory than the Japanese language, Japanese learners of English have to learn to identify, discriminate and articulate phonemes that are not used in Japanese. Clearly, for individual learners, or those without access to a skilled language specialist, it is inordinately difficult to achieve effective phonemic awareness. As Claire (1983) notes, meaning is often confused if the learner is unable to achieve functional phonemic discrimination or an acceptable pronunciation, even if the grammar, syntax and vocabulary are correctly applied.

Combining this difficulty with Gee's claim that "without motivation, there is no learning" (2003), and Prensky's (2001) firm belief that the challenge of the educator is to engage digital native students via their technology, the utilization of serious gaming to help in teaching pronunciation discrimination skills seems like a valid way to successfully motivate and engage the student. The major challenge lies in effectively designing and creating a serious game environment that sufficiently challenges the student to want to continue.

John Keller's ARCS model (Keller & Kopp 1987, Keller & Suzuki 1988) for learner motivation is considered in creating a suitable learning environment for serious game design and implementation. While the serious game we developed focuses purely on helping the learner correctly discriminate between the pronunciation of /l/ and /r/ consonants, a recognized difficulty for Japanese speakers of English (Thollar 1998, 2000, 2008, Tsubota et al, 2002), other problem pronunciations which are difficult to aurally differentiate and orally replicate could just as easily be targeted.

2 Educational Objectives

This research has three fundamental objectives. They are

- (i) to produce a method whereby the individual learner can practice and acquire the necessary auditory discrimination skills for the English /l/ and /r/ phonemes to improve their listening ability using serious games as a learning tool,
- (ii) to develop a teaching modality which provides relevance, motivation and satisfaction to digital native students, and
- (iii) to produce a method and/or application which can be used irrespective of the content to help non-native speakers of English improve their auditory discrimination skills.

Specifically, we are not looking at pedagogy, learning, or the role of the teacher. Neither are we focusing on articulation skills, second language acquisition or language learning *per se*. Rather, we are looking at how to meet learner needs in a language learning environment, where a teacher may or may not be present. As noted by Claire (1983), improving pronunciation and discriminatory listening skills is one of the biggest hurdles in the study of an unfamiliar foreign language. As such, while this research is eminently suitable for application to distance education, it should be remembered that the objective is to enable any student in any environment to successfully improve their discrimination of similar sounds that likely do not exist in their mother tongue. This being the case, the system could just as easily be used in a regular classroom setting, as it could by an individual learner with no direct access to a native speaker for pronunciation assistance.

3 *The Problem*

As noted above, in the English language, the /l/ versus /r/ contrast involves two approximants which occur in English but not in Japanese. An approximant refers to consonants that do not use a friction-based contact with speech organs (tongue, roof of mouth etc.) and only come into an “approximate” or limited contact with them. The phoneme /l/ is an alveolar lateral approximant, which means it is approximant (produced by narrowing the vocal tract at the place of articulation), alveolar (articulated with either the tip or blade of the tongue at the alveolar ridge), and is lateral (produced by forcing the current of air over the sides of the tongue, not down the center). The approximant /r/ on the other hand, is a rhotic (r based) consonant of varying phonetic properties, all of which have some relationship to [ɹ]. They are also known as tremulants, trills or *R* sounds.

Both are also *liquids*, or liquid consonants, which are articulated without friction in a similar manner to vowels, with the tongue creating a partial closure in the mouth, resulting in a resonant, vowel-like consonant. However, both phonemes are distinctly different and differently produced.

The Japanese language, on the other hand, has only one liquid consonant, a flap that varies between lateral [ɺ] and central [ɾ]. More simply put, the Japanese r sound is produced with a single muscle contraction by flapping or tapping an articulator (here, the tongue) against another speech organ (here, the alveolar ridge), leading to partial closure of the vocal tract, thereby creating a sound varying between a laterally produced /l/ and a centrally produced /r/. While the Japanese /r/ flap is designated as apical (made with the tip of the tongue like an /l/), it is undefined for laterality, meaning it may appear as either central or lateral, depending on associated vowel usage.

The practical repercussions are clear as Goto (1971) notes; Japanese who have learned English later than childhood have difficulty acoustically differentiating between English /l/ and /r/ sounds, even if they have good conversational English skills, have lived in English-speaking countries, and can correctly articulate the two sounds themselves when speaking English. Takagi &

Mann (1995) add that even after significantly long periods of residence, Japanese speakers of English cannot discriminate between the two phonemes as well as native speakers. Clearly, there is a well recognized problem.

4 Redressing the Problem

Typically, there have only been a few ways to improve discriminatory listening skills, none of which work especially well for large numbers or unmotivated students.

(i) Classroom Learning

The traditional classroom environment, comprised of a teacher, a classroom, and a number of students all in one location, is simple and effective, as borne out by the fact that it has changed little since the days of Aristotle (Stevenson & Stigler, 1992). A teacher, or knowledgeable person, imparts a body of knowledge to the students, or causes the students to “learn” or “acquire” that knowledge. While personal attention from the teacher is likely assured, the cost of supplying qualified personnel, educational resources and the physical provision of a classroom setting has come to be prohibitive of late, as demonstrated by the number of small school closures worldwide (USQ, 2012). Furthermore, by the nature of the system, teaching tends to be aimed towards the middle, with the better students not being extended, and the poorer students missing out. As class numbers increase, this tendency is further exacerbated. Due to geographic circumstances, the student needs to be in the same physical location as the teacher, at the same time. Typically, to function well, this model necessitates full time students, streamed classes, full time teachers and minimal class numbers.

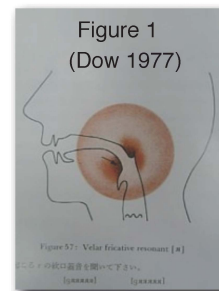
In a language class, if the teaching institution is well enough financially endowed, a Language Laboratory (LL) may be available to the learner. The LL environment is designed to make the students less passive by providing multimedia materials in which native speakers of the target language are talking in an authentic context, as well as providing students with chances to listen to themselves speaking the target language. As noted, not only is the cost often prohibitive, but as the name implies, this is still essentially nothing more than a well equipped classroom for language study. It should also be noted that typically, the classroom model does not allow learning to take place at any time, any place or any pace that the learner desires.

(ii) Individual Learning/Self Study

Until the recent boom in e-learning, the only major alternative to traditional “chalk and talk” teacher-centered study has been self study. For the motivated student, this has always been a reasonable way to learn. While it is rarely the first choice, it has long been employed by non-traditional students, including those with jobs, those with no access to a classroom, those with temporal constraints, and/or those with handicaps or requirements preventing them from attending a more conventional setting. At best, for subjects involving a lot of rote memory (such as History or

some Science subjects), the student is likely able to “learn” new material. However, in the case of language learning, such a learning modality is far from optimal. Actual learning is defined as only that part of the knowledge that the learner has consciously acquired, a minimal “intake” from the total “input” (Schmidt, 1990, Sharwood Smith, 1984). Can a student reasonably expect to learn how to utter new pronunciations or discriminate between similar new phonemes or sounds in such a situation, when the language input is so minimal ?

Over the years, many companies have attempted to offer ways to enable the student to hear and imitate native pronunciation and intonation. This led to a large volume of schools and various companies producing mysterious diagrams to instruct the student how the lips, tongue, throat and diaphragm should be placed or utilized (see figure 1), accompanied with tapes, CDs or digital files of native speakers reading words or sentences.



While the audio component may have some value in terms of practice, the diagrammatic renderings of various phonemes remain less than useful. The learning is one-way, at best, with the student having no way to evaluate their progress or the effectiveness of their auditory discrimination skills. Clearly, when confronted with such a learning task, the learner’s motivation or curiosity will likely not be piqued. Attention will be lost, the study will likely be deemed irrelevant, student confidence will certainly not increase, and satisfaction will be very low. As a consequence, such learning modalities are becoming less common now in favor of more interactive styles such as those offered by e-learning

(iii) e-learning, m-learning, u-learning & blended learning

Of late, e-learning, u-learning (ubiquitous learning), m-learning (mobile learning) and blended learning represent but a few of the new teaching modalities that have resulted from education docking with the information age. While Sweeney (2002) notes that over 40% of corporate learning took place online as early as 2002, Allen et al (2007) note that institution size is also a key factor in determining whether blended and online courses will be offered. The smaller the institution, the less likely it is to offer either blended or fully online courses.

More interactive than either of the previous two teaching modalities, and appropriate for Prensky’s digital natives (2001), despite possible size constraints, these modalities show likely future trends in education. Furthermore, the application of serious games as a way to achieve a meaningful learning outcome can easily be incorporated into any of these modern learning modalities.

5 The Rationale for Serious Games as an aid to improving L/R discrimination

Much research has shown that adult Japanese speakers of English have difficulty in

discriminating between /l/ and /r/ phonemes when listening to spoken English (Best & Strange 1992, Yamada & Tohkura 1992, Goto 1971). It has also been argued that conventional classroom teaching and/or self-study are not appropriate ways to improve auditory discrimination skills for language learners (Thollar, 2008). Coupled with Gee's (2003) belief that no learning occurs without motivation, and Prensky's (2001) insistence that digital natives are best engaged using media with which they are familiar, a case can be made that serious games targeting auditory discrimination skills are one of the best ways to help younger non-native speakers improve listening skills. Using such a justification, we designed, developed and produced a flash based adventure game that helps Japanese speakers of English improve their aural discrimination of /l/ and /r/ phonemes.

Recognizing the importance of motivation for meaningful, spontaneous learning to take place, we adopted Keller's ARCS model (Keller & Kopp 1987, Keller & Suzuki 1988) as a way to ensure a systematic motivational design process. Made into an acronym from the first letters of the words *attention*, *relevance*, *confidence* and *satisfaction*, the ARCS model represents a problem solving approach to designing the motivational aspects of learning environments to stimulate and sustain students' motivation to learn. If the subject material or method in which it is taught is perceived to be interesting or valuable, the learner will be more likely to pay *attention* to what is being taught. Similarly, if the content is perceived as *relevant*, the student will be more motivated to learn. This in turn breeds *confidence*, as the learner realizes that they are able to succeed at small tasks, opening the way for larger successes. The culmination of paying attention to relevant learning material and gaining confidence through succeeding is *satisfaction*. The process itself is cyclic and self-reinforcing. The learner wins by being able to achieve what he/she originally desired, thereby augmenting and inducing further motivation to learn and succeed.

As noted by Schmidt (1990) and Sharwood Smith (1994), language learning is only that part of the "input" that the learner "intakes". Inducing such motivation to learn, by well-thought out teaching material and learning experiences, virtually ensures a higher intake and a positive result for the learner. In language learning, especially in teaching pronunciation or auditory discriminatory skills, the learners' needs clearly involve being able to tell the difference between numerous similar sounds. If the student's *attention* is aroused by an interesting approach, such as a game, and the goal of mastering a given auditory discrimination skill is recognized as *relevant*, along with ample opportunities to succeed and gain *confidence* though making correct game choices, the learner will likely be *satisfied* with their progress, justifying serious games as a valid learning medium.

6 *Serious Games*

The motivational aspects of Keller's ARCS model can effectively be applied to serious game design and implementation. This is especially the case with *attention* and *satisfaction*, as with any

game, and if the learner accepts the *relevance* of the material being taught, and gains *confidence* through positive game play experience, serious games function as an excellent learning vehicle. While there appears to be no single definition of what constitutes a serious game, they are generally held to be games used for training, advertising, simulation, or education. Probably the best definition was made by Abt (1970, 2002), the originator of the term. Although this term was coined BEFORE the advent of the personal computer, it still seems relevant. In 1970, he wrote;

“Reduced to its formal essence, a game is an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context. A more conventional definition would say that a game is a context with rules among adversaries trying to win objectives. We are concerned with *serious games* in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement.”

This idea is not dissimilar to *games-based learning* or “*game learning*”, games with a defined learning outcome. Such games balance the subject matter with the gameplay and are defined by the ability of the player to theoretically retain and apply the same subject matter in the real world. (Prensky, 2000) The term *edutainment* (from *education* and *entertainment*) is also not uncommon, and first appeared as early as 1973 (Rey-López et al., 2006). The former tends to give precedence to the game play, while the latter, first used by the National Geographic Society, tends to focus more on entertainment. However, given the role of the game as a serious learning task, the expression *serious games* seems to best meet the objectives of a learning institution.

7 *A minimum pairs auditory discrimination serious game*

Capitalizing on the appropriateness of the serious game as an effective learning medium, we designed and implemented an adventure style game aimed at bringing about an improvement in /l/ and /r/ phoneme discrimination in the learner. The game format seems appropriate due to its intrinsic motivational qualities, and its ability to coax reluctant learners to at least have a try without fear of failing.

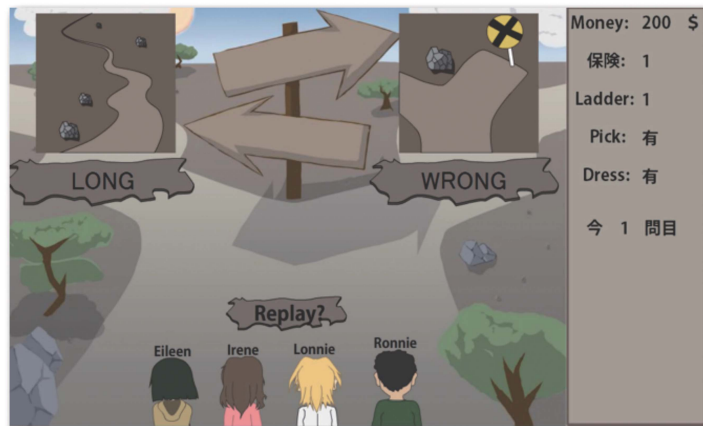
The flash-based serious game which we developed and report on here is designed as an adventure. The opening screen (see figure 2) reveals four characters who take part in the adventure; Ronnie, Lonnie, Irene and Eileen. The first two are male names and were chosen as they target pre-vocalic discrimination of L/R sounds from the initial articulation of the word. The latter two characters are female name and were similarly chosen as they target post-vocalic discrimination of the L/R phonemes after the articulation of an initial vowel, in this case following the /l/ sound. The adventure involves the learner and/or characters being asked to perform simple tasks. The tasks refer to following oral commands, whereby the learner needs to click on the correct graphic representation of a word from a minimal pair, spoken in the command stage.

Figure 2



Initially, after clicking the game start button, the game begins simply without the need to use any of the four characters. The learner/player is asked to perform a straightforward task. The task involves listening to a spoken instruction and clicking on a particular item on the screen. The command is random and is drawn from sixty four possible choices in the data bank. All of the commands involve the listener trying to differentiate between two minimal pairs, one containing an /l/ phoneme and the other an /r/ phoneme. This is demonstrated in the diagram below (figure 3), where the characters can be seen looking at a fork road.

Figure 3



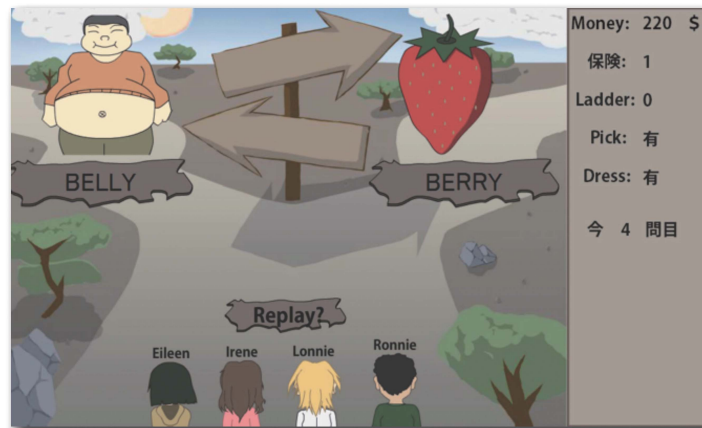
On the left is a *LONG* road and on the right is a *WRONG* road. There are two choices. Upon commencing the game by clicking the game start button, the player is given a random instruction, which, for argument's sake, might be "Take the *LONG* road". If the player could understand the command and clicks the *LONG road* icon on the left, the player wins some money, which can be used to purchase insurance, and can proceed to the next level. If the player is unsure of the command, the "*Replay?*" button can be selected to repeat the command. When the player succeeds, the next level appears automatically after the "right answer screen" (figure 4), and a another minimal pair challenge is randomly issued in this virtual adventure.

Figure 4



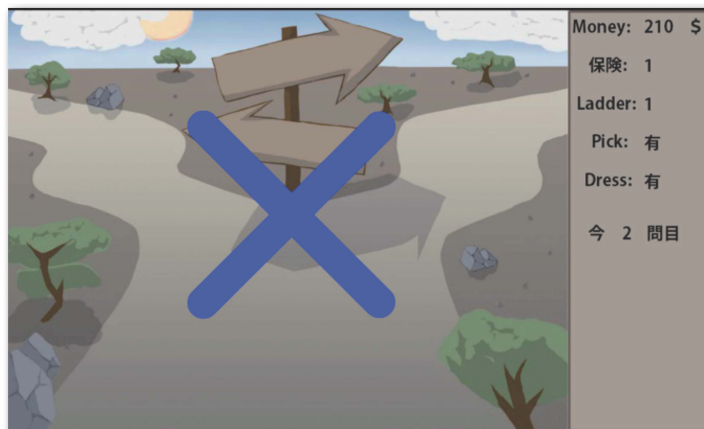
Having insurance or items which can be purchased are important as they act as a buffer if the player should make an incorrect choice. For example, consider the example below (figure 5).

Figure 5



When the player is told to “find a big BELLY”, clicking on the icon on the left side will result in the “right answer screen”, but clicking on the large strawBERRY on the right will yield the “wrong answer screen”.

Figure 6



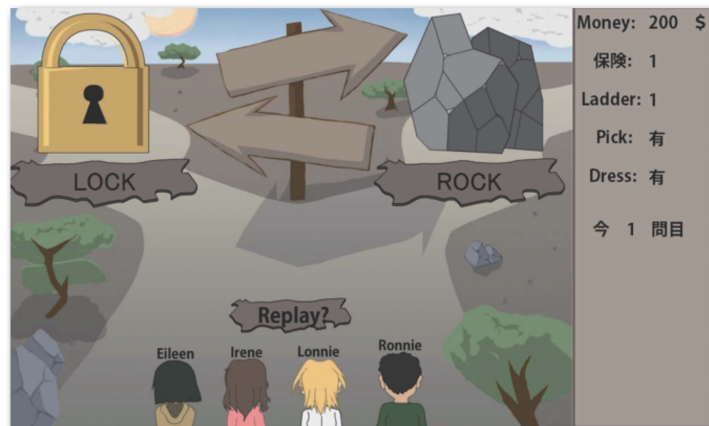
If the player has insurance, money or some items, he may avoid the “game over” scenario by using them. In the advent that the player has exhausted all insurance or money, the game finishes with either a large truck knocking the player over (see figure 7), or the player falling into a death pit filled with sharpened spears, whereupon the player is invited to play again.

Figure 7



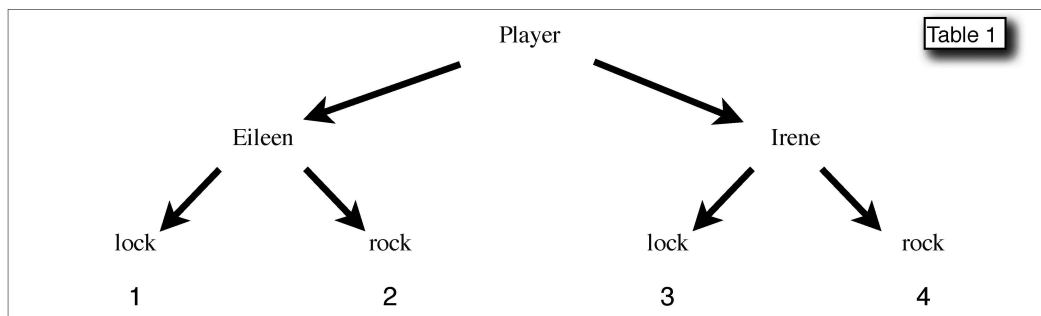
As noted, the first ten screens are simple tasks made without any reference to using the four main characters. The function of the “easy” stage is largely to build confidence, and stockpile some money. After the easy levels, if the player is showing good auditory discrimination skills - meaning few mistakes, the game becomes more difficult. At this level, the player is instructed to click on both one on the players and one of the object icons. For example, consider the following challenge (figure 8). All four players and two minimal pair objects are included in the screen.

Figure 8



The challenge might be, “*Eileen*, pick up the *ROCK*”. The player has the ability to listen to the command again by clicking on the “*Replay?*” button. If that proves too difficult, they can also click on either of the minimal pair words for their pronunciation, *LOCK* written on the left, and *ROCK* written on the right. Clicking on the names of the characters will also yield their names orally. Thus, if the player thought the correct answer was “*Eileen*, pick up the *LOCK*”, the player could easily check the pronunciation of *Eileen* and *LOCK* by clicking on them individually, or listen

to the complete command again, before committing to a final answer. There are four possible permutations and combinations using the minimal pairs involved, as noted in Table 1 below.



Excluding the 4 characters, 32 sets of minimal pairs, comprising some 64 possible actions are in the data bank. If the characters' names are also included, there are 256 possible different verbal commands. This should provide a sufficiently large enough range of variations to allow significant improvement in /l/ and /r/ auditory discrimination skills. This minimal pairs are shown below in Table 2.

1	go to the boy PLAYING	go to the boy PRAYING
2	go to the man with the big BELLY	go to the man with the big BERRY
3	go to the man COLLECTING papers	go to the man CORRECTING papers
4	walk to the blue LAKE	walk to the blue RAKE
5	can you see LICE in a boy's hair	can you see RICE in a boy's hair
6	go to the LONG way	go to the WRONG way
7	pick up the LOCK	pick up the ROCK
8	open the LIGHT door	open the RIGHT door
9	walk to the black LAMP	walk to the black RAMP
10	go to the LANE	go to the RAIN
11	walk to the man with a long LIST	walk to the man with a long WRIST
12	go to the PILOT	go to the PIRATE
13	go to the girl with a CLOWN	go to the girl with a CROWN
14	go to the man CLAPPING	go to the man CRAPPING
15	walk towards the CLOUD	walk towards the CROWD
16	go to the big CLOCK	go to the big CROC
17	go to the lady with a small FLOCK	go to the lady with a small FROCK
18	walk to the red FLAME	walk to the red FRAME
19	walk towards the FLIES	walk towards the FRIES
20	go to the FLYING fish	go to the FRYING fish
21	pick up the golden FLUTE	pick up the golden FRUIT
22	walk to the green GLASS	walk to the green GRASS
23	walk to the GLOWING boy	walk to the GROWING boy
24	go to the big LAMB	go to the big RAM
25	walk to the LOW boat	walk to the ROW boat
26	pick up the shining MANDOLIN	pick up the shining MANDARIN
27	go towards the PALACE sign	go towards the PARIS sign
28	walk to the flowers in BLOOM	walk to the flowers in BROOM
29	go to the LEADER	go to the READER
30	walk towards the LIGHTER	walk towards the WRITER
31	go to the golden LOCKET	go to the golden ROCKET
32	go to the lady BLUSHING	go to the lady BRUSHING

8 *Discussion*

The game itself is based on the use of minimal pairs. As defined by McGilvray, (2006) a minimal pair is a pair of words that differ in a single phoneme. Minimal pairs are often used to show that two sounds contrast in a language. Livbjerg et al (1995) note that the most effective learning for improving discriminatory language skills occurs when the learner has to identify words in sentences where either member of a minimal pair would fit in naturally. That is the same strategy that we have used. In the L/R serious game discussed here, minimal pairs are effectively used to help the learner gain aural discrimination competency of the English /l/ and /r/ phonemes.

The game is currently set up to ask the player to perform simple tasks using words drawn randomly from the minimal pairs in the database. It might be valuable to change this if there appears to be a particular problem with a certain combination of sounds; e.g. pro-vocalic words beginning with an /l/ phoneme may not provide difficulties, while those containing /l/ phonemes in a medial position may be more challenging. Clearly, in such cases, asking the learner to identify the character “Lonnie” would not be as beneficial as asking the player to use “Eileen”, (as opposed to Irene).

Currently, the game only involves up to two minimal pairs in one task (i.e., one character and one task). Increasing the number to three may be beneficial if direct comparison of the two phonemes, or pre- and post-vocalic phoneme positions, is desired in one utterance, in a more complex sentence. In such a case, two characters could easily be used. A typical task might be, “RONNIE and EILEEN, go to the FLYING fish.” This could create a permutation of 8 possible clicking scenarios. Using 2 characters and increasing the number of items to four instead of the current two would also lead to 16 possible combinations, which would further increase difficulty, but would involve redesigning the template and an increase in vaguely unnatural, if imaginative choices (e.g. light crown, light clown, right crown, right clown). It is also possible that the game would become more of a memory test than a tool to aid in phonemic discrimination. The current “combination of four” based on one minimal pair for items/actions, and one for characters, seems to be the best alternative.

9 *Conclusion*

In the literature, many researchers attest to success in improving /l/ and /r/ pronunciations in Japanese speakers of English. Lively et al. (1994) found that non-bilingual Japanese speakers in Japan were able to increase their ability to distinguish between /l/ and /r/ after a 3-week training period involving listening to minimal pairs read by 5 native English speakers. Participants were able to apply their learning and could distinguish between new /l/ and /r/ minimal pairs when tested. Tsubota et al (2002, 2004) describes a CALL (Computer Assisted Language Learning) instruction

system based on remediation by working with minimal pairs. Miyawaki et al (1975) found that Japanese speakers could distinguish between /l/ and /r/ as proficiently as native English speakers if the sounds were acoustically manipulated so that the utterances did not sound like everyday speech. McClelland et al (2002) report that Japanese adults can be taught to differentiate between similar speech sounds, even when that discrimination initially proves very difficult.

Others have found that Japanese speakers tend to improve their /l/ pronunciation and discriminatory skills more than they do with the /r/ phoneme (Aoyama et al 2004, Guion et al 2000, Kinnaird & Zapf 2004). A likely reason is that Japanese students suffer L1 (native language) interference when learning to differentiate between such sounds as /l/ and /r/. (Lively et al, 1993). This issue is an appropriate topic for further research, and it is hoped that further serious game research and development may help overcome some of the barriers that make it difficult for Japanese learners of English to adequately discriminate between /l/ and /r/ phonemes.

Bibliography

- 1 Abt, C.C. (1970, 2002), *Serious games*, Viking Press, New York, University Press of America, Maryland (Reprint)
- 2 Aoyama, K., Flege, J.E., Guion, S., Akahane-Yamada, R. & Yamada, T. (2004), "Perceived phonetic dissimilarity and L2 speech learning: the case of Japanese /r/ and English /l/ and /r/", *Journal of Phonetics* **32**: 233–250,
- 3 Allen, I.E., Seamen, J. & Garrett, R. (2007), *Blending in - The Extent and Promise of Blended Education in the United States*, The Sloane Consortium, Needham, MA
- 4 Best, C. & Strange, W. (1992), "Effects of phonological and phonetic factors on cross-language perception of approximants", *Journal of phonetics* **20**: 305–330
- 5 Bradlow, A. R., Pisoni, D. B., Akahane-Yamada, R., & Tohkura, Y. (1997), "Training Japanese listeners to identify English /r/ and /l/ IV: Some effects of perceptual learning on speech production", *Journal of the Acoustical Society of America*, **101**, 2299-2310.
- 6 Claire, E., (1983) *A foreign student's guide to dangerous English*, Eardley Publications, New Jersey
- 7 Dow, A.R. (Ed.), (1977), "International Horizons, Pro-English Learning System", N.V. Willemstad, Curacao, Netherlands-Antilles
- 8 Gee, J.P. (2003), *What Video Games Have to Teach Us about Learning and Literacy*, Palgrave Macmillan, New York
- 9 Goto, H. (1971), "Auditory perception by normal Japanese adults of the sounds /l/ and /r/", *Neuropsychologia* **9** (3): 317–323,

- 10 Guion, S, Flege, J.E., Akahane-Yamada, R. & Pruitt, J.C. (2000), “An investigation of current models of second language speech perception: The case of Japanese adults’ perception of English consonants”, *Journal of the Acoustical Society of America* **107** (5 Pt. 1): 2711–2724,
- 11 Itō, J. & Mester, R. A. (1995), “Japanese phonology”, in Goldsmith, J. A. *The Handbook of Phonological Theory*, 817–838, Blackwell Publishers, Malden, MA
- 12 Keller, J.M., & Kopp, T.W. (1987), “Application of the ARCS model to motivational design”, in Reigeluth, C.M., (Ed.), *Instructional Theories in Action: Lessons Illustrating Selected Theories*, Lawrence Erlbaum Publishers, New York, 289 - 320
- 13 Keller, J.M., & Suzuki, K. (1988), “Application of the ARCS model to courseware design” in D. H. Jonassen (Ed.), *Instructional Designs for Microcomputer Courseware*, Lawrence Erlbaum, Publishers, New York, 401 - 434
- 14 Kinnaird, S.K. & Zapf, J. (2004), “An acoustical analysis of a Japanese speaker's production of English /r/ and /l/”, Indiana University Linguistics Club Working Papers, Vol.4, 2004
- 15 Livbjerg, I. & Mees, I.M. (1995), “Segmental Errors in the Pronunciation of Danish Speakers of English - some pedagogic studies” in Lewis, J (1995) *Studies in General and English Phonetics*, Routledge, London
- 16 Lively, S., Logan J., & Pisoni, D. (1993), “Training Japanese listeners to identify English /r/ and /l/. II: The role of phonetic environments and talker variability in learning new perceptual categories”, *The Journal Of The Acoustical Society Of America* **94** (3), 1242-1255
- 17 McClelland, J.L., Fiez, J.A. & McCandliss, B.D. (2002), “Teaching the /r/-/l/ discrimination to Japanese adults: behavioral and neural aspects,” *Physiology & Behavior* **77**, 657–662
- 18 McGilvray, J.A. (2005), *The Cambridge Companion to Chomsky*. Cambridge University Press, Cambridge
- 19 Miyawaki, K., Strange, W., Verbrugge, R.R., Liberman, A.M., Jenkins, J.J. & Fujimura, O. (1975), “An effect of linguistic experience: the discrimination of [r] and [l] by native speakers of Japanese and English”, *Perception and Psychophysics* **18** (5), 331–340,
- 20 Prensky, M. (2000), *Digital Game Based Learning*, McGraw-Hill, New York
- 21 Prensky, M. (2001) “Digital Natives, Digital Immigrants” in *On the Horizon*, MCB University Press, Vol. 9 No. 5, October 2001
- 22 Rosenberg, M.J. (2000), *e-Learning strategies for delivering knowledge in the digital age*, McGraw-Hill, New York
- 23 Schmidt, R. (1990), “The role of consciousness in second language learning”, *Applied Linguistics* **11**, 129–58.
- 24 Sharwood Smith, M. (1994), *Second Language Learning: Theoretical Foundations*, Longman Publishing, New York
- 25 Stevenson, H.W. & Stigler J.W. (1992), *The Learning Gap*, Simon & Schuster, New York

- 26 Sweeney, K. (2002). "Online education poised for continued growth" in *Employee Benefit News*, **16** (7), 31
- 27 Takagi, N. & Mann, V. (1995), "The limits of extended naturalistic exposure on the perceptual mastery of English /r/ and /l/ by adult Japanese learners of English", *Applied Psycholinguistics* **16** (4), 379–405
- 28 Thollar, S. (1998), "Remedial Strategies in Helping Japanese Speakers of English Improve their Articulation of Pulmonic Consonants", *Hokkaido Joho Daigaku Kiyō*, **10**:1
- 29 Thollar, S. (1998), "Remedial measures in helping Japanese speakers of English in the articulation of vowels", *Hokkaido Joho Daigaku Kiyō*, **11**:2
- 30 Thollar, S. & Maeda, S. (2008), "An Investigation on the Feasibility of Applying Language Study to Hokkaido Information University's Gendai GPIT Student Learning Framework" *Hokkaido Joho Daigaku Kiyō*, **19**:2
- 31 Tsubota, Y. Kawahara, T. & Dantsuji, M. (2002), "CALL system for Japanese students of English using pronunciation error prediction and formant structure estimation", in *InSTIL 2002 Advanced Workshop*, Kyoto University, 2002 available at <http://www.ar.media.kyoto-u.ac.jp/EN/bib/intl/TSU-InSTIL02.pdf> (Accessed 10/21/2012)
- 32 Tsubota Y., Dantsuji M. & Kawahara T. (2004), "Practical Use of Autonomous English Pronunciation Learning System for Japanese Students", in *Proc. of InSTIL/ICALL2004 Symposium on Computer Assisted Language Learning*, Venice, Italy, Paper 033 available at <http://www.ar.media.kyoto-u.ac.jp/EN/bib/intl/TSU-InSTIL04.pdf> (Accessed 10/21/2012)
- 33 USQ (University of Southern Queensland) (2012), "EDU8712 Contemporary Approaches to Alternative Education" in *2012 Curriculum Handbook*, University of Southern Queensland
- 34 Yamada, R. & Tohkura, Y. (1992), "Perception of American English /r/ and /l/ by native speakers of Japanese", in Tohkura, Y., Vatikiotis-Bateson E. & Sagisaka, Y. editors, *Speech Perception, Production and Linguistic Structure*. Ohmsha, Tokyo, 155-174