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Late Emerging Reading Difficulties in English Language Learners

A Dissertation submitted in partial satisfaction
of the requirements for the degree of

Doctor of Philosophy

in

Education

by

Nicole Marie Garcia

March 2015

Dissertation Committee:
Dr. H. Lee Swanson, Chairperson
Dr. Michael J. Orosco
Dr. Marsha Ing

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The Dissertation of Nicole Marie Garcia is approved:

Committee Chairperson

University of California, Riverside

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ABSTRACT OF THE DISSERTATION

Late Emerging Reading Difficulties in English Language Learners

by

Nicole Marie Garcia

Doctor of Philosophy, Graduate Program in Education
University of California, Riverside, March 2015
Dr. H. Lee Swanson, Chairperson

Research has identified a group of students who do not begin to exhibit reading difficulties until fourth or fifth grade, suggesting late-emerging reading difficulties. Considering that these students do not show signs of reading difficulties in early grades, attempting to identify these students early becomes problematic. Additionally, little is known regarding the characteristics of late-emerging reading deficits within English language learner (ELL) populations. The purpose of this study was to examine the reading profiles of elementary-aged students identified as ELL who exhibit late-emerging reading difficulties. Data from three cohorts of Spanish-speaking ELL students (N=446) who were assessed on word level and comprehension reading skills in first through fifth grades were analyzed. The identification of late-emerging reading difficulties and the examination of reading profiles were examined using latent transition analysis in order to examine changes in profiles over time. Results suggested that ELL students exhibiting late-emerging reading difficulties displayed heterogeneous skill deficits (word level and comprehension deficits), displayed deficit patterns in word reading skills when measured with real words and adequate skill performance when measured with nonsense words,

and had a higher probability of developing reading difficulties during the transition between second to third grade. Additional findings related to previous research in the area of late emerging reading difficulties with non-ELL students is discussed as well as implications for future research.

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Late Emerging Reading Difficulties in English Language Learners

Reading is a fundamental skill necessary for advancement and prosperity within our current society. In fact, reading achievement as early as third grade has been shown to be a powerful predictor of future success (Fletcher & Lyon, 1998; Hernandez, 2011; Lloyd, 1978). Recent findings from the National Longitudinal Survey of Youth (1979) have revealed that students scoring below basic in reading at third grade accounted for 63% of all children who did not graduate from high school, while students scoring at basic level accounted for 25%, and students scoring at proficient level accounted for 12% of students not graduating (Hernandez, 2011). Further analysis revealed that children not proficient in reading by third grade who reside in low-income households and those of Hispanic or African American backgrounds are more likely to not graduate from high school in comparison to their peers who have never lived in poverty or who are White with similar reading skills. These findings are troubling given the most recent results of the National Assessment of Educational Progress ([NAEP], 2013) which report that 65% of fourth graders are below proficient in reading. Unfortunately the percentage of students scoring below proficient continues to increase at an alarming rate for fourth grade students who are minorities, reside in low income households, and who are English language learners (ELL). Compared to 54% of White students, 82% of Black and 80% of Hispanic fourth grade students scored below proficient in reading. Of fourth grade students scoring below basic in reading, 21% were White compared to 50% who were Black and 47% who were Hispanic. With regards to family income level, higher percentages of students scoring below proficient in reading exist for students eligible to

receive reduced or free lunch (i.e., 70%, 81% respectively) compared to students not eligible (49%). In addition, 93% of fourth grade ELL students compared to 62% of non-ELL students scored below proficient in reading (NAEP, 2011). Taken together these numbers not only highlight the need to improve reading achievement for all children, but they also shed light on the disproportionate trend that exists in academic success among Hispanic, African American, and ELL students when compared to their White and Asian peers.

The academic achievement gap between ethnic minority students and their White peers has been well documented, specifically within the Hispanic population (Kena et al., 2014). On average, Hispanic students have continued to score 20 points lower (i.e., over half a standard deviation) than their White peers on national assessments of reading and math for more than a decade (Kena et al., 2014). Adding to this problem is the finding that between the years of 1972-2008, Hispanics maintained the highest percentages of dropouts compared to all other races (Chapman, Laird, & Kewal, Ramani, 2010). Considering that Hispanic students are one of the fastest growing groups in the country, doubling from 11 to 22 percent between 1989 and 2009 in U.S. schools (Aud, et al., 2011; Ennis, Rios-Vargas, & Albert, 2011;), these disparities in academic success between Hispanic and non-Hispanic students is troublesome. More recent data indicate that Hispanic student enrollment continues to increase with 24 percent of Hispanic students enrolled in public school in 2011, and projections that estimate by the year 2023 Hispanic student enrollment will increase to 30 percent (Kena et al., 2014). Adding to this problem is the gap in academic achievement that exist for English language learners

(ELLs) who continue to perform below students that are proficient in English on national reading assessments (NAEP, 2014). Current data indicate that in 2013 the achievement gap between non-ELL and ELL students in reading was 38 points at the 4th grade level and 45 points at the 8th grade level, which were not measurably different from the achievement gap that existed in 1998 (Kena, et al., 2014).

Given the important role that early reading skills play on future academic success, it would appear that without adequate remediation a large percentage of Hispanic and ELL students, especially those who come from low income households, are headed in the direction of academic failure. Unfortunately, in addition to academic problems, students with reading deficits are also at a higher risk of experiencing more emotional and behavioral problems compared to typically developing readers (Arnold et al., 2005). Thus the importance of providing students with the necessary skills they need to become adequate readers cannot be overlooked. Equally important is the need to accurately and efficiently identify early reading problems in order to intervene and provide struggling students with remedial support.

Research has established an unfortunate trend in which students who start out early as poor readers continue to be poor readers, if not poorer, as they progress through school (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Juel, 1988; Stanovich, 1986; Torgesen & Burgess, 1998). Given the bleak trajectories for struggling readers, early identification and intervention practices are critical to the future success of these students. Poor readers who are identified early (e.g., before third grade) may have a better chance of receiving intervention support that can prevent further reading problems

when compared to poor readers who are not identified until the later grades (e.g., after third grade) (Lyon, et al., 2001; Jenkins, & O'Conner, 2002; Snow, Burns, & Griffin, 1998; Torgesen, 2000).

However, research has identified a group of students who do not show signs of reading deficits in early grades, rather their reading deficits do not begin to emerge until fourth or fifth grade, thus the term late-emerging reading difficulties (Badian, 1999; Catts, Compton, Tomblin, & Bridges, 2012; Chall & Jacobs, 2003; Compton, Fuchs, Fuchs, Elleman, & Gilbert, 2008; Galletly, Knight, Dekkers, & Galletly, 2009; Kieffer, 2010; Leach, Scarborough, & Rescorla, 2003; Lipka, Lesaux, & Siegel, 2006; Shaywitz, Escobar, Shaywitz, Fletcher & Makuch, 1992). Students who exhibit late-emerging reading difficulties create a dilemma within schools given that they are not being identified in the early grades and therefore not being provided with early intervention services, potentially putting these students behind at a critical time when they are preparing to transition into middle school (Compton, Fuchs, Fuchs, Elleman, & Gilbert, 2008). To further highlight the problem, current prevalence estimates for late-emerging reading difficulties have ranged from 36% to 47% of students experiencing reading deficits in the later primary grades (Badian, 1999; Catts et al., 2012; Leach et al., 2003; Lipka et al., 2006; Shaywitz et al., 1992). These numbers reveal a significant amount of students who are being deprived of early intervention services due to the lack of knowledge surrounding assessment and identification issues for students with late-emerging reading difficulties.

Reading Development

Within an instructional framework, research has identified critical skill areas that are important to the development of reading. Extensive reviews of reading literature have found support for five main skill areas including phonemic awareness, phonics, fluency, vocabulary, and comprehension across non-ELL and ELL students (August & Shanahan, 2006; National Reading Panel [NRP], 2000; Snow, Burns, & Griffin, 1998). Quality instruction geared towards acquiring competency in these five skill areas has been shown to improve reading success among young readers (NRP, 2000). Additionally, this research has been supported by previous models of reading development which emphasize the importance of decoding and listening comprehension in reading (Gough & Tunmer, 1986).

Currently, the simple view of reading (SVR) introduced by Gough and Tunmer (1986) remains the most commonly referenced model of reading development. The SVR assumes that there are two components, decoding and listening comprehension, that are necessary to be a successful reader. This model has been repeatedly supported in the literature with native English Speaking students (e.g., Aaron, Joshi, & Williams, 1999; Catts, Adolf, Hogan, & Weismer, 2005; Catts, Adolf, & Weismer, 2006; Juel, 1988; Joshi & Aaron, 2000; Vellutino, Tnmer, Jaccard, & Chen, 2007) and bilingual students (e.g., Gottardo & Mueller, 2009; Hoover & Gough, 1990; Proctor, Carlo, August, & Snow, 2005). However, the SVR has also been critiqued in the literature for being too "simple". For instance, some researchers have proposed more complex models of the SVR that include components such as expressive vocabulary and reading fluency that influence

reading comprehension beyond that of decoding and listening comprehension (Tilstra, McMaster, Van den Broek, Kendeou, & Rapp, 2009). Other research has proposed that the addition of reading fluency to the SVR model may only be appropriate as students progress through later elementary grades (Adolf, Catts, & Little, 2006; Silverman, Speece, Harring, & Ritchey, 2013). Yet another study did not find support for adding an independent vocabulary component to the SVR (Tunmer & Chapman, 2012). However, mixed findings from these studies could be attributed to the way in which constructs were defined and assessed. For instance, Tilstra et al. (2009) utilized an oral expressive definition of vocabulary, while Tunmer & Chapman (2012) used a receptive measure of vocabulary. Specifically focusing on an ELL population, Zadeh, Farnia and Geva (2010) suggested an expanded SVR model which included reading fluency as an outcome and direct and indirect relationships between cognitive processes and oral language on outcomes, within a developmental framework, as a more appropriate model. Although there continues to be debate regarding the simplicity of the SVR, most researchers agree that for both non-ELL and ELL students, decoding and listening comprehension play an important role in the development of reading comprehension. However, the nature of the relationships between decoding, listening comprehension and reading comprehension, in addition to other indicators that may influence these relationships remains a discussion point among researchers, especially with regards to ELL students. These findings highlight the importance of understanding the process of reading development in order to identify areas students might be struggling in, as well as attempt to explain why some students do not show reading deficits until the later primary grades.

Background on Late-emerging Reading Difficulties

In terms of context, the presence of late-emerging reading difficulties began to appear in the literature in the 1980's with the work of Chall, who examined the stages of reading development and noticed the "fourth grade slump"; a phenomena in which a group of students who had been making adequate progress in early reading started to fall behind in the later elementary grades (Chall & Jacobs, 2003). There has been limited research on this particular group since its emergence in the literature and although there is much we still do not know about this problem, research thus far has been able to answer some important questions surrounding this group of students.

First, given that during the later primary grades (i.e., fourth and fifth grade) reading instruction begins to shift from word recognition and spelling skills to an emphasis in reading comprehension skills and strategies, the late-emergence of reading difficulties has been attributed to poor comprehension skills (Leach et al., 2003). However, an examination of the cognitive and academic profiles for fourth and fifth grade students with late-emerging reading difficulties suggested that the reading deficits exhibited by this population were heterogeneous (Leach et al. (2003). Their findings indicated that 35% of students from this group struggled with word level processing alone, 32% struggled with comprehension alone, and 32% struggled with both word level processing and comprehension. Other researchers examining the profiles of this particular group have reported similar findings with regards to the heterogeneity of reading deficits (Catts et al., 2012; Compton et al., 2008; Lipka et al., 2006).

Second, research in this area has addressed the possibility that the explanation for late-emerging reading difficulties may be simply due to late identification. By conducting retrospective analysis, Leach et al. (2003) and Lipka et al. (2006) were able to conclude that students with late-emerging reading difficulties did not show signs of deficits until fourth or fifth grade, therefore refuting the notion that these problems were just missed by schools. Additionally, longitudinal designs examining this population have come to similar conclusions (Catts et al., 2012; Compton, et al., 2008) that reading difficulties in this group are late-emerging rather than late-identified. This clarification is important, because it provides the basis of support to further examine the developmental nature of this population as well as the issues surrounding assessment. If these students are not displaying deficits in the early grades, then early screening assessment measures are not going to identify them. The question then becomes what are the characteristics of later emerging reading deficits.

To answer this question researchers have begun to examine possible early indicators for students with late-emerging reading difficulties. Using a longitudinal design, Compton et al. (2008) assessed students on various cognitive and academic variables at the end of first, second, and fourth grade. One goal of this study was to identify predicting variables that could be assessed in first grade and be able to accurately identify students who would exhibit late-emerging reading deficits in later grades. Findings indicated that students with late-emerging reading deficits had poorer listening comprehension at the start of first grade and smaller word reading fluency slopes throughout first grade when compared with typically developing students. However,

these two indicators were not sensitive enough to accurately identify this particular group of students given high rates of false positives. Based on their results they recommended that future research explore indicators that measure the underlying processes of later reading comprehension, which may be able to better discriminate between typically developing readers and those that may transition into a reading deficit group. Unfortunately, the research in this area is still nascent, however findings from research on reading difficulties, yet not directly related to late-emergent reading difficulties, may offer some insight. For example, in a recent longitudinal study, Fuchs et al. (2012) obtained a sample of poor readers in first grade and sought to identify cognitive and academic indicators that would be able to predict reading disability status in fifth grade. Word identification fluency and rapid letter naming measures were used to screen students in first grade in order to identify low performers, these students were then given a battery of cognitive and academic measures once a year starting in first grade and ending in fifth grade. Results from this study indicated that a cognitive battery consisting of measures assessing phonological processing, rapid automatized naming, oral language comprehension, and nonverbal reasoning given in first grade to students identified as low-performing could adequately predict reading disability status in fifth grade. Although this study did not examine late-emerging reading difficulties, and defined reading disabilities by comprehension deficits only, the findings identified latent variables of phonological processing, rapid automatized naming, oral language comprehension, nonverbal reasoning, and word identification fluency intercepts as

potential indicators of later reading comprehensions, which may be helpful in attempting to predict some variations of late-emerging reading problems in ELL children.

Background on Late-Emerging Reading difficulties in English Language Learners (ELL)

The limited amount of research in the area of late-emerging reading difficulties has predominately been conducted with non-ELL students. Given the growing population of ELL students in public schools, it is imperative that research examine the patterns of late-emerging reading difficulties for ELL populations. To the author's knowledge, only one study has examined late-emerging reading difficulties in an ELL population using longitudinal data (Kieffer, 2010). This study found that ELL students were at a higher risk of exhibiting early identified reading difficulties (i.e., before third grade) as well as late-emerging reading difficulties (i.e., in fourth or fifth grade, or in grades sixth through eighth) when compared to non-ELL students. Interestingly, when socio-economic status (SES) was controlled there were no statistically significant differences in risk between ELL and non-ELL students developing a reading difficulty in the later grades (i.e., in fourth or fifth grade, or in grades sixth through eighth). Together, these findings suggest that although ELL students are at a higher risk for developing reading difficulties (i.e., early or late emerging), SES may be accounting for the majority of variance in risk specifically for ELL students with late-emerging reading difficulties. Given these results, additional research is needed to further explore the role of SES as well as identify other potential indicators of late-emerging reading difficulties with an ELL population. Additionally, given the limited research, it is unclear if the profiles of

ELL students who develop late emerging reading difficulties (i.e., early or late emerging), differ from patterns found in non-ELL samples (Kieffer, 2010).

Reading Patterns of ELL Students

By exploring the literature on reading patterns for ELL students, researchers may gain insight into the most effective ways to design future research and interventions in the area of late-emerging reading difficulties in ELL students. In a study designed to better understand the nature of reading comprehension difficulties among sixth grade ELL students, Lesaux and Kieffer (2010) found three distinct common skill profiles (i.e., slow word callers, automatic word callers, and globally impaired readers). Although there were differences between the three profiles, all three shared low vocabulary and semantic working memory skills. Additionally, the slow and automatic word caller profiles demonstrated accurate and fluent decoding skills, however they still struggled with reading comprehension difficulties, whereas the globally impaired group demonstrated deficits in both areas. These findings suggest that ELL students would display heterogeneous skill deficits similar to the findings associated with non-ELL students (Catts et al., 2012; Compton et al., 2008; Leach et al., 2003; Lipka et al., 2006). Furthermore, these findings highlight low vocabulary and semantic working memory skills as deficits that ELL students with reading problems in sixth grade appear to demonstrate. Future research should explore these variables at different grades with this population to possibly examine their significance in predicting later reading difficulties.

Another relevant study conducted by Nakamoto, Lindsey, and Manis (2007), examined word decoding and reading comprehension skills among ELL and non-ELL

students from first through sixth grade. Results revealed that ELL and non-ELL students maintained a similar trajectory for word decoding skills from first through sixth grade, however the reading comprehension skills for ELL students began to fall behind the non-ELL students by third grade. These findings are interesting when compared with those of Lesaux and Kieffer (2010) who found a group of ELL sixth grade students (21% of their sample) who displayed both word decoding and reading comprehension problems. To further complicate the issue, Lesaux, Rupp, and Siegel (2007) examined the reading development of ELL and non-ELL students from kindergarten through fourth grade and found no significant differences between the groups on reading skills at fourth grade. This study also demonstrated that early indicators (i.e., word reading, spelling, phonological processing, syntactic awareness, and working memory skills) used to predict fourth grade word reading and reading comprehension predicted reading performance in both groups. Considering the contradictory evidence in the literature regarding the reading patterns of ELL students compared to non-ELL students more research is needed to clarify and substantiate current findings.

In addition to examining reading patterns, researchers have explored possible early predictors of later reading skills in ELL students. For instance the findings from Nakamoto et al. (2007) revealed that early measures of phonological awareness, rapid automatic naming, and oral language were significant predictors for reading growth rates (decoding and comprehension) from first through sixth grade. These findings provide support to hypothesize that the current measures may in fact be useful to explore the predictability of reading disability status with an ELL population, given the similar

findings from Fuchs et al. (2012) who found that phonological processing, rapid automatized naming, oral language comprehension, and nonverbal reasoning adequately predicted reading disability status in fifth grade for non-ELL students. Another study conducted by Kieffer (2012) found that measures of English oral language proficiency and English productive vocabulary in kindergarten significantly predicted levels of English reading from third through eighth grade in an ELL population. These findings bring attention to the issue of language proficiency within this population, which has been seen as a critical component to the research area of learning difficulties in ELL students by other researchers (August, Carlo, Dressler, & Snow, 2005; Klingner, Artiles, & Barletta, 2006; Lesaux, 2006; Shifrer, Muller, & Callahan, 2011).

Rationale for Proposed Study

Considering the narrow literature base surrounding late-emerging reading difficulties in both non-ELL and ELL populations, research is needed to identify these students early and move towards creating appropriate interventions that will prevent the path towards academic failure. This study will attempt to identify the reading profiles of ELL students who exhibit late-emerging reading difficulties in order to examine the heterogeneity or homogeneous nature of difficulties within this population.

Purpose of Present Study

The purpose of this study is to examine latent reading profiles of ELL students in order to identify deficit profiles for late-emerging reading difficulties in ELL students. Findings from this research will contribute to the future development of identification and

intervention methods for students with late-emerging reading difficulties. The following research questions will be examined:

- **Research Question 1:** Do latent classes emerge for ELL students across testing waves?
- **Research Question 2:** What are the percentages of students who change latent classes across testing waves?
    - **Research Question 2a:** How does oral language influence changes in latent classes across testing waves?
- **Research Question 3:** What proportion of students can be identified as late-emerging with regards to reading difficulties?
    - **Research Question 3a:** What are the reading profiles of students identified as late-emerging?

Given previous literature, it was hypothesized that two to four latent classes would emerge across testing waves which would distinguish poor readers from good readers, and possibly identify specific skill deficit subgroups (i.e., deficits in word reading, deficits in comprehension, deficits in both word reading and comprehension) (Catts, et al., 2012; Compton et al., 2008; Leach, et al., 2003). Low percentages of movement across classes were expected given previous research that indicated stability of latent reading classes over time (Catts, et al., 2012; Compton et al., 2008). To examine how the relationship between oral language and reading skills change over time, a measure of oral language will be added as a covariate in the model. Considering the relationship that has been established in the literature between oral language and

academic success for ELL students, it was hypothesized that students with higher oral language skills would be associated with better reading skills and less movement across classes over the testing waves (August, Carlo, Dressler, & Snow, 2005; August & Shanahan, 2006; Kieffer, 2012; Klinger, Artiles, & Barletta, 2006; Lesaux, 2006; Shifrer, Muller, & Callahan, 2011). The addition of the covariate in the model will also be used to test the latent classes that emerge by examining if the relationships observed are as expected and meaningful (Nylund, 2007). The proportion of students identified as late-emerging was expected to be relatively small (3%-19%) given previous prevalence estimates cited in the literature identifying this subgroup of readers (Badian, 1999; Catts, et al., 2012; Compton et al., 2008; Kieffer, 2010, Leach, et al., 2003; Lipka et al., 2006; Shaywitz et al., 1992). Lastly, it was expected that reading profiles of students identified as late-emerging would be heterogeneous considering previous research that has found these students to have difficulties with single skills (word reading or comprehension) as well as a combination of skill deficits (word reading and comprehension) (Catts, et al., 2012; Compton et al., 2008; Leach, et al., 2003).

Methods

Participants

Data from 500 ELL students from three large school districts in the southwest U.S. who participated in a three year cohort-sequential longitudinal study were analyzed. Data collection began in the fall of 2009 and was completed in the spring of 2012. During the first year of the study students were in grades 1, 2, and 3. These students were followed for two additional years. At the third year of the study students were in

grades 3, 4, and 5. A visual representation of the study structure is presented in Table 1.

The sample included 234 males (46.8%) and 266 females (53.2%). The majority of students were Hispanic (99.6%), and parent reports indicated student's primary language spoken at home was Spanish (82%). Ten percent of the sample spoke both English and Spanish at home, whereas the remainder of students primarily spoke English (8%). Additionally, ninety-eight (98.2%) percent of the sample participated in a federally funded free or reduced lunch program. The percentage of Spanish speaking ELL students is comparable to current statistics for the state of California, which suggest the majority (89%) of socioeconomically disadvantaged (i.e., eligible for free or reduced lunch program or neither of student's parents received a high school diploma) ELL students speak Spanish (CDE, 2014).

Participating school districts used the California English Language Development Test (CELDT) to determine ELL status of students. During the first year of the study (students in grades 1-3) 11.4% of students were designated as having "Beginning" English proficiency, 27.2% were designated as "Early Intermediate", 37.3% were designated as "Intermediate", 20.2% were designated as "Early Advanced", and 4% were designated as "Advanced". Current CELDT statistics for the state of California suggest that on average 9.3% students in grades 1-3 are designated as "Beginning", 19.3% as "Early Intermediate", 41.6% as "Intermediate", 24.6% as "Early Advanced", and 5.3% as "Advanced" (CDE, 2014). Compared to the state of California, the current sample has a slightly higher percentage (2.1%) of students designated as "Beginning", a higher percentage (7.9%) of students designated as "Early Intermediate", a lower percentage

(4.3%) designated as “Intermediate”, a lower percentage (4.4%) designated as “Early Advanced”, and a slightly lower percentage (1.3%) designated as “Advanced”.

Available scores from the English Language Arts (ELA) section of the California Standards Test (CST) for students at Year 1 (grades 2-3) indicated 37.2% of students scored “below basic”, 33.3% scored at “basic”, and 29.5% scored at or above “proficient”. Available CST ELA scores for students at Year 2 (grades 2-4) indicated 29.8% “below basic”, 28.2% at “basic”, and 42% at or above “proficient”. CST ELA scores for Year 3 were not available to study investigators. Current CST ELA statistics for the state of California suggest that among ELL students between grades 2-4, 33.6% scored “below basic”, 36.6% scored at basic, and 29.6% scored at or above “proficient” (CDE, 2014). Compared to the state of California, the current sample at Year 1 was comparable to current state scores, however at Year 2 the current sample scored higher than current state CST ELA scores for ELL students.

Over the length of the study, 82 (16.4%) students were lost due to attrition (i.e., moving out of district) from Year 1 to Year 3. Additionally, given that the focus of this study was on student’s reading development and not intellectual delays, all students were administered the *Raven Colored Progressive Matrices Test* (e.g., Raven, 1976) to eliminate the possibility that later emerging difficulties were related to low aptitude. Only students with fluid intelligence scores at or above the 16th percentile were included in the data analysis to minimize the potential that discrete differences are associated with general aptitude rather than reading skills. This resulted in a sample size decrease of 10.8% (54 students), bringing the sample size used for analysis to 446 students.

Descriptive statistics for the total study sample and the sample used for analysis are provided in Table 2, which suggests comparable populations.

Classroom Instruction. The majority of students (86.5%) in the proposed sample received classroom reading instruction in English, while 13.5% received a combination of Spanish/English (80/10 ratio) reading instruction. Students receiving a combination of Spanish/English instruction started with an 80/10 ratio in second grade, then moved to a 70/20 ratio in third grade, and finally a 60/30 ratio in fourth grade, gradually increasing the percentage of English through the years until students reached a 50/50 ratio in fifth grade. Participating schools reported utilizing the Houghton Mifflin Harcourt curriculum for reading instruction.

Classroom observation data was collected during each year of the study using the *Foorman's Instructional Format and Content Codes Survey* to measure 20 instructional activities utilized during reading instruction (Foorman, Schatschneider, Eakin, Fletcher, Moats, & Francis, 2006). Classrooms containing the highest number of students participating in the study were chosen for observations, and observers were randomly assigned to schools and classrooms. Additionally, inter-rater agreements on observation surveys exceeded 85%. Instructional activities included instruction related to oral language, grammar/capitalization/punctuation, vocabulary, phonemic awareness, book and print awareness, alphabet letter recognition and reproduction, alphabetic instruction, text word work, structural analysis, previewing to prepare for reading, reading text, reading comprehension, writing composition, students reading their own writing, spelling instruction, spelling in the context of reading, giving directions/passing out reading

materials, non-reading instructions, teacher feedback, and uncodable activities. Observations were conducted during a 30-minute block of reading related instruction, which was divided into ten three-minute interval time samplings, and occurred three times a year (fall, winter, and spring). During each three-minute interval observers indicated whether any of the 20 instructional activities were observed (0= not present, 1= present). At the completion of the 30minute observation (10 intervals), the number of times a classroom activity was observed during the each of the 10 three-minute intervals was totaled. The 20 instructional activities observed can be combined to represent 7 overall components (Foorman et al. 2006). These components can be described as "grammar/spelling" (time spent on grammar, mechanics, explicit spelling instruction), "writing" (time spent on writing, word work), "phonemic awareness/alphabetics" (time spent on phonemic awareness and alphabetic instruction), "comprehension" (time spent on previewing books, reading comprehension, contextualized spelling), "oral language" (time spent on letter recognition, oral language), "directions" (time spent on directions and preparations, feedback, book reading), and "vocabulary" (time spent on structural analysis, vocabulary). Classroom mean scores (average of number of times instructional activities related to each composite were observed) across all intervals on each component are presented in Table 3 by cohort and grade for the current study. Even within grade levels, there is considerable variation between classrooms observed on most all components given the large standard deviations noted. Across all grades more time appears to be spent on directions, preparations, book reading, and feedback as well as comprehension related activities. Vocabulary related activities appear to become more

prominent in grades 3-5, while activities related to phonemic awareness and the alphabetic principle appear to be more prominent in grades 1 and 2. Overall data suggests that classroom reading instruction for the students in this study incorporated instructional practices that have been established in the literature as important to the reading development of ELL students, such as phonemic awareness, phonics, fluency, comprehension, vocabulary, and oral language instruction (August & Shanahan, 2006; National Reading Panel, 2000).

Measures

This study is part of a larger study that included group and individual administrations of a battery of cognitive, reading, and language assessments. This study only focused on reading and vocabulary measures given that the purpose of this study was to examine difficulties in reading skills and the influence of oral language on those difficulties within an ELL population. The series of tests were counterbalanced into one of six presentation orders. All participants were administered both English and Spanish versions of each test, however no Spanish and English versions of the same test (except for the Spanish/English expressive vocabulary test) were presented simultaneously (one after the other). Instructions were given in Spanish for all tasks requiring Spanish responses unless noted otherwise. Inter-rater agreements exceeded 85%. Given that the research questions for the current study focus on English reading, only English measures will be utilized in the current data analysis. Table 4 provides means and standard deviations for the measures used in the current data analysis and descriptions are provided below.

Vocabulary measure.

Expressive One-Word Picture Vocabulary Test- Spanish-Bilingual Edition. The Expressive One-Word Picture Vocabulary Test Spanish-Bilingual Edition (Brownell, 2001) assesses English and Spanish expressive vocabulary. Students were presented with pictures of objects, actions, or concepts and were asked to orally name each picture. Items were administered in both languages, with the first language chosen for administration determining the order, until the child achieved ceiling. If the child achieved a ceiling in English before Spanish, Spanish alone was continued and vice versa. The technical manual reported the correlation of item difficulty to item order for the standardization sample at .95. Cronbach alpha internal reliability estimates for the combined current sample at the first wave of data collection ranged from .95 for English and .97 for Spanish.

The English subtest was selected as a measure of oral language in the current study to analyze its effect as a covariate on latent classes and transitions of classes across time.

Reading measures.

Woodcock-Muñoz Language Survey- Revised (WMLS-R). This test established a norm referenced reading level in English and Spanish (Woodcock, Muñoz-Sandovol, Ruef, & Alvarado, 2005). The WMLS-R Spanish and English Letter Word Identification and Passage Comprehension subtests were administered. The Letter Word Identification subtest measures letter and word identification skills and has a reported median internal reliability across ages of .97 (WMLS-R; Woodcock et al., 2005). This subtest required

participants to identify and or orally name letters of the alphabet as well as fluently read stimulus words, with items gradually increasing in difficulty. The Passage Comprehension subtest measures how well a student understands written discourse as it is being read and has a reported median internal reliability across ages of .84 (WMLS-R; Woodcock et al., 2005). Participants are asked to silently read a short passage which contains a missing word. The participant must then orally provide the missing word, ensuring that it makes sense within the context of the passage. Beginning items are based on symbolic learning and increase in difficulty. The Letter Word Identification and Passage Comprehension subtests create the *reading cluster* which measures reading achievement. The manual reports median internal reliability estimates for the reading cluster between ages 5 to 19 at .95 (WMLS-R; Woodcock et al., 2005). Cronbach alpha internal reliability estimates for the combined current sample at the first wave of data collection ranged from .90 (English) to .88 (Spanish) for the Passage Comprehension subtest, and .96 (English) to .97 (Spanish) for the Letter Word identification subtest.

Woodcock Reading Mastery Test . The Word Attack subtest of the Woodcock Reading Mastery Test (Woodcock, 1998) was administered in English according to the standardized instructions. The Woodcock technical manual reports internal reliability of the subtest at .88. The measure required the child to orally read a list of pseudowords arranged in increasingly difficult order. A Spanish version of the task was also administered using the same rules. The Spanish version was developed using specific letter rules for each English item to ensure effective translation; for example "ift" was translated to "iyo". Previous research reported Kuder Richardson (KR-20) internal

reliability estimates ranging from .79-.84 for English and .94-.97 for Spanish (Swanson, Saez, & Gerber, 2006). Additionally, Cronbach alpha internal reliability estimates for the combined current sample at the first wave of data collection ranged from .96 for English and .97 for Spanish.

The English versions of the three reading measures described above were selected as indicators of the latent classes in the current study.

Procedures

All participants were tested individually, and in small groups (10 to 15 students) after informed consent was obtained for participation. For each testing wave, two sessions of individual testing lasted thirty minutes to one hour for each session, and group testing occurred over the course of two consecutive days for approximately one hour each day. In addition, the presentation orders of Spanish and English tests were randomized, and test order was counterbalanced across all participants.

Cut-off score for defining reading Risk. Students were first separated into two groups, those at risk for reading difficulties (RD) and those not at risk for RD (NonRD) using an absolute cutoff score on each of the three standardized reading measures English. Currently there is no standard agreed upon method of defining risk status for reading difficulties for ELL students, however the 25th percentile on a standardized norm-referenced reading measure is a common method used to identify students at risk for RD in the literature (Fletcher et al., 1989; Siegel & Ryan, 1989; Stanovich & Siegel, 1994; Lipka et al., 2006; Kieffer, 2010). Because the literature has suggested subgroups reside within students with RD who are ELL (e.g., Lesaux, Lipka, & Siegel, 2006), students

were subgrouped using passage comprehension, word identification, and word attack subtest scores above and below the 25th percentile creating three new dichotomous variables that were used for analysis. The criteria for identifying students at risk for RD were scoring at or below the 25th percentile on standardized norm reference reading measures, while students scoring above the 25th percentile were identified as NonRD. Table 4 provides percentages of students identified as RD for the measures used in data analysis across cohorts and grades.

Data Analysis

Latent Class Analysis (LCA) was utilized to identify latent classes that reflect patterns of reading difficulties among ELL students using the PROC LCA procedure in SAS version 9.3 (Lanza, Dziak, Huang, Xu & Collins, 2011). LCA models categorize subjects into classes using observed items by estimating two types of parameters including item response probabilities referred to as p's (rho's) and latent class prevalence's referred to as γ's (gamma's). Item response parameters provide information on the probabilities of subjects in a specific class endorsing various items on the indicator variables included in the model, which are then used to interpret and label the latent classes. Latent class prevalence parameters provide information regarding the probabilities of latent class membership in each class. The LCA model includes r observed items, u, and a categorical latent variable c, with K classes (See Figure 1). Model fit within LCA is determined by analyzing parsimony and various fit statistics such as the likelihood-ratio statistic G^2, Bayesian Information Criteria (BIC), adjusted BIC, Akaike Information Criterion (AIC), and Entropy. In general, simpler models

(estimating fewer parameters) are preferred over more complex models and smaller BIC and AIC values suggest better model fit (Collins & Lanza, 2010). Results from a simulation study conducted by Nylund, Asparouhv, and Muthén (2007) suggested that the BIC outperformed other information criteria such as AIC, CAIC, and adjusted BIC on correctly identifying the number of latent classes across various modeling settings, however for categorical LCA models the adjusted BIC was the most consistent across various models and sample sizes. Entropy values range from 0 to 1, with higher values suggesting better membership classification (Celeux & Soromenho, 1996). Additionally, the likelihood-ratio statistic G^2 is used to compare two or more nested models by means of the likelihood-ratio difference test.

In the current analysis multiple group LCA models were conducted at all three time points (testing waves) to ensure measurement invariance of classes across all time points. Each model contained 3 groups which represented each cohort in the study. Cohort 1 included students who were in 1st grade in Year 1, 2nd grade in Year 2, and 3rd grade in Year 3. Cohort 2 included students who were in 2nd grade in Year 1, 3rd grade in Year 2, and 4th grade in Year 3. Cohort 3 included students who were in 3rd grade in Year 1, 4th grade in year 2, and 5th grade in Year 3.

Once the number of latent classes was established, Latent Transition Analysis (LTA) was utilized to analyze classification stability over time using the PROC LTA procedure in SAS version 9.3 (Lanza, Dziak, Huang, Xu & Collins, 2011). LTA denotes subgroups in which individual membership can change over time. Although an extension of Latent Class Analysis (LCA), the LTA procedure differs from LCA by assessing

individual change in membership overtime with the addition of multiple time points (See Figure 2). Included in the model are j observed items,u, repeatedly measured at multiple time points, t, which are indicators of the categorical latent class variables c, with K classes at each time point. Within LTA, latent classes may be temporary states in which individuals may move in and out of, thus latent classes are referred to as latent statuses within LTA modeling (Collins & Lanza, 2010). The LTA model estimates the following sets of parameters: probabilities of transitions between latent status over time referred to as τ's (tau's), and item response probabilities conditional on latent status membership and time referred to as ρ's (rho's).

Lastly, a covariate was added to the LTA model to examine how transition probabilities differ as a function of the covariate (i.e., oral language). This was because LC groups in reading may be merely a function of oral language and therefore it was necessary to determine if the LC group transitions were maintained when oral language was partialed from the analysis. LTA models with covariates do not estimate latent status prevalence's or transition probabilities, rather only item response probabilities ρ's (rho's) and regression coefficients are estimated (B_0's and B_1's). All models were specified using the Full Information Maximum Likelihood (FIML) estimation which allows for missing data on observed indicators by utilizing the Expectation Maximization (EM) algorithm, with the exception of covariates. Figure 3 displays the LTA model utilized within the current study.

Results

Latent Class Analysis

Multiple LCA models with varying number of classes were generated at each time point (testing wave) in order to determine a meaningful model that provided the best fit to the data. Each model consisted of three indicator variables with two response categories each, and three groups that represented each cohort. Measurement parameters were constrained to be equal across groups for all models to allow for easy comparisons when selecting model fit.

Table 5 describes the model fit results for year 1, year 2, and year 3 multiple group LCA models. The 2- class model was consistently the best fitting across years 2 and 3 given the lower AIC, BIC, adjusted BIC, and higher entropy values specified. The fit criteria for the year 1 models supported both the 2- class and 3-class models, however the entropy value was higher (.82) for the 2- class model suggesting it provided better membership classification. Overall, the 2-class model was superior across all time points given that is was the most parsimonious and provided a more meaningful interpretation of the data. Additionally, 100% of the seeds (random starting values) fit the same model for the 2- class models across all time points, suggesting well-identified solutions (Lanza & Collins, 2010).

Measurement invariance. In order to identify if the item-response probabilities were invariant across cohorts, two models were compared using the likelihood-ratio test (a x^2 difference test), where one model allowed parameters to vary across cohorts and the other constrained parameters to be equal across cohorts. The likelihood-ratio test $G^2_\Delta = G^2_2$

- G_1^2 is distributed as a x^2 with $df = df_2 - df_1$. The results from the likelihood ratio tests across each time point are provided in Table 6. Results for year 2 and year 3 time point models indicated non significant differences in G_Δ^2 statistics, suggesting that measurement invariance across cohorts held for year 2 and year 3 models. However, results from year 1 models indicated a significant difference in the G_Δ^2 statistic suggesting that at least one p parameter was different across cohorts. Additionally, the AIC value was lower for the model that allows parameters to vary across groups in year 1 (Model 1), while the BIC and adjusted BIC values were lower for the model with constrained parameters. Given that equality (invariance) across groups for year 1 was not established, this time point was removed from subsequent analysis.

Interpreting Classes. Item probabilities for the 2- class LCA models were examined at each time point to interpret the meaning of each class. The values are the probability of a subject being at risk for RD (scores below the 25th percentile) or NonRD (scores above the 25th percentile) on each indicator within a given class. Figure 4 displays the item probability plots for the 2- class model at each time point. The *y*-axis represents the probability of being at risk for RD or NonRD. Item response probabilities were similar across time points, with individuals in class 1 having a higher probability of being NonRD and individuals in class 2 having a higher probability of being at risk for RD on all three indicators of reading. Thus, class 1 can be described as "good readers" and class 2 can be described as "struggling readers". Students in the "good readers" class were more likely to score above the 25th percentile on Passage Comprehension, Letter Word ID, and Word Attack measures. Students in the "struggling readers" class were more

likely to score below the 25th percentile on Passage Comprehension, Letter Word ID, and Word Attack measures suggesting that these students were at risk in both word level and comprehension reading skills. Class membership probabilities provide estimates of the proportion of the sample that represent each class. Table 7 provides class membership probabilities for each group (i.e., cohort) at each time point. The "good readers" class represented the majority of the sample (71%-84%) across each time point and cohort, while struggling readers represented 18% to 32% of the sample.

Addition of a covariate to the 2-class LCA model

The English Expressive Vocabulary variable was entered into the model as a covariate. Hypothesis testing for the significance of the covariate were conducted by means of a likelihood ratio x^2 test. The baseline model without the covariate X, estimating p_1 parameters is compared with the model that includes the covariate estimating p_2 parameters using the log-likelihoods associated with each model (ℓ). The value generated from -2($\ell_1 - \ell_2$) is distributed as a x^2 with $df = p_2 - p_1$. The hypothesis test for the year 2 models with and without a covariate was -2(-550.80-(-526.18) = 49.24 with df=3, significant at p<.0001. The hypothesis test for the year 3 models with and without a covariate was -2(-538.18-(-530.60) = 15.16 with df=3, significant at p<.0001. Results from the hypothesis testing suggested that English Expressive Vocabulary was a statistically significant predictor of latent class membership across both time points.

The estimates of the intercepts (β_0's), odds, regression coefficients (β_1's), and odd ratio's are provided in Table 8 for year 2 and Table 9 for year 3 across all three

cohorts at each time point. The "good readers" class served as the reference (stated as Ref in Tables) latent class. All of the intercepts were negative suggesting that when students had an English Expressive Vocabulary score equal to zero (mean of variable) they were less likely to be in the "struggling readers" class than they were to be in the "good readers" class. The regression coefficients corresponding to the "struggling readers" class were negative, suggesting that a one-unit (one standard deviation) increase in English Expressive Vocabulary was associated with a *decrease* in the odds of being in that latent class (i.e., struggling reader class). For example, examining the regression coefficient for cohort 1 in year 2 (Table 8), if English Expressive Vocabulary was increased by one standard deviation, the odds of being in the "struggling readers" class relative to the "good readers" class would decrease by a factor of .30. Results suggest that students with higher English Expressive Vocabulary scores were more likely to be in the latent class that reflected good readers and less likely to be in the latent class that reflected struggling readers.

Latent Transition Analysis

Similar to the LCA procedure described above for determining number of classes, multiple LTA models with varying latent statuses were conducted in order to determine the best number of latent statuses that were both meaningful and informative and fit the data the best. While the 2-class multiple group LCA model was found to be the best model for the data at both times of measurement independently, it is important to base LTA model selection on data from all time points of measurement together (Collins & Lanza, 2010). Table 10 provides the summary of information for multiple group models

with two through six latent statuses. As referenced in bold, the AIC values suggested three latent classes, whereas the BIC index suggested two latent statuses. The two latent status multiple group model was chosen due to it being conceptually more meaningful as well as the most parsimonious model.

Results of the 2-latent status multiple group LTA model are provided in Tables 11 and 12. In order to assign meaning to the latent statuses identified, item response probabilities were examined similar to the LCA procedure for interpreting latent classes. Table 11 provides the item response probabilities for the 2-latent status multiple group LTA model. Results were similar to those found for the 2-class multiple group LCA model, where latent status 1 represents students who were more likely to be NonRD on reading measures and latent status 2 represents students who were more likely to be at-risk for RD. Thus, the same labels used for the 2-class multiple group LCA model (i.e., "good readers", "struggling readers") were applied to the 2-latent status multiple group LTA model.

The top section of Table 12 shows the prevalences of latent statuses for each cohort at both time points. These were very similar to the LCA membership probabilities described in Table 7. The "good readers" latent status was the most prevalent across each cohort and the two time points, however the incidence of "good readers" appeared to decrease over time within each cohort. For example, within cohort 1 the prevalence of "good readers" decreased from year 2 to year 3, while the prevalence of "struggling readers" increased. This pattern can be seen across cohorts. In order to understand the

extent to which students move between latent statuses over time, transition probabilities were examined which are provided in the second section of Table 12.

The results of the transition probabilities suggested that students in the "good readers" latent status had a high probability (90%) of remaining in the same latent status from year 2 to year 3 across cohorts. The probability of students in the "good readers" latent status in year 2 moving into the "struggling readers" latent status in year 3 ranged from 10 to 20%, with the highest probability occurring in cohort 1 (2^{nd} graders moving to 3^{rd} grade). Students within the "struggling readers" latent status had an 80 to 89% probability of remaining in the same latent status from year 2 to year 3. Additionally these students had about a 10% probability of moving into the "good readers" group by year 3.

A further examination of data was done on students who emerged from the "good readers" latent status in year 2 to the "struggling readers latent" status in year 3. Individual posterior probabilities were examined which suggested that within cohort 1 seven students transitioned into the "struggling readers" status from year 2 to year 3 (2^{nd} graders moving into 3^{rd} grade). Within cohort 2 eight students transitioned into the "struggling readers" status from year 2 to year 3 (3^{rd} graders moving into 4^{th} grade). Within cohort 3, thirteen students transitioned into the "struggling readers" status from year 2 to year 3 (4^{th} graders moving into the 5^{th} grade). Standard scores on English reading measures and latent status for these students are provided in Tables 13-15.

Examining standard scores in Tables 13-15 for these students across grades revealed patterns associated with late-emergent reading difficulties (i.e., students display

average to above average reading scores during the first two time points, then display below average reading scores at the last time point). Four students within cohort 1, three students within cohort 2, and three students within cohort 3 (referenced in bold with Tables 13-15) had a drop in standard reading scores. The majority of other students had varying reading scores (average to above average and/or below average) in previous years with some indication of previous below average performance. Of the 10 students identified (approximately 2% of the study sample) as showing characteristics of late-emerging reading difficulties, the majority (7 students) exhibited a pattern showing scores below the 25th percentile on Passage Comprehension and Letter-Word ID measures but above the 25th percentile on the Word Attack measure. This finding suggested that these students were at-risk in comprehension skills and decoding skills as measured with real words, but were not at-risk in decoding skills as measured with nonsense words.

Measurement Invariance. In order to identify if the item-response probabilities were invariant across groups and times within the 2-latent status multiple group model, two models were compared using a x^2 difference test, where one model allows parameters to vary across groups and time and the other constrains parameters to be equal across groups and time similar to the procedure used with LCA analysis described above. The results from the likelihood ratio tests across each time point are provided in Table 16. Results indicate a significant G_{Δ}^2 statistic suggesting that at least one p parameter is different across groups and times, however the AIC and BIC values are lower for Model 2 (assuming measurement invariance across groups and times), suggesting that it is a better model fit compared to Model 1 (allowing probabilities to vary across times and groups).

Addition of a covariate to the 2-latent status multiple group LTA model

In order to examine the relationships between Expressive Vocabulary, group membership in latent statuses, and transitions between latent statuses, Expressive Vocabulary was introduced into the model as a covariate. First, hypothesis testing for the significance of the Expressive Vocabulary covariate was conducted by means of a likelihood ratio x^2 test, similar to the procedure conducted within the LCA procedures. The baseline model without the covariate X, estimating p_1 parameters is compared with the model that includes the covariate estimating p_2 parameters using the log-likelihoods associated with each model (ℓ). The value generated from -2($\ell_1 - \ell_2$) is distributed as a x^2 with $df = p_2 - p_1$. The hypothesis test for the 2-class multiple group LTA models with and without a covariate was -2(-1030.81- (-1012.90) = 35.82 with df=3, significant at p<.0001, suggesting Expressive Vocabulary was a statistically significant predictor of latent status membership across all time points and groups.

The estimates of the intercepts (β_0's), odds, regression coefficients (β_1's), odd ratio's, and effect sizes are provided in Table 17 and for all three cohorts. The "good readers" class served as the reference latent class and Cox index effect sizes (Cox, 1970) were calculated from the log odds (logits). The regression coefficients corresponding to the "struggling readers" class were negative across all cohorts, suggesting that a one-unit (one standard deviation) increase in Expressive Vocabulary was associated with a *decrease* in the odds of being in that latent status. The associated effect sizes were small (0.38, 0.31, 0.18) across all cohorts, suggesting weak substantive significance (Cohen, 1988). For example, examining the regression coefficient for cohort 1, if Expressive

Vocabulary was increased by one standard deviation in Year 2, the odds of being in the "struggling readers" status relative to the "good readers" status in Year 3 would decrease by a factor of .53 which corresponds to a .38 effect size. Results are similar to the results provided within LCA, suggesting that students with higher Expressive Vocabulary scores in Year 2 were more likely to be in the latent status that reflected good readers and less likely to be in the latent class that reflected struggling readers in Year 3.

Addition of transition covariate

In order to determine how Expressive Vocabulary effects transitions between latent statuses, it was entered into the model as a predictor of transitions with the diagonal element of the transition probability matrix as the reference category. The reference category was set in this way so that the odds ratios could be interpreted as the effect of Expressive Vocabulary on the odds of making a particular transition from year 2 to year 3, relative to being in the same latent status as year 3.

Hypothesis testing for the significance of Expressive Vocabulary as a covariate on transitions was conducted by means of a likelihood ratio x^2 test. The hypothesis test for the 2-class multiple group LTA models with and without a covariate on transitions was -2(-1030.81- (-1012.08) = 37.46 with df=9, significant at p<.001, suggesting Expressive Vocabulary was a statistically significant predictor of latent status transitions.

The regression coefficients (Table 18) reflect the change in odds (Table 19) of transitioning to another latent status (in relation to the reference latent status), conditional on membership in latent status at Year 2, associated with a one unit increase in the predictor. For example, the effect of Expressive Vocabulary on the transition from "good

readers" to "struggling readers" within cohort 1 suggests that a one-unit (one standard deviation) increase in Expressive Vocabulary was associated with a decrease in odds (.77) of transitioning into the "struggling readers" status at year 3. This result is similar to cohort 2 and cohort 3 with regard to students transitioning from "good readers" to "struggling readers", suggesting that better Expressive Vocabulary scores decreases a students odds of becoming an at-risk reader (i.e., late emerging reading difficulty).

The effect of Expressive Vocabulary on the transition from "struggling readers" to "good readers" within cohort 1 suggests that a one-unit (one standard deviation increase in Expressive Vocabulary was associated with a decrease in odds (0.96) of transitioning into the "good readers" status at year 3. This result is similar to cohorts 2 and 3, suggesting that even with an increase in Expressive Vocabulary students within the "struggling readers" group at year 2 are more likely to stay within that same latent status in year 3 than transitioning into the "good readers" status. The associated effect sizes ranged from negligible to very small (0.01 to 0.16) across all cohorts, suggesting very weak substantive significance (Cohen, 1988).

Discussion

Findings from this study revealed that a two latent class ("struggling readers" and "good readers") model consisting of three English reading indicators provided a parsimonious summary of risk status over time for ELL children. Students within the "struggling readers" class exhibited deficits in word reading, comprehension, and or deficits in both word reading and comprehension. These findings were consistent with previous research that has generally identified two to four latent status models that

distinguish poor readers from good readers with varying combinations of specific skill deficits (Catts, et al., 2012; Compton et al., 2008; Leach, et al., 2003). Within each cohort and at each time point assessed, the incidence of "good readers" was more prevalent than "struggling readers" in the current data. However, a decreasing pattern of the prevelences for "good readers" was observed from year 2 to year 3 within each cohort suggesting that as students moved into a higher grade the "good readers" class became smaller.

The probabilities of students who changed latent classes across year 2 to year 3 were minimal (10% to 20%) suggesting stability of latent reading classes over time, which is a finding supported by similar models in previous research (Cats, et al., 2012; Compton et al., 2008). Students within the "struggling readers" group in year 2 had a 10% probability of moving into the "good readers" group in year 3 across all three cohorts. Students within the "good readers" group at year 2 had an 11% to 20% probability of moving into the "struggling readers" group in year 3. Findings suggested that students transitioning from second grade to third grade (cohort 1) had the highest probability of transitioning into the "struggling readers" group. This finding suggests that students moving into third grade may be at higher risk of developing reading difficulties compared to students transitioning from third to fourth grade or from fourth or fifth grade. This highlights the need for early intervention and prevention efforts during this period, especially considering that research has identified third grade reading performance to be a strong predictor of academic success (Hernandez, 2011).

The proportion of students identified as exhibiting characteristics of late-emerging reading difficulties was 2% of the study sample. While low, this was to be expected

considering that previous research cites relatively small prevalence estimates of this population ranging from 3% to 19% (Badian, 1999; Catts, et al., 2012; Compton et al., 2008; Kieffer, 2010, Leach, et al., 2003; Lipka et al., 2006; Shaywitz et al., 1992). Reading profiles of these students suggested difficulties with single skills in the areas of word reading or comprehension, as well as with both word reading and comprehension skills combined. This finding is consistent with previous research, which has suggested heterogeneous skill deficits among students identified as exhibiting late-emerging reading difficulties (Catts, et al., 2012; Compton et al., 2008; Leach, et al., 2003). While examining the reading profiles of these students an interesting performance pattern emerged for the majority of the group. Students exhibited patterns of difficulties in comprehension skills and word reading skills as measured with real words, but adequate performance patterns in word reading skills as measured with nonsense words. While previous research has found that early phonological skills are significant predictors of reading growth rates and future reading performance for ELL students (Lesaux, Rupp, and Siegel, 2007; Nakamoto et al., 2007; Fuchs et al., 2012), current findings suggest that phonological skills may not play as significant as a role in relation to the development of late-emerging reading difficulties as compared to general reading development.

Within the current study English Expressive Vocabulary was utilized as a measure of oral language to examine the relationship between oral language and changes in reading skills over time. Findings suggest that students with higher oral language skills were associated with a decrease in probability of being in the "good readers" latent class as well as a decrease in probability of transitioning from the "good readers" latent class

into the “struggling readers” latent class. This finding was expected given the positive relationship that has been established in the literature between oral language and academic success for ELL students (August, Carlo, Dressler, & Snow, 2005; August & Shanahan, 2006; Kieffer, 2012; Klinger, Artiles, & Barletta, 2006; Lesaux, 2006; Shifrer, Muller, & Callahan, 2011). However, despite English Expressive Vocabulary being a significant covariate within the LTA model, results revealed negligible to very small effect sizes suggesting weak substantive significance.

The current study findings add to the limited research that has been conducted to date on late-emerging reading difficulties within ELL students. Overall, findings are consistent with previous research that has been done with non-ELL populations with regards to number of latent statuses, composition of latent classes, prevalence estimates, and reading profiles. Additional findings suggest that the transition between second to third grade is associated with a higher probability of developing reading difficulties, phonological and alphabetic principle skills may not play a strong role in late-emerging reading difficulties, and the relationship between English oral language skills, latent classes, and transitions between classes do not reveal substantive meaningful significance.

Findings from this study should be interpreted with caution given the small sample size and the focus on probability estimates which can be subject to various interpretations given the lack of guidelines regarding what is deemed a significant or non significant probability.

Additionally, limitations exist within the modeling framework chosen within this study based on it's simplicity. It is possible that the inclusion of only three dichotomized indicator variables within the model limited the opportunities to identify more than 2 classes. Including more indicator variables and/or allowing the variables to be entered into the model as continuous data may have provided richer results, however given the current study's sample size adding additional indicator variables and maintaining model specification was not feasible. Furthermore, the author of this study chose to conduct the analysis using PROC LCA and PROC LTA procedures in SAS version 9.3 (Lanza, Dziak, Huang, Xu & Collins, 2011) which required use of categorical variables. Currently formal guidelines on appropriate sample sizes within LCA and LTA do not exist. An adequate sample size for a particular model depends on multiple elements such as number of indicators, type of data, complexity of model, and the overall contingency table. Collins, Lanza, Schafer, & Flaherty (2002) recommend a sample size of at least 300 when conducting LTA, however LTA models have been reported within the literature with sample sizes as low as 111 (Marcoulides, Gottfried, Gottfried, & Oliver, 2008) and 177 (Compton, et al., 2008). In general larger sample sizes are preferred. More complex models with larger sample sizes have the capability of exploring heterogeneity in the number of latent statuses at different time points, heterogeneity in transitions, multiple covariates, and alternative measurement models which can provide a better representation of the data.

Future research is needed to further explore the movement of reading difficulties among ELL students across later grades with larger sample sizes, monolingual

comparison groups, and clearly defined ELL samples. It is also necessary to investigate the reading deficit profiles of these groups to examine potential assessment and intervention implications and explore how individual probabilities might be used to classify individual students.

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Table 1

Structure of Cohort-Sequential Longitudinal Study

Time point	Grade				
	1	2	3	4	5
2009-2010 (Year 1)	X_1	X_2	X_3	-	-
2010-2011 (Year 2)	-	X_1	X_2	X_3	-
2011-2012 (Year 3)	-	-	X_1	X_2	X_3

Note. X_1= Cohort 1, X_2= Cohort 2, X_3= Cohort 3

Table 2

Descriptive Variables for the Total Study Sample and the Sample Used for Analysis

	Total Study Sample			Sample Used for Analysis		
Variable	*N*	*Frequency*	*Percent*	*N*	*Frequency*	*Percent*
Gender	500			446		
Male		234	46.8%		201	45.1%
Female		266	53.2%		245	54.9%
Ethnicity	500			446		
Hispanic		498	99.6%		445	99.8%
Other		2	0.4%		1	.2%
Home Language	500			446		
Spanish		410	82.0%		363	81.4%
Spanish and English		48	9.6%		40	9.0%
English		42	8.4%		43	9.6%
Grade (Time 1)	500			446		
First		163	32.6%		137	30.9%
Second		153	30.6%		137	30.7%
Third		184	38.8%		172	38.3%
Grade (Time 2)	500			446		
Second		165	33.0%		138	30.9%
Third		152	30.4%		137	30.7%
Fourth		183	36.6%		171	38.3%
Grade (Time 3)	418			375		
Third		136	32.5%		114	30.4%
Fourth		123	29.4%		113	30.1%
Fifth		159	38.04		148	39.5%
Free or Reduced Lunch	500			446		
Yes		491	98.2%		437	98.0%
No		9	1.8%		9	2.0%
CELDT Proficiency	500			446		
Beginning		57	11.4%		48	10.8%
Early Intermediate		136	27.2%		119	26.7%
Intermediate		186	37.3%		166	37.2%
Early Advanced		101	20.2%		94	21.1%
Advanced		20	4.0%		19	4.2%

Note. CELDT = California English Language Development Test, CST ELA= California Standards Test-English Language Arts, *= CST ELA scores were only available for 183 students at time 1 and 383 students at time 2. No scores were available at time 3.

Table 2 cont.

Descriptive Variables for the Total Study Sample and the Sample Used for Analysis cont.

CST ELA (Time 1)*	183			166		
Below Basic – Far Below		68	37.2%		58	34.9%
Basic		61	33.3%		57	34.3%
Proficient – Advanced		54	29.5%		51	30.7%
CST ELA (Time 2)*	383			342		
Below Basic – Far Below		114	29.8%		93	27.2%
Basic		108	28.2%		95	27.8%
Proficient – Advanced		161	42.0%		154	45.1%

Note. CELDT = California English Language Development Test, CST ELA= California Standards Test-English Language Arts, *= CST ELA scores were only available for 183 students at time 1 and 383 students at time 2. No scores were available at time 3.

Table 3

Composites from the Foorman's Instructional Format and Content Codes Survey

		Grammar Spelling	Writing	PA	Comp.	Oral Lang.	Direct.	Vocab.
	N	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Cohort 1								
Grade 1	24	4.81 (4.24)	9.35 (8.55)	18.42 (11.66)	18.06 (11.87)	10.37 (8.40)	28.39 (14.95)	7.23 (5.10)
Grade 2	18	6.54 (5.91)	14.33 (10.91)	10.67 (7.45)	18.46 (14.85)	8.67 (6.73)	21.83 (8.43)	9.67 (9.54)
Grade 3	21	8.90 (7.00)	10.74 (8.17)	7.68 (7.44)	24.05 (10.14)	15.26 (6.42)	23.84 (6.77)	12.16 (5.11)
Cohort 2								
Grade 2	21	4.21 (4.36)	6.89 (6.34)	12.57 (10.25)	14.50 (11.21)	7.82 (7.49)	26.00 (17.23)	7.86 (6.30)
Grade 3	17	5.10 (7.30)	9.48 (8.46)	9.33 (6.78)	18.19 (9.27)	7.95 (6.27)	19.90 (8.17)	11.67 (7.43)
Grade 4	27	6.88 (5.82)	12.54 (10.98)	7.04 (7.22)	19.42 (10.76)	13.08 (6.81)	23.75 (8.21)	13.92 (5.50)
Cohort 3								
Grade 3	14	4.40 (4.05)	6.40 (5.59)	14.25 (9.64)	20.95 (14.92)	9.40 (9.40)	32.95 (14.46)	10.00 (7.62)
Grade 4	20	4.28 (4.92)	7.96 (7.11)	6.76 (5.20)	21.92 (10.13)	6.96 (5.78)	18.32 (4.97)	8.71 (6.23)
Grade 5	18	4.71 (6.80)	(12.76 (8.61)	6.81 (5.12)	23.38 (16.39)	10.80 (7.27)	22.29 (6.81)	11.48 (8.10)

Note. PA= Phonemic Awareness and Alphabetics, Comp.= Comprehension, Oral Lang.= Oral Language, Direct.= Directions, Vocab.= Vocabulary, M= Mean, SD= Standard Deviation

Table 4

Variable Means, Standard Deviations, and Percent Identified as At-Risk for Reading Difficulties by Cohort

		Express. Vocab	Letter Word ID		Passage Comp.		Word Attack	
	N	M (SD)	M (SD)	% RD	M (SD)	% RD	M (SD)	%RD
Cohort 1								
Grade 1	137	88.97 (16.24)	105.99 (12.24)	9.5%	92.57 (14.89)	39.7%	99.27 (15.69)	27.2%
Grade 2	138	97.93 (14.96)	106.23 (13.79)	18.1%	104.89 (14.89)	25.5%	98.16 (12.44)	14.6%
Grade 3	114	92.85 (12.71)	99.60 (15.06)	21.1%	102.42 (15.13)	34.2%	100.74 (14.68)	21.1%
Cohort 2								
Grade 2	137	93.43 (16.26)	103.00 (15.83)	21.9%	93.86 (12.68)	30.7%	99.92 (18.12)	25.5%
Grade 3	137	99.32 (15.36)	105.00 (16.15)	16.2%	103.02 (14.90)	26.3%	95.83 (12.48)	19.0%
Grade 4	113	91.23 (12.99)	100.89 (17.32)	23.0%	99.70 (15.09)	41.6%	101.11 (14.15)	23.2%
Cohort 3								
Grade 3	172	93.94 (15.58)	98.68 (14.73)	24.4%	89.09 (11.39)	52.2%	100.01 (16.03)	31.4%
Grade 4	170	97.71 (13.91)	101.64 (14.34)	22.8%	99.01 (14.80)	35.9%	91.90 (11.74)	22.2%
Grade 5	148	91.78 (12.88)	100.18 (16.42)	27.7%	101.49 (15.82)	45.9%	101.06 (14.68)	27.2%

Note. M= Mean, SD= Standard Deviation

Table 5

Summary of LCA Model Fit Information

Multiple group LCA models for Time point 1 (N=446)								
Classes	Log Likelihood	df	G^2	AIC	BIC	Adjusted BIC	Entropy	Seed %
1	-784.16	20	262.47	268.47	280.77	271.25	1.00	100%
2	**-667.98**	**14**	**30.11**	**48.11**	**85.01**	**56.45**	**.82**	**100%**
3	**-656.18**	**8**	**6.51**	**36.51**	**98.02**	**50.41**	**.61**	**100%**
4	-654.58	2	3.31	45.31	131.42	64.77	.74	75%
Multiple group LCA models for Time point 2 (N=446)								
Classes	Log Likelihood	df	G^2	AIC	BIC	Adjusted BIC	Entropy	Seed %
1	-704.23	20	329.07	335.07	347.38	337.85	1.00	100%
2	**-550.80**	**14**	**22.22**	**40.22**	**77.13**	**48.56**	**.90**	**100%**
3	-546.12	8	12.86	42.86	104.36	56.76	.89	100%
4	-542.46	2	5.55	47.55	133.66	67.01	.86	90%
Multiple group LCA models for Time point 3 (N=375)								
Classes	Log Likelihood	df	G^2	AIC	BIC	Adjusted BIC	Entropy	Seed %
1	-665.87	20	269.89	275.89	287.67	278.15	1.00	100%
2	**-538.18**	**14**	**14.50**	**32.50**	**67.84**	**39.29**	**.94**	**100%**
3	-534.69	8	7.54	37.54	96.44	48.85	.75	85%
4	-531.97	2	2.09	44.09	126.55	59.92	.76	45%

Note. df= Degrees of freedom; G^2= Likelihood ratio G squared statistic; AIC= Akaike's information criterion; BIC= Bayesian information criterion.

Table 6

LCA Likelihood Ratio Test Results for Measurement Invariance across groups

	G^2_Δ	df	Sig.	AIC	BIC	Adjusted BIC
Year 1						
Model 1	28.85	12	p<.005	43.26	129.36	62.72
Model 2				48.11	85.01	56.45
Year 2						
Model 1	19.96	12	p>.05	44.26	130.37	63.72
Model 2				40.22	77.13	48.56
Year 3						
Model 1	11.49	12	p>.05	45.01	127.48	60.85
Model 2				32.50	67.84	39.29

Note. df= Degrees of freedom; G^2= Likelihood ratio G squared statistic; AIC= Akaike's information criterion; BIC= Bayesian information criterion.

Table 7

LCA Class Membership Probabilities

Membership probabilities for Year 2		
	Good Readers Probability (SE)	Struggling Readers Probability (SE)
Cohort 1 (2^{nd} graders)	.80 (.04)	.20 (.04)
Cohort 2 (3^{rd} graders)	.82 (.02)	.18 (.02)
Cohort 3 (4^{th} graders)	.76 (.04)	.24 (.04)
Membership probabilities for Year 3		
	Good Readers Probability (SE)	Struggling Readers Probability (SE)
Cohort 1 (3^{rd} graders)	.78 (.04)	.22 (.04)
Cohort 2 (4^{th} graders)	.77 (.04)	.23 (.04)
Cohort 3 (5^{th} graders)	.71 (.04)	.29 (.04)

Note. SE= Standard error estimates

Table 8

Intercepts (β_0's), *odds, regression coefficients* (β_1's), *and odd ratio's for Year 2*

Cohort 1 (Year2)	Latent Class	
	Good Readers	Struggling Readers
Intercepts		
β_0's	Ref	-1.55
Odds	Ref	0.21
Expressive Vocabulary (p<.0001)		
β_1's	Ref	-1.20
Odds ratios	Ref	0.30
Cohort 2 (Year2)	Latent Class	
	Good Readers	Struggling Readers
Intercepts		
β_0's	Ref	-1.74
Odds	Ref	0.18
Expressive Vocabulary (p<.0001)		
β_1's	Ref	-1.23
Odds ratios	Ref	0.29
Cohort 3 (Year2)	Latent Class	
	Good Readers	Struggling Readers
Intercepts		
β_0's	Ref	-1.08
Odds	Ref	0.34
Expressive Vocabulary (p<.0001)		
β_1's	Ref	-0.69
Odds ratios	Ref	0.50

Note: Ref= Reference group

Table 9

Intercepts (β_0's), *odds, regression coefficients* (β_1's), *and odd ratio's for Year 3*

Cohort 1 (Year3)	Latent Class	
	Good Readers	Struggling Readers
Intercepts		
β_0's	Ref	-1.27
Odds	Ref	0.28
Language Proficiency (p<.0001)		
β_1's	Ref	-0.81
Odds ratios	Ref	0.45
Cohort 2 (Year3)	Latent Class	
	Good Readers	Struggling Readers
Intercepts		
β_0's	Ref	-1.21
Odds	Ref	0.30
Language Proficiency (p<.0001)		
β_1's	Ref	-0.49
Odds ratios	Ref	0.62
Cohort 3 (Year3)	Latent Class	
	Good Readers	Struggling Readers
Intercepts		
β_0's	Ref	-0.88
Odds	Ref	0.41
Language Proficiency (p<.0001)		
β_1's	Ref	-0.30
Odds ratios	Ref	0.74

Note: Ref= Reference group

Table 10

Summary of LTA model fit information with two time points

Latent Status	Log Likelihood	df	G^2	AIC	BIC
2	**-1030.81**	**176**	**249.83**	**279.83**	**341.33**
3	**-994.42**	**158**	**177.04**	**243.04**	**378.35**
4	-970.47	134	129.15	243.15	476.86
5	-952.76	104	93.73	267.73	624.46
6	-940.15	68	68.51	314.51	818.85

Note. df= Degrees of freedom; G^2= Likelihood ratio G squared statistic; AIC= Akaike's information criterion; BIC= Bayesian information criterion.

Table 11

LTA Item Response Probabilities

	Latent Status 1	Latent Status 2
E-Passage Comprehension		
Not At risk	**0.812**	0.123
At risk	0.188	**0.877**
E-Letter Word Identification		
Not At risk	**0.990**	0.107
At risk	0.010	**0.893**
E- Word Attack		
Not at risk	**0.943**	0.269
At risk	0.057	**0.731**

Table 12

Prevalence of latent Statuses, and Transition Probabilities in Latent Status Membership

	Good Readers	Struggling Readers
Prevalence of Statuses		
Cohort 1		
Year 2 (2nd graders)	0.793	0.207
Year 3 (3rd graders)	0.759	0.241
Cohort 2		
Year 2 (3rd graders)	0.824	0.175
Year 3 (4th graders)	0.758	0.242
Cohort 3		
Year 2 (4th graders)	0.761	0.239
Year 3 (5th graders)	0.711	0.289
Transitions from 2nd grade to 3rd grade		
Good Readers	**0.905**	0.095
Struggling Readers	0.199	**0.801**
Transitions from 3rd grade to 4th grade		
Good Readers	**0.896**	0.104
Struggling Readers	0.109	**0.891**
Transitions from 4th grade to 5th grade		
Good Readers	**0.894**	0.106
Struggling Readers	0.128	**0.872**

Table 13

Standard scores, latent status, and probability of correct latent status membership for students transitioning into the "struggling readers" group with cohort 1

		E-Passage Comp	E-Letter-word	E- Word Attack	Latent Status
Student 1					
	Grade 1	**107**	**114**	**104**	**-**
	Grade 2	**97**	**112**	**104**	**Good Reader**
	Grade 3	**86**	**85**	**96**	**Struggling Reader**
Student 2					
	Grade 1	**90**	**103**	**111**	**-**
	Grade 2	**92**	**97**	**107**	**Good Reader**
	Grade 3	**82**	**82**	**91**	**Struggling Reader**
Student 3					
	Grade 1	84	104	79	-
	Grade 2	92	100	108	Good Reader
	Grade 3	82	83	97	Struggling Reader
Student 4					
	Grade 1	**91**	**103**	**107**	**-**
	Grade 2	**92**	**100**	**108**	**Good Reader**
	Grade 3	**82**	**83**	**97**	**Struggling Reader**
Student 5					
	Grade 1	**107**	**120**	**104**	**-**
	Grade 2	**91**	**92**	**90**	**Good Reader**
	Grade 3	**79**	**85**	**86**	**Struggling Reader**
Student 6					
	Grade 1	87	103	111	-
	Grade 2	84	97	101	Good Reader
	Grade 3	68	80	82	Struggling Reader
Student 7					
	Grade 1	86	88	77	-
	Grade 2	79	92	103	Good Reader
	Grade 3	83	79	85	Struggling Reader

Note. E-Letter Word Identification= English Letter Word Identification subtest of the Woodcock Munoz Language Survey- Revised (WMLS-R); E-Passage Comprehension= English Passage Comprehension subtest of the WMLS-R

Table 14

Standard scores and latent status membership for students transitioning into the "struggling readers" group with cohort 2

		E-Passage Comp	E-Letter-word	E- Word Attack	Latent Status
Student 1					
	Grade 2	102	98	95	-
	Grade 3	99	100	96	Good Reader
	Grade 4	90	85	97	Struggling Reader
Student 2					
	Grade 2	**91**	**95**	**108**	**-**
	Grade 3	**91**	**95**	**99**	**Good Reader**
	Grade 4	**71**	**77**	**94**	**Struggling Reader**
Student 3					
	Grade 2	**106**	**112**	**109**	**-**
	Grade 3	**107**	**107**	**105**	**Good Reader**
	Grade 4	**87**	**89**	**94**	**Struggling Reader**
Student 4					
	Grade 2	98	101	113	-
	Grade 3	99	112	111	Good Reader
	Grade 4	90	89	103	Struggling Reader
Student5					
	Grade 2	**108**	**130**	**119**	**-**
	Grade 3	**100**	**119**	**109**	**Good Reader**
	Grade 4	**93**	**86**	**86**	**Struggling Reader**
Student 6					
	Grade 2	81	86	91	-
	Grade 3	93	92	91	Good Reader
	Grade 4	85	87	90	Struggling Reader
Student 7					
	Grade 2	98	92	93	-
	Grade 3	85	92	94	Good Reader
	Grade 4	68	84	92	Struggling Reader
Student 8					
	Grade 2	91	88	80	-
	Grade 3	90	96	96	Good Reader
	Grade 4	80	89	91	Struggling Reader

Note. E-Letter Word Identification= English Letter Word Identification subtest of the Woodcock Munoz Language Survey- Revised (WMLS-R); E-Passage Comprehension= English Passage Comprehension subtest of the WMLS-R

Table 15

Standard scores and latent status membership for students transitioning into the "struggling readers" group with cohort 3

		E-Passage Comp	E-Letter-word	E- Word Attack	Latent Status
Student 1					
	Grade 3	**105**	**112**	**105**	**-**
	Grade 4	**99**	**103**	**113**	**Good Reader**
	Grade 5	**86**	**88**	**108**	**Struggling Reader**
Student 2					
	Grade 3	83	96	90	-
	Grade 4	99	95	97	Good Reader
	Grade 4	70	88	94	Struggling Reader
Student 3					
	Grade 3	88	98	99	-
	Grade 4	92	100	108	Good Reader
	Grade 5	82	83	97	Struggling Reader
Student 4					
	Grade 3	86	92	77	-
	Grade 4	92	95	91	Good Reader
	Grade 5	82	80	83	Struggling Reader
Student 5					
	Grade 3	86	94	88	-
	Grade 4	108	98	96	Good Reader
	Grade 5	86	90	90	Struggling Reader
Student 6					
	Grade 3	92	99	104	-
	Grade 4	67	95	111	Good Reader
	Grade 5	86	90	97	Struggling Reader
Student 7					
	Grade 3	**92**	**94**	**90**	**-**
	Grade 4	**85**	**96**	**98**	**Good Reader**
	Grade 5	**74**	**88**	**90**	**Struggling Reader**
Student 8					
	Grade 3	**98**	**93**	**108**	**-**
	Grade 4	**89**	**92**	**101**	**Good Reader**
	Grade 5	**75**	**86**	**89**	**Struggling Reader**
Student 9					
	Grade 3	88	100	89	-
	Grade 4	91	96	88	Good Reader
	Grade 5	94	90	88	Struggling Reader

Note. E-Letter Word Identification= English Letter Word Identification subtest of the Woodcock

Munoz Language Survey- Revised (WMLS-R); E-Passage Comprehension= English Passage Comprehension subtest of the WMLS-R

Table 15 cont.

Standard scores and latent status membership for students transitioning into the "struggling readers" group with cohort 3 cont.

		E-Passage Comp	E-Letter-word	E- Word Attack	Latent Status
Student 10					
	Grade 3	92	85	83	-
	Grade 4	97	92	88	Good Reader
	Grade 5	93	86	86	Struggling Reader
Student 11					
	Grade 3	73	70	81	-
	Grade 4	91	92	90	Good Reader
	Grade 5	79	85	86	Struggling Reader
Student 12					
	Grade 3	85	94	81	-
	Grade 4	91	93	88	Good Reader
	Grade 5	89	87	80	Struggling Reader
Student 13					
	Grade 3	88	97	96	-
	Grade 4	94	93	90	Good Reader
	Grade 5	96	89	85	Struggling Reader

Note. E-Letter Word Identification= English Letter Word Identification subtest of the Woodcock Munoz Language Survey- Revised (WMLS-R); E-Passage Comprehension= English Passage Comprehension subtest of the WMLS-R

Table 16

Likelihood ratio test for equivalence of item response probabilities across groups and times

	G^2	df	AIC	BIC	ℓ
Model 1: Item-response probabilities vary across times and groups	191.51	146	281.51	466.03	-1001.65
Model 2: Item-response probabilities equal across times and groups	249.83	176	**279.83**	**341.33**	-1030.81

G_2^2 - G_1^2= 58, df=30, , p<.001

Table 17

Intercepts (β_0's), *odds, regression coefficients* (β_1's), *odd ratio's, and effect sizes (ES) for LTA with covariate*

Cohort 1	Latent Status		
	Good Readers	Struggling Readers	ES
Intercepts			
β_0's	Ref	-1.46	
Odds	Ref	0.23	
Expressive Vocabulary (p<.0001)			
β_1's	Ref	-0.63	
Odds ratios	Ref	0.53	0.38
Cohort 2	Latent Status		
	Good Readers	Struggling Readers	
Intercepts			
β_0's	Ref	-1.64	
Odds	Ref	0.19	
Expressive Vocabulary (p<.0001)			
β_1's	Ref	-0.51	
Odds ratios	Ref	0.60	0.31
Cohort 3	Latent Status		
	Good Readers	Struggling Readers	
Intercepts			
β_0's	Ref	-1.17	
Odds	Ref	0.31	
Expressive Vocabulary (p<.0001)			
β_1's	Ref	-0.29	
Odds ratios	Ref	0.75	0.18

Note: Ref= Reference group

Table 18

Regression coefficients (β_1's) for LTA with transition covariate

	Latent Status	
	Good Readers	Struggling Readers
Effect of English Expressive Vocabulary on the probability of transitioning to …..		
	Year 3 latent status	
Conditional on year 2 latent status		
Cohort 1 (2nd to 3rd grade)		
Good Readers	Ref	-0.27
Struggling Readers	-0.05	Ref
Cohort 2 (3rd to 4th grade)		
Good Readers	Ref	-0.01
Struggling Readers	0.05	Ref
Cohort 3 (4th to 5th grade)		
Good Readers	Ref	-0.06
Struggling Readers	0.01	Ref

Table 19

Odds ratio's and effect sizes (ES) for LTA with transition covariate

Cohort 1	Latent Status	
	Good Readers	Struggling Readers
	Odds Ratio (ES)	*Odds Ratio (ES)*
Effect of English Expressive Vocabulary on the probability of transitioning to …..		
	….year 3 latent status	
Conditional on year 2 latent status		
Cohort 1		
Good Readers	Ref	0.77 (0.16)
Struggling Readers	0.96 (0.03)	Ref
Cohort 2		
Good Readers	Ref	0.99 (0.01)
Struggling Readers	1.05 (0.03)	Ref
Cohort 3		
Good Readers	Ref	0.94 (0.04)
Struggling Readers	1.01 (0.01)	Ref

Figure 1

Latent Class Analysis Model Example

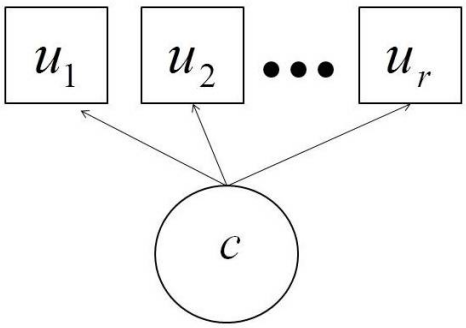

Figure 2

Latent Transition Analysis Model Example

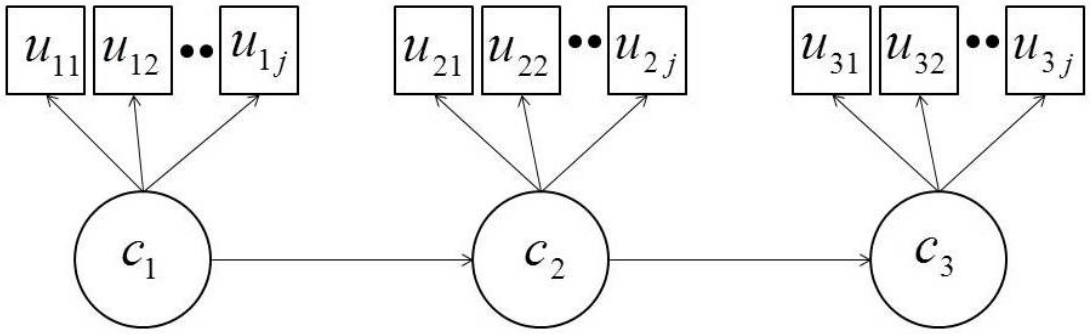

Figure 3

Latent Transition Analysis Model for Current Study

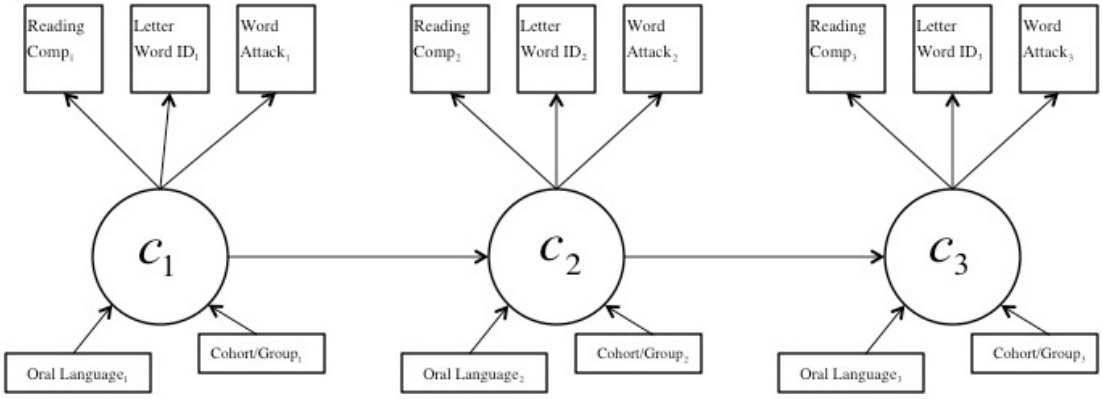

Figure 4

LCA Item Response Probabilities