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Cat in a hat or cat in a cap?: An investigation of developmental trajectories of phonological awareness for Korean children

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Running Head: Development of phonological awareness in Korean

Cat in the Hat or Cat in the Cap?

An Investigation of the Developmental Trajectories of Phonological Awareness for Korean Children

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Abstract

This study investigated trajectories of Korean children's growth in the awareness of four phonological units – syllable, body, rime, and phoneme – over time, by following a sample of 215 children over a period of 15 months, beginning at their first year of preschool and collecting four waves of data. Much of the existing research suggests that children who speak European languages tend to find subsyllabic phonological units, onset and rime, salient. In contrast, the results revealed that Korean children tended to find body and coda more accessible, and that the growth trajectories for body and rime awareness differed. Korean children had a higher awareness of the body unit than the rime unit at the beginning of the study, and their body awareness grew at a much faster rate than did their rime awareness. These findings support the emerging evidence that young Korean children find body-coda more accessible than onset-rime.

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Key words: Phonological awareness; intrasyllabic awareness; longitudinal; Korean; preschool children

Phonological awareness is critical for the mastery of literacy in alphabetic writing systems (Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997). Many studies have demonstrated that individual differences in phonological awareness are one of the most powerful predictors of early word reading skills in English (see Snow, Griffin, and Burns, 1998 for a review) and also in other European languages such as Spanish, Italian, Swedish, Greek, Portuguese, Norwegian, and German (see Ziegler & Goswami, 2005 for a review).

Despite the substantial attention paid to phonological awareness, however, only a few studies have examined whether, and how, the phonological characteristics of a spoken language influence the development of phonological awareness (Caravolas & Bruck, 1993; Durgunoglu & Oney, 1999). In particular, although much evidence has suggested that sensitivity to onsets and rimes is a natural constituent of phonological awareness for children who speak European languages (e.g., English, French, and Dutch), some inconsistent results have been reported recently (e.g., Geudens & Sandra, 2003; Geudens, Sandra, & Martensen, 2005; Savage, Blair, & Rvachew, 2006). Furthermore, the majority of previous studies of phonological awareness were limited to cross-sectional research designs and to European languages. The current study examined the developmental trajectories of young Korean children's phonological awareness. In particular, this study sought to confirm emerging evidence that Korean children tended to divide the syllable differently from their English-speaking counterparts.

Data from Korean-speaking children may provide particular insights into the relationship between the phonological structures of a language and children's phonological awareness development because the Korean language has many characteristics that distinguish it from more frequently studied languages such as English and Dutch. Specifically, the Korean oral language has clear syllabic boundaries and four simple syllable types (i.e., V, VC, CV, and CVC) with no consonant clusters allowed. Of these, the consonant-vowel (CV) syllable type (which corresponds to the body unit) occurs most frequently in speech (approximately 62% of spoken syllables) (Kim, Y.-S., 2007). In contrast, English and Dutch, for example, have complex syllable structures, allowing consonant clusters in either the onset or coda position. Furthermore, there is a co-occurrence constraint in the rime such that these languages have a rime-based phonological lexicon (Kessler & Treiman, 1997; Martensen, Maris, & Dijkstra, 2000).

In this paper, the term phonological awareness is used in an inclusive way, not making a theoretical distinction between explicit (or metalinguistic) and implicit (or epilinguistic) phonological awareness (Gombert, 1992). This approach is aligned with Stanovich's (1992) view, who proposed the use of a term, "phonological sensitivity," rather than phonological awareness. Although distinguishing explicit vs. implicit phonological awareness may be relevant for theory, the inclusive definition of phonological awareness is used in this paper based on the evidence that explicit and implicit phonological awareness tasks tap one underlying construct (see Anthony & Lonigan, 2004).

Background and Context

The majority of evidence suggests that children's phonological awareness develops sequentially, beginning with a shallow sensitivity to large phonological units (e.g., syllables) and proceeding toward a deep awareness of small phonological units (e.g., phonemes) (see Adams, 1990; Anthony & Lonigan, 2004; Stanovich, 1992; Treiman, 1992; Treiman & Zukowski, 1991, 1996; Ziegler & Goswami, 2005), although this is not without debate (see Carroll, Snowling, Hulme, & Stenvenson, 2003 for example). Children learn to manipulate syllables first (e.g., segmenting pencil into two syllables, pen.cil). Then, they become capable of manipulating sub-syllabic phonological units, onsets and rimes in English (e.g., segmenting pen into /p/ and /en/), and, finally, of manipulating the smallest unit of sound, the phoneme (e.g., segmenting pen into /p/, /e/, /n/). In the hierarchy of phonological awareness, rime awareness is often referred as the intermediate or intrasyllabic level. Studies of typically developing English-speaking children have shown that three- and four-year olds generally have good syllabic awareness, while four- and five-year olds have onset-rime awareness (Ziegler & Goswami, 2005).

Intrasyllabic Awareness in English and Korean

Many studies support that onset-rime is the salient and accessible intrasyllabic phonological unit in English (Stahl & Murray, 1994; Treiman, 1983, 1985, 1992; Treiman & Zukowski, 1991), as well as in Dutch, Norwegian, and German (de Jong & van der Leij, 2003; Hoien, Lundberg, Stanovich, & Bjaalid, 1995; Wimmer, Landerl, & Schneider, 1994; see Ziegler & Goswami, 2005 for a review). Onset is a syllable-initial consonant or a consonant cluster, while rime refers to the syllable-final vowel or vowel-consonant(s) sequence. English-speaking children tend to manipulate a one-syllable word, can, into two parts: the consonant /k/, the onset, and subsequent vowel and consonant /æn/, the rime. The rime /æn/ is further segmented into two phonemes /æ/ and /n/.

It has been proposed that distributional properties of a language may be responsible for the saliency of the onset-rime awareness. Specifically, in English, many words have the same sounds in the rime, called rime neighbors. For example, the following words are rime neighbors because they share the same sound /æt/ in the rime unit: m<u>at</u>, h<u>at</u>, c<u>at</u>, p<u>at</u>, b<u>at</u>, and s<u>at</u>. One hypothesis that has acquired some empirical support is that it is the predominance of rime neighbors in English that may be responsible for the emergence of the rime unit as so salient in this language (De Cara & Goswami, 2002, 2003; Kessler & Treiman, 1997). In other words, as children acquire vocabulary, they become exposed to identical sounds in the rime unit across many lexical items. In order to acquire or store vocabulary, they are therefore required to develop the phonological representation of onset-rime as a predominant unit of analysis (Metsala & Walley, 1998; Walley, Metsala, & Garlock, 2003). For example, for a child to acquire both of the words cat and bat, s/he needs to implicitly understand that cat differs from bat only in the onset, sharing the same sounds in the rime.

However, the onset-rime as a fixed internal syllabic structure has recently been questioned and alternative views have been offered (e.g., Geudens et al., 2005; Savage et al., 2006; Yip, 2002). Error analysis from a syllable recall task showed that Dutch-speaking children were as likely to break up, as to retain, the rime (Geudens et al., 2005). Geudens and her colleagues (2005) argued that the rime effects found in previous studies with Dutch-speaking children may be attributed to the phonological similarity between items in a task, due to the sonority of consonants in particular, rather than the perceived internal structure of a syllable, and that distributional properties of a language do not themselves give rise to the emergence of the rime effects. In other words, because sonorants (i.e. liquids and nasals) are more vowel-like and thus tend to adhere more closely to preceding vowels than do obstruents (i.e., stops and fricatives), one may tend to keep vowel+sonorant as a unit compared to vowel+obstruent. When sonority was controlled in the items, Dutch-speaking children tended not to treat rimes as a cohesive unit (Geudens & Sandra, 2003). Data from Dutch-speaking children are informative because Dutch has similar distributional properties to English (Geudens & Sandra, 2003; Geudens et al., 2005; Martensen et al., 2000).

Furthermore, recent cross-linguistic data suggested that phonological representation of the onset-rime boundary may not be universal across languages. For instance, children who speak Korean (Kim, Y.-S., 2007; Yoon, H.-K., Bolger, Kwon, & Perfetti, 2002; Yoon, Y.-B., & Derwing, 2001), Arabic (Saiegh-Haddad, 2003), and Hebrew (Share & Blum, 2005) tended to segment a syllable into body and coda, not onset and rime. The body is made up of the syllable-initial sequence of consonant(s) and the following vowel, and the coda is constituted from the syllable-final consonant, or consonant cluster. According to this proposed body-coda sub-syllabic structure in Korean, for example, Korean speakers would manipulate a one syllable word, can (캔), into /kæ/, the body, and /n/, the coda. This boundary has been shown to be psychologically salient and more accessible than the onset-rime boundary for both Korean college students and beginning readers (Kim, Y.-S., 2007; Yoon, Y.-B., & Derwing, 2001). For example, a previous study (Kim, Y.-S., 2007) demonstrated the saliency of the body-coda boundary for Korean kindergarteners and first graders using blending and segmenting tasks (e.g., blending /mu/ and /l/ into /mul/; and segmenting /mul/ into /mu/ and l/). Importantly, it was found that Korean children's ability to manipulate the body-coda unit predicted their pseudoword reading and spelling skills in Korean.

Korean oral language shows some evidence that the body unit may be particularly salient. For example, some Korean poems and language games involve manipulation and repetitions of the body unit (Kim, C.-G., 1987; Lee & Hahn, 1999). Furthermore, according to the studies in English which found predominance of rime neighbors (De Cara & Goswami, 2002, 2003; see also Ziegler & Goswami, 2005), it would be predicted that salience of the body unit in Korean may be explained by predominance of body neighbors (i.e., there would be more words that share same sounds in the body unit, for example, kang, kam, kan, kak). However, analyses of monosyllabic Korean words revealed that it was not the case (see Kim, Y.-S., 2007). With absence of predominant body neighbors, it was postulated that the high frequency of the CV syllable type in spoken Korean may account for the emergence of body awareness. The frequent occurrence of the CV syllable type may help Korean children notice phonological patterns, and thus develop stable phonological representations of the body-coda unit (Kim, Y.-S., 2007).

Despite the focus on psychological saliency of the intrasyllabic phonological unit due to its potential role in literacy development (Bryant, MacLean, Bradley, & Crossland, 1990; Goswami & Bryant, 1990; but see Hulme, Hatcher, Nation, Brown, Adams, & Stuart, 2002 and Muter, Hulme, Snowling, & Stevenson, 2004 for the importance of phoneme awareness over rime awareness in literacy development in English), few previous studies in English have explicitly examined equally sized intrasyllabic units, body vs. rime. Furthermore, no studies have investigated how intrasyllabic phonological awareness develops in children over time, for example, the parallel investigation of growth trajectories in rime and body awareness. Previous studies have been limited to the capture of a single-occasion snapshot of children's performance on syllable division tasks. Thus, these studies were unable to address a number of important questions linked to change: Do children's growth trajectories differ for more or less salient intrasyllabic units? When do children first show differences in their ability to manipulate different intrasyllabic units? Does children's performance with salient intrasyllabic units begin at a higher initial level than, and grow at a similar rate as, performance with less salient intrasyllabic units? Or, does children's performance with salient intrasyllabic units start at a lower, or similar, level and grow at a faster rate? I address these questions here, using longitudinal data on young Korean-speaking children.

Korean Writing System and Early Literacy Instruction in Korea

Korean has a fairly transparent alphabetic writing system called Hangul, thus each Hangul letter represent a phoneme in a consistent manner. Hangul is written in syllable blocks rather than a horizontal representation of letters found in Roman alphabet writing system. For example, the moon, /tal/, is written as 달 rather than a string of letters, ㄷ ㅏ ㄹ (Kim, Y.-S., 2007).

In Korea formal education does not start until first grade and kindergarten is not part of formal education. The vast majority of children receive literacy instruction prior to first grade and in fact children are expected to be able to read prior to first grade. The dominant approach to early literacy instruction in Korea is whole language or whole word instruction (Aheeaegae Hangul onje gahruchilgga, 2002; Hangul gyoyook bangbupron, 2002). The researcher's informal observations and conversations with teachers and directors of the preschools that participated in this research confirmed the predominance of whole word instruction: whole words or syllables were presented to children as a chunk and there was no explicit instruction of phonics or phonological awareness in these schools. In fact, none of teachers and directors who participated in this study were even familiar with the concepts of phonological awareness.

The Purpose of the Present Study

The present study investigated growth over time of Korean children's phonological awareness skills. The research questions were: On average, what are the developmental trajectories of phonological awareness in four phonological units (syllable, body, rime, and phoneme) for Korean children between four and five years of age? Specifically, do Korean children's trajectories for body awareness have a higher initial status and faster rate of change than their trajectories for rime awareness? It was hypothesized that, like children learning other languages, Korean children would perform better with larger phonological units (e.g., syllables) than with smaller units (phonemes). It was also hypothesized that children's body awareness would develop at a faster rate than rime awareness.

Research Design

Sites

Data were collected on children attending five preschools in two metropolitan cities in South Korea. Two of the preschools were in Seoul, in the northern part of South

Korea, and three preschools were in Daegu, in the southern part of South Korea. Although this sample is one of convenience, rather than being a nationally representative random sample, children from preschools in the two widely-separated cities were included in order to enhance the generalizability and external validity of the findings.

Sample

The sample included 215 four- and five-year old children from low to low-mid socioeconomic family backgrounds. These children did not have any hearing, visual, nor speech difficulties. Four waves of data were collected on the sampled children, at the beginning, middle, and end of the first preschool year, as well as three months after the second preschool year started. Thus, each data collection was at least four months apart. Table 1 displays descriptive statistics on the sample of children, by wave.

Of the total sample of 215 children, 128 children began participating in this study in the first wave of data collection, while 87 children joined the study in the second wave. The overall attrition rate was 34 percent. Thus, 128 children provided data at the first wave of data collection, 206 children at the second wave, 178 children at the third wave, and 141 children at the fourth wave, all of whom are included in the analyses. The evident attrition was due primarily to school transfers that took place during the change in academic year that occurred between the third and fourth wave of data collection. Some children continued in their existing preschool for a second year, while others transferred to another preschool or a kindergarten. In sensitivity analyses, comparisons were made between children who participated in all four waves of data collection and those who participated in one, two, or three waves and it was found that the children retained in the sample did not differ from the non-retained children in several observed variables (e.g., phonological awareness and parental education).

Procedures

All instruments were administered on each occasion of measurement by the researcher and by four research assistants. The research assistants – two graduate students of early childhood development and two child educators – were trained rigorously in the administration of the measures. To minimize practice effects, the order of items and the order of options within the items were randomized on each occasion of measurement. In addition, the order of administration of the phonological awareness measures was varied systematically across the different examiners to control for fatigue effects (e.g., syllable awareness task was administered first to some children while rime awareness task was administered to others). The entire assessment battery was administered individually to each child in a quiet room in two sessions of approximately 30-35 minutes each.

Measures

There were no standardized instruments available to assess children's early language or literacy skills in Korean. Therefore, the researcher developed, pilot-tested, and revised all of the instruments used in this study. Each measure is described below, beginning with four outcome variables.

Outcome: Phonological awareness

Four oddity tasks were used to measure: (a) syllable awareness, (b) body awareness, (c) rime awareness, and (d) phoneme awareness, respectively (see Appendices A-1 & A-2 for the items used). In subsequent analyses, scores derived from each of these four oddity tasks were measured as separate outcome variables. In each task, children were asked to select the 'odd word' out among three words in the target phonological unit; pictures[1] were presented along with each word and children were allowed to point at the picture to indicate their responses. All of the words included in the oddity tasks were common words that children typically encountered in everyday interactions in Korea. Directions for the tasks were presented orally. Each task consisted of two training items and 15 test items (There were three training items for the phoneme awareness task). If the child's answers were incorrect for four items in a row, the administration of the test stopped.

The students received feedback on their responses to the training items, but not on their responses to the test items. Children were asked to repeat each stimulus word to ensure their correct perception of the items. Each item in an oddity task was scored dichotomously (1 = correct; 0 = incorrect) and the scores totaled, providing a maximum possible score of 15 correct on each task.

Oddity tasks have often been used in the investigation of phonological awareness in English (e.g., Bradley & Bryant, 1985; Goswami, Ziegler, & Richardson, 2005). However, there are cautionary notes in the literature about using the oddity task as a measure of phonological awareness. The literature has provided a mixed picture on this issue, some studies suggesting a potential problem with the reliability of oddity task measurement (Hulme et al., 2002; Schatsneider, Francis, Foorman, Fletcher, & Mehta, 1999) and others finding reasonable reliability and high loading to phonological awareness (Muter et al., 2004). In the present study, the internal-consistency reliability of the items for each oddity task, estimated by Cronbach's alpha, is reasonably high (ranging from .85 to .90). Furthermore, it has been cautioned that in implicit phonological awareness tasks such as matching tasks and oddity tasks, children's performance may be influenced by global phonological similarity in the distractor items (Carroll & Snowling, 2001; Snowling, Hulme, Smith, & Thomas, 1994). Efforts were made in the pilot tests to examine the effects of the phonological characteristics of distractors in the body awareness task and rime awareness task (see below and Appendix B for a detailed description and results of these sensitivity analyses).

Syllable Awareness. The child was asked to select the word that did not share the first syllable with the other two (e.g., /na-bi/, /na-mu/, /ʃi-ge/). All items consisted of two syllable words. The Cronbach's alpha internal-consistency reliability estimate for the fifteen items in this task was .90.

Body awareness. The child was asked to select the word that had a different sound in its body (e.g., /kaŋ/, /kam/, /tul/). The first ten items on the task consisted of monosyllabic CVC words and the last five items consisted of two syllable words. Estimated Cronbach's alpha for the fifteen items in this task was .89. In the pilot test, the linguistic characteristics of the target odd word (or distractors) in the body awareness task were varied in order to investigate whether its phonological characteristics influence children's performance. The distractors varied, including those requiring a rime change (i.e., the distractor shared the same onset as the other two words; e.g., puk, pul, pam), those requiring an onset-coda change (i.e., the distractor shared the same vowel as the other two words; sam, p^han, p^hal), and those requiring a syllable change (i.e., the distractor did not share any sounds with the other two words; e.g., mal, puk, man). When children's performance on these three types of distractors in the body awareness task was compared to the one in the rime awareness task, no particular pattern emerged. In other words, there was no particular type of distractor that was consistently more difficult nor easier in the body and rime awareness tasks (see Appendix B for details). Therefore, the items that had syllable change distractors were used in this study.

Rime awareness. The child was asked to select the word that had a different sound in the rime among three words (e.g., /pom/, /kom/, /hak/). The first ten items consisted of monosyllabic CVC words while the last five items consisted of two syllable words. Estimated Cronbach's alpha for the fifteen items in this task was .85. Again, the phonological characteristics of distractors in the rime oddity task were varied in the pilot study. Specifically, the distractors were based on a body change (i.e., the distractor shared the same coda as the other two words; e.g., kam, nam, mom), an onset-coda change (i.e., the distractor shared the same vowel with the other two words; e.g., dol, mok, sol), and a syllable change (i.e., the distractor did not share any sounds with the other two words; e.g., mat, kuk, cuk). Details of children's performance on these different conditions are presented in Appendix B. As in the body awareness task, the items with distractors involving syllable changes were used in the study.

Phoneme (onset) awareness. The child was asked to select the odd word out from among three words that differed, or not, in the first consonant (e.g., /ki/, /ko/, /se/). The first five items consisted of CV monosyllabic words, the next five items of CVC monosyllabic words, and the last five of two syllable words. The CV monosyllable was chosen to reduce the difficulty of the task to minimize a floor effect. Estimated Cronbach's alpha for the fifteen items in this task was .87.

Principal Question Predictor

Age. The main question predictor in growth modeling analyses (see below for details) was the child's age, in months. All the children's ages were centered at 50 months, the youngest age of any child in the first wave. Thus, the intercept is a predicted value of each outcome at 50 months.

Control Predictors

Covariates were included to control for both substantive and design-based heterogeneity. "Substantive" control predictors represented parental education and the child's gender. "Design" control predictors included an indicator of the child's data-collection cohort and the fixed effects of the preschool site.

Parent education. Parents' highest level of education has been shown to correlate highly with children's literacy development in both English-speaking (Bryant, MacLean, Bradley, & Crossland, 1990) and Korean-speaking children (Kim, Y.-S., 2007). The majority of parents (parents' highest level of education) in this sample had completed high school (46%, n = 93) and 31 percent (n = 62) had completed junior college. However, some parents had graduate-level education while other parents had only middle-school education. In the analyses, for complete generality in the relationship with the outcomes, parent education was specified as a vector of dichotomous predictors (i.e., middle school, junior college, four year college, and graduate school), with high school completion omitted to provide the reference category.

Gender. The child's gender was represented by a dichotomous predictor that indicated whether the child was male (1 = male; 0 = female).

Cohort. Because 128 children participated in the study from the first wave of data collection while 87 children joined the study in the second wave, in all of the analyses a dichotomous control predictor was included to distinguish between the two cohorts (1 = child participated from the first wave onwards; 0 = otherwise).

Preschool. A vector of dichotomous predictors were included to represent the fixed effects of attendance at each of the five different preschools, in order to control for all observed and unobserved differences in outcome due to site (Preschool A was omitted to provide the reference category).

Data Analysis

Analyses were conducted by fitting multilevel models for change (Singer & Willett, 2003) in the person-period dataset and investigated the developmental trajectories of children's awareness for each of the four phonological units measured, using SAS PROC MIXED with the MIVQUE0[2] estimation method. In each case, residuals were examined to confirm that the usual linearity, normality, and homoscedasticity assumptions were adequately met at both level-1 and level-2.

Preliminary exploratory analyses of the empirical growth trajectories of each child over time, for each of the four outcome variables suggested that there were a few children who "topped out," approaching the ceiling score of 15 in syllable and body awareness even at the first wave of data collection, while many children "floored" at zero in rime and phoneme awareness tasks at this wave. Thus, to model individual change appropriately, and to prevent children's predicted scores from taking on illegal values that lay outside the available minimum (0) and maximum scores (15), a logit-transformation[3] was applied to each outcome before proceeding with the analyses, as is evident on the left-hand side of the hypothesized composite multilevel model for change presented below:

$$\text{Log}\left(\frac{Y_{ij}+\frac{1}{6}}{15+\frac{1}{6}-Y_{ij}}\right)=\begin{pmatrix}\gamma_{00}+\gamma_{10}\text{ AGE}_{ij}+\gamma_{01}\text{MALE}_i+\gamma_{02}\text{ COHORT}_i\\ +\gamma_{03a-d}\text{ PARENT EDUCATION}_i+\gamma_{04a-d}\text{ PRESCHOOL}_i\end{pmatrix}+\left(\zeta_{0i}+\zeta_{1i}\text{AGE}_{ij}+\varepsilon_{ij}\right)$$

where $\varepsilon_{ij} \sim N(0,\sigma_{\varepsilon}^2)$ and $\begin{bmatrix}\zeta_{0i}\\ \zeta_{1i}\end{bmatrix} \sim N\left(\begin{bmatrix}0\\0\end{bmatrix},\begin{bmatrix}\sigma_0^2 & \sigma_{01}\\ \sigma_{10} & \sigma_1^2\end{bmatrix}\right)$

In this model, Y is the generic outcome and represents – in their respective analyses – the variables syllable awareness, body awareness, rime awareness, and phoneme awareness of child i at time j. Notice that, in taking logits of Y, both the numerator and denominator "started" within the logarithmic transformation to avoid infinities, by adding one sixth (1/6) in each case, as recommended by Tukey (1977). After completing multilevel modeling of change, with the model as specified above, fitted values for each outcome were detransformed before constructing the fitted plots that are used to illustrate the findings in their original metric.

In this model, parameters γ_{00} and γ_{10} represent initial status at 50 months and the rate of change over time (in months), respectively, of the population average growth trajectories in the logit-transformed outcome, after controlling for gender, cohort, parental education, and the fixed effects of preschool. Potential two-way interactions were tested between child age and the control predictors in preliminary analyses and none was found to be statistically significant except for the two-way interaction between child age and the fixed effect of preschool site D in the prediction of body awareness, which was retained in the final fitted model. Residual, ε_{ij}, represents the portion of child i's observed outcome at time j that is not predicted by their age, whereas level-2 residuals ζ_{0i} and ζ_{1i} represent deviations of the individual growth parameters (initial status and rate of change in the logit-transformed world, respectively) from their population averages over all children. Notice that, based on preliminary analyses, the effects of the control variables were fixed across children and therefore the control variables do not appear as random effects in the model.

Results

Table 1 presents the sample means of the syllable, body, rime, and phoneme awareness tasks, by wave of data-collection. Notice that sample means for syllable and body awareness were similar at all waves (all ps > .18). On the other hand, children's average performance on syllable and body awareness was consistently higher across all waves than on tasks involving rime and phoneme awareness (all ps = .000). It is also notable that the sample average scores for rime awareness and phoneme awareness remained almost constant over time. However, because the linguistic complexities and structure of the phonological awareness measures were not comparable, comparisons of children's mean performance across phonological units other than body and rime awareness should be interpreted with caution.

<Insert Table 1 here>

In Table 2, a taxonomy of fitted multilevel models is presented for change for each of the four logit-transformed outcomes after controlling for parental education, gender, cohort status, and the fixed effects of preschools. Notice that children's syllable, body, and rime awareness grew over time while phoneme awareness did now show any growth. Furthermore, the growth rate for body awareness is larger than that for rime awareness, after controlling for parental education, gender, cohort status, and fixed effects of preschools. Children's logit- transformed syllable awareness increased over time at a rate of .14 points per month (p = .01) and logit- transformed body awareness increased over time at a rate of .10 per month (p < .001), on average, respectively. There was a statistically significant two-way interaction between child age and the fixed effect of preschool site D in the prediction of body awareness such that children in the preschool D showed a faster rate of change in the logit-transformed body awareness. The rate of change in logit-transformed rime awareness was smaller (γ_{10} = .04, p = .001) and the rate of change in logit-transformed phoneme awareness was not statistically significantly different from zero (γ_{10} = .02, p = .56).

An examination of the variance components estimated for each of the multilevel models for change suggests that there was statistically significant (level-1) variation in the observed outcome values around the individual trajectories for all the four phonological units after controlling for gender, parental education, cohort status, and fixed effects of preschools. Furthermore, both the initial status and the rate of change of the individual growth trajectories differed significantly among children and their initial status and rate of change significantly and positively covaried for syllable awareness, body awareness, and phoneme awareness, after controlling for gender, parental education, cohort status, and fixed effects of preschools. In contrast, for rime awareness, there was no significant variation among children in initial status and rate of change, after controlling for gender, parental education, cohort status, and fixed effects of preschools.

<Insert Table 2 here>

Because it is difficult to interpret these effect sizes directly, due to the presence of the logit transformations, the results are illustrated graphically in Figure 1, as fitted growth trajectories for prototypical children whose values of the control predictors (including preschool sites) have been set to their sample averages. Thus, each fitted trajectory in Figure 1 represents the average trajectory for each outcome across children and across sites. The fitted values are detransformed back into their original metrics, before plotting and so the trajectories appear curvilinear. Notice that the fitted growth trajectories in syllable awareness and body awareness show a different pattern than those for rime awareness and phoneme awareness, which were nearly flat. On average, children's performance on the body awareness task was more elevated initially and increased at a faster (instantaneous) rate at each age than on the rime awareness task. This suggests that young Korean children were more sensitive to the body unit than the rime unit at 50 months, and that their sensitivity to the body unit grew more rapidly over time than did their sensitivity to the rime unit.

<Insert Figure 1 here>

Discussion

The main goal in this study was to expand upon what is known about phonological awareness by examining growth trajectories of Korean children's awareness of four phonological units over time. Thus, trajectories of growth were estimated and compared in children's awareness of intrasyllabic phonological units (i.e. body vs. rime) for young Korean children. The results demonstrated that the average trajectory of growth in body awareness differed from that of growth in rime awareness for young Korean children. Children were more sensitive to the body unit at 50 months and their sensitivity to the body unit grew at a faster rate at each age than did their sensitivity to the rime unit (see Figure 1). Although the rime unit is the same size and at the same hierarchical level as the body unit in the subsyllabic structure, it does not appear to be as salient as the body unit for young Korean children. This provides evidence that Korean children find the body unit more accessible than the rime unit, confirming previous studies (Kim, Y.-S., 2007; Yoon, H.-K. et al., 2002; Yoon, Y.-B., & Derwing, 2001). This is the first study to demonstrate different developmental trajectories for awareness of more and less salient intrasyllabic units.

The longitudinal aspect of the current study strengthens the claim that children's phonological awareness develops as a function of characteristics of the oral language being learned. A relationship between oral language characteristics and children's phonological awareness in that language has been demonstrated in previous studies (Caravolas & Bruck, 1993; Durgonoglu & Oney, 1999). For example, Durgonoglu and Oney (1999) found Turkish-speaking children to have highly developed phoneme awareness compared to English-speaking children, and explained this finding with the fact that considerable attention is paid to phonemes in Turkish due to the prevalence of vowel harmony in the language. Similarly, the growing evidence that English-speaking children and Korean-speaking children differ in their sensitivity to intra-syllabic units can be explained by the structural differences in the phonology and phonotactics of those languages. It has been speculated, and some empirical evidence suggests, that the existence of many words that have the same sounds in the rime unit (i.e., rime neighbors) in English, French, and German may account for the saliency of the rime in those languages (Ziegler & Goswami, 2005). Thus, it has been hypothesized that the predominance of the CV syllable may account for the accessibility of the body unit. In other words, as Korean children are exposed to CV syllables more frequently than VC syllables, they may found the same sounds in the CV unit more accessible than the VC unit (Kim, Y.-S., 2007). A similar hypothesis has been offered for the Semitic languages (e.g., Hebrew) that have found salience of the body unit (Share & Blum, 2005). That is, simple open CV syllables predominate (along with CVC syllables) in Hebrew and the abundant presence of CV syllables may predispose Hebrew speakers to find the body unit more accessible (Share & Blum, 2005).

While the findings of the present study expand our understanding of the development of phonological awareness, many questions remain about the status of the intrasyllabic phonological awareness. In particular, recent evidence did not provide support for the psychological saliency of the onset-rime structure in English and Dutch (Geudens & Sandra, 2003; Geudens et al., 2005; Savage et al., 2006). Geudens and her colleagues' (2003, 2005) studies with Dutch-speaking children suggested that the saliency of onset-rime awareness may be attributed to the sonority of the items in the task rather than the perceived structure in individual syllables. Unfortunately, the present study did not compare sonority conditions of the items. It should be noted that in Korean words, obstruents occur more frequently in the onset and sonorants occur more frequently in the coda such that many items used in the phonological awareness tasks in the present study reflect this. For example, in the rime oddity task, five items shared the same sounds in a vowel+obstruent structure whereas ten items shared the same sounds in a vowel+sonorant structure. Future work is warranted to investigate the intrasyllabic phonological awareness by controlling for sonority of items in phonological awareness tasks in languages other than Dutch. Furthermore, future studies should include multiple measures of phonological awareness, given the debate about explicit vs. implicit phonological awareness (Gombert, 1992; Hulme et al., 2002).

Although differences in the linguistic structures in the items used in the various phonological awareness tasks did not permit me to compare children's performance trajectories across all four phonological units directly (except for body awareness and rime awareness), it is worth noting that children's performances on syllable and body awareness tasks were very similar at each wave. This is particularly interesting given that, by necessity, the linguistic structure of the syllable awareness task was more complex than that of the other units; all the items consisted of two syllable words. Thus, it may suggest that Korean children perform more accurately in syllable unit tasks than in other phonological unit tasks as shown previously (Kim, Y.-S., 2007). This is congruous with previous findings that children start developing their phonological representation with the largest phonological unit, the syllable. Furthermore, this may be promoted by the simple syllable structure and saliency of the syllable in Korean, as children learning other languages that have a simple syllable structure (e.g., Turkish, Greek, and Italian) also showed high levels of syllable awareness. However, it should be noted that the first 10 items in the syllable awareness task required children's understanding of matching syllables in the CV syllable type[4], thus children may have used the same unit in the syllable and body oddity task. Further research should include a wider variety of syllable types in syllable awareness tasks.

Despite simpler linguistic structures in the phoneme awareness task (five monosyllabic CV words, five monosyllabic CVC words, and five disyllabic words) than in the syllable, body, and rime awareness tasks, children's performance on the phoneme task started at the lowest elevation and did not grow over time. Although many studies in English have shown that children's phoneme awareness emerges last, no growth during the period in the study (or the slow rate of growth when controlling for children's initial word reading skills – see below) in this Korean sample was somewhat surprising because studies with English-speaking children suggest that phoneme awareness is promoted by learning to decode (Perfetti, Beck, Bell, & Hughes, 1987; Stuart, 2005). A future longitudinal study with a longer time span is warranted.

Another possibility for the present finding that children's awareness of the body unit grew at a faster rate than the rime unit is the orthographic structure of the Korean written language. Although children in the beginning of the study were just starting the first year of preschool, and thus receiving systematic literacy instruction for the first time, they were exposed to literacy instruction over the 15 months of data collection. Furthermore, it is possible that they received some informal guidance in literacy before entering preschool. Thus, it is possible that children's exposure to Korean orthography may have influenced their performance on phonological awareness tasks over time. Particularly relevant is the possibility that visual cues in the Korean orthography promote the saliency of the syllable unit and body unit (Kim, Y.-S., 2007). The Korean alphabet letters are written in nonlinear, square-framed syllable blocks, instead of a linear string of letters, and this orthographic representation makes the syllable visually salient. Furthermore, in Korean writing, a syllable should consist of at least CV – if there is no initial consonant (such as V or VC syllable in oral language), a character (circle shape which does not have any sound value in the onset position) is written in so that orthographically they are presented as CV or CVC (Kim-Renaud, 1997). In addition, for the CVC and CVCC syllable types in written Korean language, in many cases the body unit (CV) is presented together horizontally while a letter for the coda is added to the bottom of the horizontal arrangement (see Kim, Y.-S., 2007 for details). For example, in 밤 /pam/ (night or chestnut), the CV unit, 바, is aligned and presented together. This horizontal presentation of CV may render the CV unit visually salient, which may influence the rapid growth of children's body awareness over time. However, the fact that children's performance at the first wave, before they had been exposed to extensive systematic literacy instruction, was higher for body than for rime awareness suggests that their performance might well have been influenced by Korean oral language structures rather than exposure to Korean orthography. It should be noted that although the present study cannot tease out the effect of oral language completely from the potential effect of orthographic structure of the Korean language, it is possible that these two factors have conduced the results of the present study. It is plausible that the Korean oral language may make the body unit salient prior to children's introduction to Korean writing system while the Korean writing structure may make this even more prominent.

In conjunction with previous findings that Korean second graders' syllable awareness and phoneme awareness predicted their word reading (Cho & McBride-Chang, 2005) and body awareness predicted pseudoword reading and spelling for Korean kindergarteners and first graders (Kim, Y.-S., 2007), it appears that it would be beneficial for Korean children to receive training in salient phonological units, namely, syllable, body, and phoneme, before or during literacy education. Since the Korean language has an alphabetic writing system, called Hangul, in which each phoneme is represented by a letter and both syllable and body may be orthographically salient (Kim, Y.-S., 2007), it may be particularly helpful to train children at the syllable, body, and phoneme level.

In conclusion, this study contributes to our understanding of growth in phonological awareness with a child's age. Future work should explore developmental patterns of phonological awareness, in particular in languages with many open syllables. Furthermore, studies are needed to investigate linguistic and cognitive bases of phonological awareness and the relationship between children's rate of growth in phonological awareness and the rate of growth in their literacy skills.

End notes

1. Pictures were in color and carefully selected to find the most representative images with which Korean young children are likely to be familiar.

2. The MIVQUE0 method of estimation was used to avoid problems of non-positive definiteness that were generated in maximum-likelihood estimation.

3. Essentially, by logit transforming nonlinear models were fitted. In fact, the results were identical when nonlinear model procedure were employed using PROC NLMIXED. However, in this article results from logit transformation are reported because when using PROC NLMIXED, the author was not able to examine the assumptions.

4. This choice was made because of constraints in selecting high frequency words that are familiar to young children.

Appendix A-1. List of items included in the syllable and body oddity tasks.

Syllable Oddity Task			Body Oddity Task		
Hangul /IPA/	Hangul /IPA/	Hangul /IPA/	Hangul /IPA/	Hangul /IPA/	Hangul /I
Practice items					
시계 /ʃɪ.gɛ/	시장 /ʃɪ.caŋ/	나비 /na.bɪ/	강 /kaŋ/	감 /kam/	물 /mul/
조개 /co.gɛ/	조끼 /co.k͈ɪ/	공부 /koŋ.bu/	발 /pal/	곰 /kom/	공 /koŋ/
Test items					
새장 /sɛ.caŋ/	버스 /bʌ.sɯ/	새우 /sɛ.u/	형 /hʲʌŋ/	달 /tal/	담 /tam/
사탕 /sa.tʰaŋ/	사진 /sa.cɪn/	구름 /ku.rɯm/	문 /mun/	봄 /pom/	물 /mul/
후추 /hu.tʃu/	모자 /mo.ca/	모래 /mo.rɛ/	북 /puk/	불 /pul/	콩 /kʰoŋ/
누구 /nu.gu/	머리 /mʌ.rɪ/	누나 /nu.na/	신 /ʃɪn/	맛 /mat/	말 /mal/
꼬리 /k͈o.rɪ/	꼬마 /k͈o.ma/	채소 /tʃɛ.so/	삼 /sam/	길 /kɪl/	산 /san/
비옷 /pɪ.ot/	비누 /pɪ.nu/	노래 /no.rɛ/	밤 /pam/	방 /paŋ/	돌 /tol/
토끼 /tʰo.k͈ɪ/	가게 /ka.gɛ/	가위 /ka.wʲɪ/	산 /san/	점 /cʌm/	절 /cʌl/
세수 /sɛ.su/	하마 /ha.ma/	하늘 /ha.nɯl/	몸 /mom/	목 /mok/	눈 /nun/
자리 /ca.rɪ/	호수 /ho.su/	자두 /ca.du/	손 /son/	발 /pal/	솜 /som/
수박 /su.bak/	수건 /su.gʌn/	바다 /pa.da/	집 /cɪp/	짐 /cɪm/	턱 /tʰʌk/
바지 /pa.cɪ/	구멍 /ku.mʌŋ/	구두 /ku.du/	감자 /kam.ca/	색깔 /sɛk.k͈al/	생일 /sɛŋ.ɪl
상자 /saŋ.ca/	침대 /tʃɪm.dɛ/	상추 /saŋ.tʃu/	삼촌 /sam.tʃon/	상자 /saŋ.ca/	벌레 /pʌl.lɛ
냄새 /nɛm.sɛ/	국자 /kuk.ca/	국수 /kuk.su/	친구 /tʃɪn.gu/	공주 /koŋ.cu/	침대 /tʃɪm.
김치 /kɪm.tʃɪ/	반찬 /pan.tʃan/	김밥 /kɪm.bap/	술래 /sul.lɛ/	장미 /caŋ.mɪ/	숙제 /suk.tɕ
동물 /toŋ.mul/	동생 /toŋ.sɛŋ/	별빛 /pʲʌl.pɪt/	녹차 /nok.tʃa/	반지 /pan.cɪ/	밤색 /pam.

Note: A subscript after consonants is used to denote the tensed consonants ㄸ, ㄲ, ㅉ, /t͈, k͈, tɕ͈/, respectively. Efforts were made to make syllabic structure among items identical, but a few items have slightly different syllabic structures.

Appendix A-2. List of items included in the rime and phoneme oddity tasks.

Rime Oddity Task			Phoneme Oddity Task		
Hangul /IPA/	Hangul /IPA/	Hangul /IPA/	Hangul /IPA/	Hangul /IPA/	Hangul /IPA/
Practice items					
실 /ʃɪl/	감 /kam/	삼 /sam/	키 /kɪ/	코 /ko/	새 /sɛ/
봄 /pom/	곰 /kom/	학 /hak/	사과 /sa.kwa/	토끼 /tʰo.k͈ɪ/	수박 /su.bak/
			제비 /cɛ.bɪ/	바람 /pa.ram/	조개 /co.gɛ/
Test items					
문 /mun/	담 /tam/	잠 /cam/	구 /ku/	개 /kɛ/	벼 /pʲʌ/
말 /mal/	발 /pal/	곰 /kom/	사 /sa/	해 /hɛ/	소 /so/
점 /cʌm/	방 /paŋ/	껌 /k͈ʌm/	배 /pɛ/	무 /mu/	비 /pɪ/
불 /pul/	물 /mul/	성 /sʌŋ/	너 /nʌ/	차 /tʃa/	초 /tʃo/
목 /mok/	달 /tal/	속 /sok/	피 /pʰɪ/	파 /pʰa/	혀 /hʲʌ/
돌 /tol/	밥 /pap/	삽 /sap/	꿀 /k͈ul/	잠 /cam/	종 /coŋ/
창/tʃaŋ/	북 /puk/	국 /kuk/	복 /pok/	뱀 /pɛm/	팔 /pʰal/
방 /paŋ/	펜 /pɛn/	강 /kaŋ/	밀 /mɪl/	셋 /sɛt/	못 /mot/
십 /ʃɪp/	집 /cɪp/	춤 /tʃum/	꿈 /k͈um/	꽃 /k͈ot/	반 /pan/
솜 /som/	색 /sɛk/	몸 /mom/	둘 /tul/	칼 /kʰal	콩/kʰoŋ/
임금 /ɪm.gɯm/	은행 /ɯn.hɛŋ/	동생 /toŋ.sɛŋ/	모자 /mo.ca/	하나 /ha.na/	허리 /hʌ.rɪ/
물건 /mul.gʌn/	공책 /koŋ.tʃɛk/	동전 /toŋ.cʌn/	두부 /tu.bu/	도시 /to.ʃɪ/	꼬리 /k͈o.rɪ/
동물 /toŋ.mul/	얼굴 /ʌl.gul/	점심 /cʌm.ʃɪm/	고래 /ko.rɛ/	배추 /pɛ.tʃu/	구두 /ku.du/
벌집 /pʌl.cɪp/	안경 /an.kʲʌŋ/	물병 /mul.p͈ʲʌŋ/	색깔/sɛk.k͈al/	병원/pʲʌŋ.wʌn/	반찬 /pan.tʃan/
가족 /ka.cok/	발목 /pal.mok/	병원 /pʲʌŋ.wʌn/	밥통/pap.toŋ/	글자 /kʌl.ca/	블록 /pɯl.lok/

Appendix B. Pilot sample means, standard deviations, and t statistics for testing differences in body awareness tasks and rime awareness tasks with varied linguistic manipulations in the target word in the oddity tasks (n = 75).

Body Awareness		Rime Awareness		t-statistic (p) :comparison of body and rime awareness
	Mean (SD)		Mean (SD)	
Rime change	2.81 (1.22)	Body change	1.21 (0.95)	-9.87 (.000)
Onset coda change	2.37 (1.18)	Onset coda change	1.40 (1.08)	-5.84 (.000)
Syllable change	2.40 (1.25)	Syllable change	1.71 (1.43)	-3.64 (.001)

*Note: A total of 24 items (8 items in each linguistic structure for distractors) was used in the body awareness task and rime awareness task, respectively. The order of items for each linguistic manipulation condition was randomly arranged.

In the body awareness tasks, children's performance on the rime change distractor items was statistically significantly higher than on the onset-coda change distractor items (t = 3.65, p = .000) as well as on the syllable change distractor items (t = 3.3.2, p = .001). In the rime awareness tasks, children's performance on the body change distractor items was statistically significantly higher than syllable change distractor items (t = -3.01, p = .004). Note that in all the three distractor conditions children's performance was superior in the body awareness tasks, as shown in the table.

In addition to the pilot test, an attempt was made to examine the potential effect of global sound similarity in the distractors in the fourth wave of data collection. A subsample of children (n = 63) were given another body awareness task. In this task, the odd word (distractor) shared the same consonant sounds as one of the other two words and only differed in the vowel (e.g., kaŋ, kam, kim). In this case, the global sound similarity was controlled because two phonemes are shared in the two words that share the same sounds in the body unit (CV, /k/ and /a/ in the example) as well as in one of the two words and the distractor (CC, /k/ and /m/ in the example). Children's performance on this task (m = 10.11) was not statistically different from their performance on the body awareness task in which the odd word had an entirely different syllable (m = 10.44) (F (1, 62) = .84, p = .36). In addition, a forced choice similarity judgment task (15 items) was administered to these children (e.g., kuk, puk, pul), requiring them to identify two words that share similarity in sounds. This task was administered first on the first day of the assessments. The results showed that children based similarity judgments more on the body unit (m = 9.57, SD = 2.91) than on the rime unit (m = 2.94, SD = 1.96) (t = 11.23, p = .000).

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Table 1. Sample means (standard deviations) of children's gender, age, and phonological awareness, by wave.

Variable	Wave	Mean (SD)	Min - Max
Number of children (male)		% male	
128 (68)	1	.53	
206 (104)	2	.50	
178 (87)	3	.49	
141 (73)	4	.52	
Age in months	1	56.51 (3.74)	50-64
	2	61.73 (3.59)	54-68
	3	65.64 (3.59)	58-73
	4	69.60 (3.63	62-77
Phonological awareness			
Syllable	1	5.48 (4.19)	0-15
	2	7.41 (4.67)	0-15
	3	8.32 (4.77)	0-15
	4	9.78 (4.30)	0-15
Body	1	5.68 (4.18)	0-15
	2	7.28 (4.80)	0-15
	3	7.88 (4.60)	0-15
	4	9.66 (4.08)	0-15
Rime	1	3.14 (3.08)	0-11
	2	3.68 (3.40)	0-13
	3	3.33 (3.32)	0-13
	4	4.20 (3.30)	0-13
Phoneme	1	2.52 (3.25)	0-14
	2	2.46 (2.88)	0-15
	3	2.80 (3.23)	0-15
	4	2.81 (2.94)	0-15

Table 2. Fitted multilevel models for change in which the logit-transformation of children's syllable awareness, body awareness, rime awareness, and phoneme awareness, are predicted by their Age (in months), controlling for gender, parental education, entering cohort and the fixed effect of preschool (n = 201).[=]

	Parameter	Outcome			
		Logit Syllable	Logit Body	Logit Rime	Logit Phoneme
Fixed effects					
Initial status					
Intercept	γ_{00}	-2.54*	-2.44***	-2.32***	-4.59***
Male	γ_{01}	-0.13	-0.44	-0.11	-0.71*
Entering cohort	γ_{02}	0.41	1.41*	0.06	1.98*
Parental Education:					
Middle school	$\gamma_{03\ a}$	-0.91	-1.06	-0.49	-0.60
Junior college	$\gamma_{03\ b}$	0.23	-0.14	0.08	0.48
Four year college	$\gamma_{03\ c}$	1.17*	-0.00	0.39	-0.13
Graduate school	$\gamma_{03\ d}$	3.69**	1.94	1.12*	1.27
Preschool Site:					
Preschool B	$\gamma_{04\ a}$	-0.33	-0.15	-0.14	2.13**
Preschool C	$\gamma_{04\ b}$	0.46	1.37	-0.39	3.76***
Preschool D	$\gamma_{04\ c}$	0.97	-1.33*	0.56	-0.27
Preschool DxAge	$\gamma_{04\ d}$		0.12*		
Preschool E	$\gamma_{04\ e}$	1.14	-0.97	-0.38	-0.92
Rate of change					
Age	γ_{10}	0.14*	0.10***	0.04**	0.02
Variance Components					
Level-1	σ^2_{ε}	2.43***	2.69***	2.60***	2.56***
Level-2 intercept	σ^2_0	0.34	0.23	0.53	0.14
Level-2 rate of change	σ^2_1	0.57***	0.04***	0.00	0.15***
Level-2 covariance	σ_{01}	0.07***	0.06***	-0.02	0.04***
Goodness-of-fit					
-2LL (Restricted)		3191.9	2813.5	2568.7	2955.5

Key: * p < .05; ** p < .01; *** p < .001

= Children for whom parental education was not available were excluded from all fitted models.

Figure 1. Predicted age-trajectories of syllable awareness, body awareness, rime awareness, and phoneme awareness for an average student (all control variables, including the fixed effects of site, have been set to their respective sample means).