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Becoming Better Versed: Towards the Design of a Popular Music-based Rhyming Game for Disadvantaged Youths

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Abstract: This study examines patterns of rhyme identification among English Language Learners (ELLs) towards the development of an educational game, JOLLY, intended to improve phonemic awareness among school-aged children in the Philippines. Leveraging on students' intrinsic interest in Western popular music, we ask students to identify rhyming words from among the song lyrics. We find that the extent to which an English phoneme is similar to a Tagalog phoneme determines how likely it is to be identified. From these findings, we draw implications on how JOLLY's underlying domain model can be structured with each song as a learning object and each learning object consisting of an inventory of phonemes to be mastered. We also recommend the use of open, possibly social, student models to help learners track their progress and that of their peers.

Keywords: English comprehension, Philippines, rhyme, participatory design, JOLLY

1. Introduction

Phonemic awareness is a metalinguistic skill that has been operationalized in a number of different ways (Yopp, 1988) but refers generally to a speaker's ability to isolate and manipulate meaningful sounds in their language. These skills underlie basic literacy achievement in all languages that use a phonemic writing system (Lundberg, Olofsson, & Wall, 2015), but English presents a case where these skills can be especially important for a variety of socio-historical reasons.

Specifically, written English is an example of a semi-phonological writing system, where the vowel sounds outnumber vowel symbols nearly three times over and historical lexical borrowings sometimes generate word-specific spelling practices. For example, the words *bough*, *through* and *trough* all end *–ough* but each contain a different vowel sound. The complicated relationship between graphemes (the letters that represent a sound) and phonemes (the sounds) is sometimes challenging even for native speakers, and can present particular challenges to young L2 (i.e. second language) learners trying to master English spelling conventions.

Using rhyme successfully requires phonemic awareness. In fact, some research operationalizes the measurement of phonemic awareness with rhyming tasks (cf., Yopp, 1988), and it is known to predict later development in reading. Therefore, activities designed to help students practice these skills are important to fostering literacy more broadly. For example, if the same activity can also encourage spelling practice while providing students with the motivation to persist through the amount of repetition required for mastery, students' reading fluency is likely to improve.

In this paper, we explore the design of a computer-based English language learning system in development, tentatively entitled JOLLY. JOLLY is intended to teach English-language phonemic awareness using popular songs. This study and others like are important in the context of education in the developing world because English skills can open doors to economic opportunities (see Errighi, Bodwell, & Khatiwada, 2016; Viscondi, 2012). Despite the status of English as one of two official languages in the Philippines, up to 40% of 6th grade Filipino students have average to poor mastery of English. Primary school children with poor access to educational resources are at a particular disadvantage, and are frequently unable to develop their English language skills under these circumstances. The development of technology-enhanced learning environments like JOLLY offers additional opportunities for the children to master English language skills through motivating activities that their interest in and knowledge of popular music as the vehicle for learning.

This paper describes results of paper-based participatory design (PD) activities with economically disadvantaged students in the greater Manila area of the Philippines. The activities' broader goal was to arrive at specifications for JOLLY'S design and implementation. This paper limits its scope to findings related to phonemic awareness and attempts to answer questions about the phonological learning objects (i.e. Wiley, 2002), that may be more or less difficult to master during these tasks, allowing us to explore the implications for instructional design in this domain.

2. Methods

Students from two state elementary schools (Schools A and B) from Quezon City in the Philippines participated in the study. These schools had comparable student populations (7,419 students in School A, 6,377 in School B), with most students coming from a low socio-economic bracket, with parents employed in blue-collar jobs.

Each school was scheduled for two Saturday PD workshops. We hosted 73 students in all, who may or may not have been among the survey respondents. Students were invited by the schools, who were asked to select 12 students from each grade level (4th-6th), distributed across high, mid, and low achievement sections). After students with incomplete data were excluded, 57 students remained (27 from School A and 30 from School B). The distribution was well balanced for gender (m=38, f=22) and grade level, although there were slightly more students in the 5th and 6th grade (n= 24, 22) than there were in 4th grade (n=13), due primarily to a lack of availability of 4th grade students in the mid-level classes. This also resulted in slightly lower numbers for mid-level students (n=14) compared to high and low-level students (n=23, 22).

Participatory design is a co-creation method in which various stakeholders take on the roles of both users and designers. Essential to participatory design is coming to a nuanced understanding of the users' situation in order to develop a technological artifact that fits user needs (Simonsen & Robertson, 2012). During the PD activities, students were grouped in teams of six, two per grade level. Each group had a facilitator. Team assignments were permanent. The first session consisted of a pre-test and activity 1 while the second session consisted of activities 2-4 and a post-test. The pre- and post-tests were accomplished individually but the activities were accomplished by group.

The pre- and post-tests were identical in form, but used different songs. In the pre-test, three songs were selected based on their popularity according to feedback from the students, their suitability to the rhyming tasks, and the age-appropriateness of their content: Katy Perry's *Roar*, Jessie J's *Flashlight* and *Price Tag*. Students were provided with copies of the song lyrics. They were then asked to listen to each song and to write down groups of perfect and imperfect rhymes (e.g., *guess* and *mess* vs. *like* and *life*). In this study, only perfect rhymes are considered. In the post-test, the same procedure was repeated with three different songs: Bruno Mars's *Uptown Funk*, Lukas Graham's *Seven Years*, and Lin-Manuel Miranda's *Hamilton*.

Four group activities were used to help students better learn to identify rhymes, each of which built on the rules in the preceding activity. In Activity 1, students were given cards with letters (see Figure 1) and were asked to form pairs of perfect or imperfect rhyming words with the cards. In Activity 2, the same cards were used. Students were once again asked to form rhymes, but once a rhyming pair was formed, they then had to change one letter in one word so that the pair would no longer rhyme. Activity 3 built on the modification rules of Activity 2. Students were asked to choose one of the songs from the pre-test and to modify the lyrics by substituting rhymes for the original lyrics. For example, the song "Price Tag" would turn in to "Rice Bag." The students then performed the song. Finally, in Activity 4, students were asked to create their own rules for forming rhymes, (e.g., nouns only, verbs only, must have a minimum of 4 letters, and so on).

Figure 1. Rhyming Activity Materials.

3. Analysis

This study considers the identification of perfect rhymes, which were defined phonemically based on the structure of the final syllable of the word. For this study, we consider perfect rhymes to be two words that have identical phonemes in the syllable nucleus and coda (also known as the syllable rime). That is, a perfect rhyme would be a word pair like *hand* and *band,* which have the identical phonemes in the syllable rime (/ænd/), but not *hand* and *bands,* since the latter has a slightly different rime structure (/ændz/).

All words in the songs in this study were automatically transcribed into the International Phonetic Alphabet (International Phonetic Association, 1999) and checked by a trained phonetician (the 1st author). Rhyme Groups (words that share the same phonemic pattern in the syllable rime) were then identified in each song. In total, 81 unique Rhyme Groups (RGs) were found across all 6 songs (15 in Roar, 13 in Flashlight, 29 in Price Tag, 26 in Uptown Funk, 23 in Seven Years, and 48 in Hamilton). More than half of these (n=51) occur only in one song. As Table 1 shows, the post-test songs were more difficult in that they had more perfect rhyme groups (RGs), more words in total (AW), more unique words (UW), more rhyming words total (RW), and more words per rhyme group (RW/RG).

Two sets of scores were generated for the pre- and post-test answers in this study to determine the effect of phonological effects. First, we calculated the *percent student population score,* a value that is measured only at the song level, and then we calculated the *average score*, a value that measures at both the song level and at the student level. The *percent student population score* is the percentage of students who ever correctly identified any rhyming pair from a given RG in a particular song. This score provides us with an overview of which RGs were most difficult to identify in each song. The *average score* calculation required two steps. First, for every student, we divided the number of rhyming words correctly matched in that song by the total number of words in that Rhyme Group (RG) for that song. Next, we averaged this value across all students. We calculated this value separately for each song, so that the same RG could potentially have a range of values. For example /aɪt/ had an average score of 66% in Flashlight, 2% in Uptown Funk, and 37% in Price Tag. This score helps to normalize how well students were identifying the entire Rhyme Group.

Rhyming words in each song were further coded for both study external (phonetic) and study internal (position and frequency across songs) effects. Internal conditions included word position within each song, the number of times that the word occurred in each song, the number of times the RG occurred across songs, and the frequency of occurrences for each RG in the pre-Test songs.

4. Results

We examine how well students are able to identify rhyming words in a song and factors that might have an impact on the extent to which a rhyme is recognized. These factors include word position, word incidence, and phonemic effects.

Table 1.
Rhyming characteristics by song. The number of Rhyming Groups (RGs), All Words in the song (AW), Unique Words in the song (UW), and Rhyming Words (RW) is given alongside values that normalize the number of RGs by other values. Examples of RGs are also given.

Song	**RG n**	**AW n**	**UW n**	**RW n**	**RG/ AW**	**RW /RG**	**RW/ UW**	**RG Examples**		
Pre-test										
Roar	15	443	94	48	3%	3.2	51%	*Died, pride*	*Drain, insane*	*hands, stands*
Flashlight	13	386	79	31	3%	2.4	39%	*Life, wife*	*Daddy, happy*	*Come, some*
Price Tag	29	424	161	81	7%	2.8	50%	*He, me*	*Quick, sick*	*Do, to, you*
Post-test										
Uptown Funk	26	584	137	74	4%	2.8	54%	*Sat, that*	*Mess, guess*	*for, roar*
Seven Years	23	437	161	93	5%	4.0	58%	*Hey, say*	*Down, uptown*	*Tell, well*
Hamilton	48	538	256	183	9%	3.8	71%	*Fly, I, sky*	*Light, night*	*Heart, start*

4.1 Pre-Test vs. Post Test

Students' pre-and post-test scores were compared. T-tests suggest that students perform better on the pre-test than the post test (t = 9.89, df = 56, p < .001), but the reader should recall that the post-test songs were more difficult in terms of the number of words (total) and the number of RGs per song. Tests controlling for these factors show that the total number of words per song significantly affects both the percent student score (r=-.24, t=-2.76, df=122, p=.006) and the average score (r=-.26, t=-3.06, df=122, p=.002). The effect is stronger for the number of RGs per song, where the t-values are of even larger magnitude for both percent student score (r=-.31, t=-3.64, df=122, p < .001) and average score (r=-.37, t=-4.37, df=122, p < .001). Finally, we show evidence that if a given RG showed up in one of the pre-test songs, the percentage of students who could identify that RG in the post-test was significantly higher (r=0.45, t=4.39, df=77, p < .001), although this effect was not shown in the average scores (r=.13, t=1.14, df=77, p=0.26) .

4.2 Word position and incidence in the song

We hypothesized that a word's position or incidence (i.e. number of instances) within a song may increase the likelihood of students citing it. To investigate, we first computed for the percentage of students who cited the word and correlated that percentage with the song's position and incidence. Note that position and incidence were all relative to the number of words in the song: The 10^{th} word in a song with 100 words would be at position 0.10 whereas the 10^{th} word in a song with 200 words would be at position 0.05.

We find only weak evidence for the effects of either position or incidence in a song. An early appearance in a song appears to decrease the chances that students will identify the rhyme. This is seen in both a pre-test song (Price Tag) and a post-test song (Seven Years), at levels that are robust enough to hold for the aggregated data (r=-0.19, p<.002). Recency effects (i.e. last occurrence) were not significant, and incidence (the number of times a word appears in the song) was only significant for one song (Seven Years, r = 0.31, p <.02).

4.3 Phonetic Effects

Of the phonetic factors considered, vowel characteristics had the strongest effects. Vowels that were coded as being close to the 5-vowel Tagalog system in the perceptual space (recall Figure 3, above) were more likely to be identified. This effect was significant for the percent student score (r=.23, t=2.03, df=77,p=.047), if not the average score (r=.14, t=1.53, df=122,p=.13). When only the vowels that are phonemically identical to Tagalog (e.g., the vowel in beat [i] vs. the vowel in bit [bIt]), the effect was even stronger, though again only for percent student score (r=.25, t=2.24, df=77,p=.03), and not for the average score (r=.13, t=1.48, df=122,p=.14).

A wide range of consonant effects (based on the manner of articulation) were not significant for either outcome measure. This finding carries over into the examination of syllable weight, which was did not effect the percent student score, but did effect the average score. Analyses show that the more phonemes per syllable rime, the higher the average score (r=.20, t=2.29, df=122,p=.02). This effect appears to be driven by the weight of the syllable nucleus (r=.22, t=2.51, df=122,p=.01), as the weight of the syllable coda, which exclusively considers how many consonants are present, did not significantly affect the average score (r=.07, t=.80, df=122,p=.42).

5. Conclusion

We use a PD approach to arrive at design guidelines for JOLLY, a new game to improve English language learning. In the process we make several contributions to what is known about considerations for language learning, we articulate implications on JOLLY's design, this paper's contribution, and discuss ways forward.

5.1 Contributions

We mention in section 2 that language learning involves increasing a learner's phonological inventory. One of this study's contributions is the identification of the phonological features that are most likely to pose the most difficulty. We provide evidence that, perhaps unsurprisingly, English phonemes that are closest if not identical to Tagalog phonemes are easiest for Filipino learners to find. There is an opportunity, therefore, for JOLLY's to provide learners with more practice with less familiar phonemes.

A second contribution is the innovative approach of anchoring the rhyming tasks on popular songs. Because the learners already indicated a fondness for music, providing exercises that make use of media that they already enjoy may provide an intrinsically motivating context in which to improve their English skills.

5.2 Implications on Software Design

From the analysis, we can draw implications that may guide JOLLY's underlying domain and student models. A domain model is a representation of expert knowledge within an area of study (Woolf, 2010). It represents facts, procedures, or any other kind of knowledge that students need to complete a learning task. The domain of JOLLY consists of the 44 phonemes in the English language. Each song represents a subset of these phonemes and therefore presents students with an opportunity to demonstrate knowledge of these phonemes by forming rhyming pairs of words from the song. Returning to the concept of a phonological inventory, each phoneme can constitute an inventory item or a unit knowledge that students need to master. Each song is an aggregation of these knowledge units.

The songs can then be represented as learning objects (e.g, Wiley, 2002), small instructional units that can be reused as needed. These learning objects will need metadata that indicates, among other things, the song's phonological inventory and overall level of difficulty. This information can then help to control the sequence of learning tasks being presented to the student.

5.3 Future Work

Future work will consider other domain and student factors that may have an impact on JOLLY's design. Domain factors include the effects of orthographic similarity (e.g., Yarkoni, Balota, & Yap, 2008), morphological complexity, phonotactic probability, age of acquisition scores (e.g., Kuperman, Stadthagen-Gonzalez, & Brysbaert, 2012), and near-rhymes..

Student factors include ability levels, media preferences, and socio-economic circumstances that have an impact on the relative difficulty of the material, student motivation, and access to technology, respectively.

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