Assessing the Importance of Metalinguistic Skills to the Word Reading and Reading Comprehension Abilities of Adult Basic Education Students

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ASSESSING THE IMPORTANCE OF METALINGUISTIC SKILLS TO THE WORD READING AND READING COMPREHENSION ABILITIES OF ADULT BASIC EDUCATION STUDENTS

By

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# TABLE OF CONTENTS

List of Tables vii

List of Figures viii

Abstract ix

INTRODUCTION 1
  Importance of Metalinguistic Skills to Reading Abilities in Children and ABE Students 2
  Phonological Awareness 3
  Morphological Awareness 4
  Orthographic Knowledge 5
  Shared and Unique Contributions of the Metalinguistic Skills to Reading Abilities 7
  Indirect Effects of the Metalinguistic Skills on Reading Comprehension 9
  Current Study 11

METHOD 14
  Participants 14
  Measures 14
  Procedure 16

RESULTS 23
  Checking for Data Issues and Descriptive Statistics 23
  RQ1: Importance of Metalinguistic Skills to Word Reading and Reading Comprehension 24
  RQ2: Examining Mediators of the Metalinguistic Skills-Reading Comprehension Relations 32

DISCUSSION 36
  Direct Contributions of the Metalinguistic Skills to Word Reading Skills 37
  Direct Contributions of the Metalinguistic Skills to Reading Comprehension 40
  Indirect Contributions of the Metalinguistic Skills to Reading Comprehension 42
  Educational Implications 44
  Limitations and Future Directions 45
  Conclusion 47

APPENDICES 65
  A. FSU IRB APPROVAL, RE-APPROVAL AND INFORMED CONSENT FORMS 65
  B. DEMOGRAPHIC SURVEY 70
  C. MORPHOLOGICAL AWARENESS AND ORTHOGRAPHIC KNOWLEDGE MEASURES 72

REFERENCES 80

BIOGRAPHICAL SKETCH 90
LIST OF TABLES

1. Descriptive Statistics for all Measures 49
2. Correlations Among the Measures 50
3. Model Fit Indices for all Word Reading and Reading Comprehension MIMIC Models 51
4. Model Fit Indices for Decoding and Vocabulary Mediation Models 52
5. Path Estimates of the Metalinguistic Skills with Decoding and Vocabulary as Mediators 53
LIST OF FIGURES

1. Hypothesized 4-Factor MIMIC Model of Word Reading 54
2. Hypothesized 4-Factor MIMIC Model of Word Reading Controlling for Age 55
3. Post-Hoc 4-Factor MIMIC Model of Word Reading I 56
4. Post-Hoc 4-Factor MIMIC Model of Word Reading II 57
5. Hypothesized 5-Factor MIMIC Model of Reading Comprehension 58
6. Hypothesized 5-Factor MIMIC Model of Reading Comprehension Controlling for Age 59
7. Post-Hoc 5-Factor MIMIC Model of Reading Comprehension I 60
8. Post-Hoc 5-Factor MIMIC Model of Reading Comprehension II 61
9. Mediators of the Morphological Awareness-Reading Comprehension Relationship 62
10. Mediators of the Phonological Awareness-Reading Comprehension Relationship 63
11. Mediators of the Orthographic Knowledge-Reading Comprehension Relationship 64
ABSTRACT

The purpose of this study was to investigate the shared and unique contributions of three metalinguistic skills to the word reading and reading comprehension abilities of Adult Basic Education (ABE) students. Across studies, the metalinguistic skills of phonological awareness, morphological awareness, and orthographic knowledge have emerged individually as important predictors of ABE students’ word reading and reading comprehension skills. In contrast to the children’s literature, no studies have simultaneously included and considered the shared and unique predictive utility of all three metalinguistic skills to reading skills in ABE students. In addition, the study examined whether the relations of the three metalinguistic skills to reading comprehension were mediated by decoding and vocabulary knowledge. Jointly, the best fitting models indicated that the predictors accounted for 64% of the word reading variance and 91% of the reading comprehension variance. The metalinguistic skills did not emerge as uniquely predictive of word reading or reading comprehension skills; however, all three metalinguistic skills were significantly, indirectly related to reading comprehension via decoding and vocabulary knowledge as mediators. These results help to develop a more comprehensive model of the underlying component processes involved in ABE students’ word reading and reading comprehension skills. The findings also may inform instructional practices and future intervention research in ABE programs.
INTRODUCTION

The competencies to manipulate and understand sound units (phonological awareness), letter and spelling patterns (orthographic knowledge), and small units of meaning (morphological awareness) are central processes to reading development (Apel & Masterson, 2001; Ehri, 1995, 2005; Nagy, 2007). Independently, each of these three metalinguistic skills has been identified as an important contributor to the word reading and reading comprehension skills of children (Deacon & Kirby, 2004; Conrad, Harris, & Williams, 2013) and adults enrolled in Adult Basic Education (ABE) classes (Tighe & Binder, 2015; Binder, Snyder, Ardoin, & Morris, 2011). Recent research has also suggested the importance of the simultaneous shared and unique contributions of these three metalinguistic skills to children’s reading abilities (Apel, Wilson-Fowler, Brimo, & Perrin, 2012; Deacon, 2012; Kim, Apel, & Al Otaiba, 2013; Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003; Roman, Kirby, Parrila, Wade-Woolley, & Deacon, 2009). In addition, some of the metalinguistic skills have also been found to exert indirect effects on children’s reading comprehension abilities through word reading skills (Deacon, Kieffer, & Laroche, 2014; Kieffer & Box, 2013; Jarmulocwicz, Hay, Taran, & Ethington, 2008) and vocabulary knowledge (Kieffer & Box, 2013; Nagy, Berninger, & Abbott, 2006). Although preliminary evidence suggests that individually these metalinguistic skills are important contributors to ABE students’ reading abilities, these skills have not been simultaneously included within a single study in order to investigate the shared and unique direct and indirect contributions of the metalinguistic skills to reading abilities in this population. Thus, the purpose of the current study was twofold: 1. to simultaneously examine the shared and unique direct contributions of the three metalinguistic skills to the word reading and reading comprehension abilities of ABE students; and 2. to investigate whether the metalinguistic skills exhibit unique
indirect effects on reading comprehension through decoding and vocabulary knowledge mediators.

**Importance of Metalinguistic Skills to Reading Abilities in Children and ABE Students**

Metalinguistic awareness is defined as the conscious ability to reflect on, understand, and manipulate the structural elements of written and spoken language (Nagy, 2007). Phonological awareness, morphological awareness, and orthographic knowledge are commonly recognized as the three primary metalinguistic skills (Apel & Masterson, 2001). These metalinguistic skills form the foundational knowledge required for the development of early word reading skills in children (Apel & Masterson, 2001; Ehri, 1995, 2005). Metalinguistic skills are also essential to higher order, complex reading comprehension skills (for a review see Nagy, 2007; Perfetti, 2007; Perfetti, Landi, & Oakhill, 2005). Because no research has examined the simultaneous influence of all three metalinguistic skills to the development of ABE students’ reading skills, I begin each section by presenting evidence of the importance of these metalinguistic skills to children’s reading abilities. Next, I expand upon and review the few studies that have investigated the predictive utility of at least one of the metalinguistic skills to the word reading and reading comprehension skills of ABE students. It is important to bear in mind that research on children can help guide and inform research for ABE students; however, it is not clear that these two populations exhibit similar component reading skill profiles (Nanda, Greenberg, & Morris, 2010; Greenberg, Ehri, & Perin, 1997, 2002; Thompkins & Binder, 2003).

**Phonological Awareness**

Phonological awareness, an individual’s knowledge and ability to reflect on the sound structure of language (Wagner & Torgesen, 1987), is the most extensively researched of the three metalinguistic skills. There is substantial evidence of the importance of phonological awareness
to the development of reading skills in children (for reviews see Adams, 1990; Ehri et al., 2001; National Reading Panel, 2000). Phonological awareness has emerged as a unique predictor of children’s reading abilities independent of several component skills including morphological awareness (Carlisle, 1995; Deacon, 2012; Kim et al., 2013; Roman et al., 2009), orthographic knowledge (Deacon, 2012; Badian, 2001; Kim et al., 2013; Roman et al., 2009), verbal IQ (Badian, 2001; Bradley & Bryant, 1983), vocabulary knowledge (Kim et al., 2013); nonverbal IQ (Bradley & Bryant, 1983), and rapid automatized naming (RAN) (Kirby, Parrila, & Pfeiffer, 2003; Roman et al., 2009). Some studies have suggested that the unique contribution of children’s phonological awareness to reading comprehension diminishes at higher grade levels, as word decoding skills become relatively automatic and orthographic and morphological skills become increasingly important (Badian, 2001; Carlisle, 1995; Deacon & Kirby, 2004; de jong and van der Leij, 2002; Singson, Mahony, & Mann, 2000).

Despite the prevalence of results affirming the importance of phonological awareness to reading skills in the children’s literature, the predictive utility of phonological awareness to reading skills has rarely been examined in the ABE population. Across four studies, phonological awareness emerged as an important predictor of word reading skills (Greenberg et al., 1997), reading comprehension (Thompkins & Binder, 2003; Tighe & Binder, 2015), and a composite score of word reading, fluency, and comprehension skills (Binder et al., 2011). In addition, Tighe and Schatschneider (in press a) reported a moderate effect size ($r = .34$) between phonological awareness and reading comprehension skills in struggling adult readers. This limited research suggests that phonological awareness is an independent contributor to ABE students’ reading skills. However, more research is necessary to assess the magnitude of the
shared and potential unique contribution of phonological awareness in conjunction with the other
two metalinguistic skills to reading abilities in this population.

Morphological Awareness

Morphological awareness, the conscious ability to understand and manipulate small units
of meaning (morphemes) to produce and decompose complex words (Carlisle, 1995), has also
been identified as an important predictor of word reading skills (Deacon, 2012; Carlisle &
Nomanbhoy, 1993; Kim et al., 2013; Kirby et al., 2012; Mahony, Singson, & Mann, 2000;
McCutchen, Green, & Abbott, 2008; Nagy et al., 2006; Roman et al., 2009; Singson et al., 2000)
as well as reading comprehension skills (Apel et al., 2012; Carlisle, 1988, 1995, 2000; Deacon &
Kirby, 2004; McCutchen et al., 2008; Nagy et al., 2006, 2003) in children across varying grade
levels. Moreover, morphological awareness has been found to contribute additional unique
variance to children’s reading abilities beyond the component skills of vocabulary knowledge
(Apel et al., 2012; Deacon, 2012; Kim et al., 2013; Nagy et al., 2006, 2003; Mahony et al., 2000;
Singson et al., 2000), phonological awareness (Apel et al., 2012; Carlisle, 1995; Carlisle &
Nomanbhoy, 1993; Deacon & Kirby, 2004; Deacon, 2012; Kim et al., 2013; Kirby et al., 2012;
Mahony et al., 2000; McCutchen et al., 2008; Nagy et al., 2003; Roman et al., 2009; Singson et
al., 2000), orthographic knowledge (Apel et al., 2012; Deacon, 2012; Kim et al., 2013; Nagy et
al., 2003; Roman et al., 2009), RAN (Apel et al., 2012; Roman et al., 2009), and verbal and
nonverbal IQ (Deacon & Kirby, 2004; Kirby et al., 2012).

Similarly, recent accumulating evidence indicates that morphological awareness is an
important predictor of ABE students’ word reading (To, Tighe, & Binder, in press) and reading
comprehension skills (Fracasso, Bangs, & Binder, in press; Herman, Gilbert-Cote, Reilly, &
Binder, 2013; Tighe & Binder, 2015; Tighe & Schatschneider, in press b; To et al., in press).
Morphological awareness has been found to contribute unique variance to reading comprehension after controlling for decoding (Herman et al., 2013; To et al., in press), phonological awareness (Tighe & Binder, 2015), and vocabulary knowledge (Tighe & Schatschneider, in press b). However, relative to the children’s literature, there is a dearth of research on the importance of morphological awareness to the word reading skills of ABE students and there is no research on the relationship of morphological awareness to reading abilities in conjunction with the other two metalinguistic skills.

**Orthographic Knowledge**

Orthographic knowledge is defined as an individual’s sensitivity to conventional spelling patterns and rules and an individual’s knowledge of mental representations of specific written words and/or word parts stored in memory (referred to as mental graphemic representations [MGRs]) (Apel, 2011). Considerable attention has been devoted to investigating the contribution of orthographic knowledge to children’s spelling skills (Conrad et al., 2013; Kim et al., 2013; Nagy et al., 2003; Walker & Hauerwas, 2006; Zhao, 2011); however, orthographic knowledge has also been identified as an important contributor to children’s word reading (Apel et al., 2012; Conrad et al., 2013; Cunningham, Perry, & Stanovich, 2001; Deacon, 2012; Kim et al., 2013; Nagy et al., 2003; Roman et al., 2009; Wagner & Barker, 1994) and reading comprehension skills (Apel et al., 2012; Badian, 2001; Nagy et al., 2003). In addition, orthographic knowledge has been found to contribute additional variance to word reading skills beyond phonological awareness (Apel et al., 2012; Conrad et al., 2013; Cunningham et al., 2001; Deacon, 2012; Kim et al., 2013; Nagy et al., 2003; Roman et al, 2009; Wagner & Barker, 1994), morphological awareness (Apel et al., 2012; Deacon, 2012; Kim et al., 2013; Nagy et al., 2003 Roman et al., 2009), RAN (Apel et al., 2012), vocabulary knowledge (Apel et al., 2012; Kim et al., 2013; Nagy
et al., 2003), and IQ (Wagner & Barker, 1994). However, in the two studies that included reading comprehension as an outcome measure as well as all three metalinguistic skills, orthographic knowledge did not contribute unique variance (after controlling for the other two metalinguistic skills and vocabulary and/or RAN) (Apel et al., 2012; Nagy et al., 2003). Badian (2001) reported that the unique predictive utility of preschool orthographic knowledge (controlling for the autoregressor effect of earlier reading skills, phonological skills, verbal IQ, and verbal memory) to later reading comprehension skills increased at subsequent grade levels (third and seventh grade levels). Thus, the unique role of orthographic knowledge in conjunction with the other two metalinguistic skills to reading comprehension has not been established in children between the second and fourth grade levels. However, it is not clear whether orthographic knowledge exerts a unique influence on reading comprehension skills at higher grade levels once both phonological awareness and morphological knowledge are taken into account.

Orthographic knowledge has also been identified as an important predictor of word reading (Greenberg et al., 1997), reading comprehension (Thompkins & Binder, 2003), and a composite score of reading skills (word reading, fluency and comprehension) in ABE students (Binder et al., 2011). Tighe and Schatschneider (in press a) reported a moderate effect size ($r = .40$) between orthographic knowledge and reading comprehension in struggling adult readers. Further, there is evidence that orthographic knowledge is a separable skill from phonological awareness, contributing unique variance to reading comprehension skills in this population (Thompkins & Binder, 2003). These studies suggest that orthographic knowledge is a significant independent contributor to adults’ reading skills. Further, the past findings indicate that orthographic knowledge may be an important unique contributor to adults’ reading
comprehension skills beyond phonological awareness. However, none of the research has assessed the joint and unique predictive utility of orthographic knowledge to word reading and reading comprehension skills while controlling for both phonological and morphological awareness.

**Shared and Unique Contributions of the Metalinguistic Skills to Reading Abilities**

To date, only a handful of studies have simultaneously included all three metalinguistic skills and investigated the shared and unique contributions of these skills to children’s word reading (Apel et al., 2012; Deacon 2012; Kim et al., 2013; Nagy et al., 2003; Roman et al., 2009) and reading comprehension skills (Apel et al., 2012; Nagy et al., 2003). In conjunction with age and vocabulary or RAN skills, the three metalinguistic skills accounted for a substantial portion of the variance in real and pseudoword reading skills (40% to 82%) in children across the first through eighth grade levels (Deacon, 2012; Roman et al., 2009). Likewise, the three metalinguistic skills and vocabulary knowledge captured a large amount of the reading comprehension variance in fourth graders (69%; Nagy et al., 2003). Thus, it is evident that there is considerable overlap among the three metalinguistic skills in predicting children’s word reading and reading comprehension abilities.

However, recent research has reported that the each of the metalinguistic skills make unique, direct contributions (controlling for the other two metalinguistic skills) to children’s reading skills. For example, Deacon (2012) reported that phonological awareness, morphological awareness, and orthographic knowledge each accounted for unique variance in first and third grade students’ real word (7%, 0.7%, 10%, respectively) and pseudoword reading skills (17%, 2%, 5%, respectively), after also controlling for age and vocabulary knowledge. Controlling for vocabulary knowledge and the other metalinguistic skills, Nagy et al. (2003)
reported that orthographic knowledge contributed unique variance to word reading skills and that morphological awareness emerged as a unique predictor of reading comprehension in second graders. Finally, Roman et al. (2009) included an older sample of fourth, sixth, and eighth graders and investigated the shared and unique contributions of age, the three metalinguistic skills and RAN skills to real word and pseudoword reading skills. All three metalinguistic skills emerged as unique contributors to both types of word reading skills. Collectively, these studies support evidence for considerable overlap as well as dissociable contributions of all three metalinguistic skills to the reading abilities of children across first through eighth grade levels.

Although none of the research in the adult literacy field has simultaneously investigated the contributions of all three metalinguistic skills to reading abilities, four studies have considered the concurrent predictive utility of combinations of two of the metalinguistic skills to reading abilities (Binder et al., 2011; Greenberg et al., 1997; Thompkins & Binder, 2003; Tighe & Binder, 2015). For example, Tighe and Binder (2015) reported that decoding, phonological awareness, and morphological awareness jointly accounted for 70% of the reading comprehension variance. Morphological awareness emerged as a unique predictor, capturing an additional 37% of the reading comprehension variance independent of phonological awareness. This finding is mirrored in a recent meta-analysis on struggling adult readers, which reported that morphological awareness exhibited a significantly stronger relationship with reading comprehension ($r = .59$) as compared to the relationship between phonological awareness and reading comprehension ($r = .34$) (Tighe & Schatschneider in press a).

Other studies have investigated the predictive utility of orthographic knowledge and phonological awareness to the reading skills of ABE students. For example, Thompkins and Binder (2003) found that three phonological tasks, a short-term memory task, a word-picture
pairing task, and two orthographic tasks accounted for 55% of the adults’ reading comprehension variance. Both orthographic tasks emerged as unique predictors; however, only one of the phonological tasks (a phonological spelling task) emerged as a unique predictor of reading comprehension skills. Binder et al. (2011) reported that phonological awareness, orthographic knowledge, and oral reading fluency emerged as unique predictors of ABE students’ reading skills (composite score of word reading, fluency, and comprehension). Finally, a few studies have indicated that ABE students may compensate for phonological deficits by relying more on their orthographic skills as compared to children matched on reading achievement levels (Greenberg et al., 1997, 2002; Thompkins & Binder, 2003). In summary, these studies suggest that independently the three metalinguistic skills are important component processes to ABE students’ word reading and comprehension abilities. In addition, these studies provide preliminary evidence that morphological and phonological awareness are distinct, important reading component skills and that orthographic knowledge and phonological skills are distinct, important reading component skills in this population. No studies have included both morphological awareness and orthographic knowledge or concurrently estimated the contributions of all three metalinguistic skills to reading abilities. Thus, the first aim of the current study was to simultaneously investigate the shared and potential unique, direct contributions of all three metalinguistic skills to word reading and reading comprehension skills in ABE students.

**Indirect Effects of the Metalinguistic Skills on Reading Comprehension**

Recent research in the children’s literature has found that the metalinguistic skills (with a particular emphasis on morphological awareness) exhibit direct and/or indirect effects (via word reading and/or vocabulary skills) on reading comprehension across multiple grades and varying
language backgrounds (Deacon et al., 2014; Jarmulocwicz et al., 2008; Kieffer, Biancarosa, & Mancilla-Martinez, 2013; Kieffer & Box, 2013; Kieffer & Lesaux, 2012; Nagy et al., 2006). For instance, Deacon et al. (2014) reported that third and fourth graders’ morphological awareness skills were partially mediated (exerted significant direct and indirect effects on reading comprehension) via word reading skills after controlling for phonological awareness, vocabulary, age, and nonverbal reasoning. Similarly, Kieffer and Box (2013) found that morphological awareness exhibited significant direct and indirect effects (via word reading fluency and academic vocabulary) to reading comprehension in both native English-speaking and Spanish-speaking sixth grade learners. In older, fourth to ninth graders, Nagy et al. (2006) also found support for partial mediation of morphological awareness to reading comprehension by reading vocabulary. In contrast, some studies have reported that the contributions of morphological awareness to reading comprehension are fully mediated by reading vocabulary (Goodwin, Huggins, Carlo, August, & Calderon, 2013) and decoding and morphophonological accuracy (a measure of proper primary stress placement in the production of derived, complex words; Jarmulocwicz et al., 2008). In addition, Kieffer and Lesaux (2012) reported that morphological awareness exhibited a direct effect on sixth graders’ reading comprehension skills that was not mediated by word reading fluency. Beyond morphological awareness, Jarmulocwicz et al. (2008) found that the relation of phonological awareness to reading comprehension was fully mediated by decoding skills, controlling for morphological awareness, receptive language, and morphophonological accuracy in a sample of third graders.

These studies present mixed findings and highlight some gaps in the literature as to the underlying mechanisms of the relations between metalinguistic skills and reading comprehension in children. Most notably, mediation analyses have not been conducted simultaneously to
investigate the relations of the three primary metalinguistic skills (morphological awareness, phonological awareness, and orthographic knowledge) to reading comprehension (via word reading and/or vocabulary skills). This seems striking given that many prominent reading theories have argued for the importance and intertwined role of these three metalinguistic skills to word reading (Apel & Masterson, 2001; Ehri, 1995, 2005), vocabulary acquisition (Nagy, 2007), and reading comprehension skills (Nagy, 2007; Perfetti, 2007; Perfetti et al., 2005). These models suggest that metalinguistic processing skills may influence reading directly as well as indirectly through word-level and meaning access and retrieval skills (e.g., vocabulary knowledge). Many of the divergent findings in the extant literature may be attributed to variability in the samples’ ages, grade levels, and language backgrounds as well as differences in the studies’ methods (e.g., types of mediator measures, outcome measures, and covariates included). Thus, further research is needed to elucidate the nature of the inter-relations among the metalinguistic skills and the influence of these skills on decoding and vocabulary knowledge mediators and reading comprehension skills.

Direct effects of the metalinguistic skills beyond decoding and vocabulary skills provide support for a model of reading comprehension that is more complex than the prominent Simple View of Reading (SVR) model (Gough & Tunmer, 1986; Hoover & Gough, 1990). The SVR postulates that reading comprehension represents the product of an individual’s decoding and linguistic comprehension skills (including vocabulary knowledge). There has been a plethora of empirical support for the SVR model with children enrolled in K-12 education (Goff, Pratt, Ong, 2005; Tilstra, McMaster, Van den Broek, Kendeou, & Rapp, 2009; Vellutino, Tunmer, Jaccard, & Chen, 2007; Verhoeven & van Leeuwe, 2008). In addition, a couple of studies have supported the SVR model with struggling adult readers (Braze, Tabor, Shankweiler, & Mencl, 2007;
Sabatini, Sawaki, Shore, & Scarborough, 2010). In struggling adult readers, the SVR component skills have accounted for a substantial amount of the reading comprehension variance (64-76%). However, neither of these studies investigated the role of the three metalinguistic skills in conjunction with the SVR components to adults’ reading comprehension skills. The additional unaccounted for reading comprehension variance may be attributable to metalinguistic skills in this population. Thus, in addition to considering the direct effects of the metalinguistic skills, the second aim of the current study was to examine whether any of the metalinguistic skills exhibited indirect effects on reading comprehension via decoding and vocabulary knowledge mediators in ABE students.

**Current Study**

The purpose of the current study was twofold. First, the shared and unique contributions of the three metalinguistic skills to the word reading and reading comprehension skills of ABE students were examined. Building off of the children’s literature, it was hypothesized that all three metalinguistic skills would emerge as unique predictors of word reading skills (Deacon 2012; Kim et al., 2013; Roman et al., 2009). In the adult literacy field, morphological awareness has been identified as a consistent predictor of reading comprehension (Herman et al., 2013; To et al., in press) even after controlling for phonological awareness (Tighe & Binder, 2015) and vocabulary knowledge (Tighe & Schatschneider, in press b). Thus, it was conjectured that morphological awareness would emerge as a unique predictor of reading comprehension skills, which is also consistent with the children’s literature (Nagy et al., 2003). Nagy (2007) hypothesized that some of the reading comprehension variance accounted for by vocabulary knowledge can be attributed to metalinguistic skills and therefore, vocabulary knowledge was included as a covariate in the analyses (for a review see Nagy, 2007).
Second, decoding skills and vocabulary knowledge were investigated as potential mediators of the relations between the three metalinguistic skills and reading comprehension. Despite theoretical conjectures (Nagy, 2007; Perfetti, 2007; Perfetti et al., 2005), a single study has not empirically and simultaneously investigated the direct and indirect effects (via word reading and vocabulary knowledge) of all three metalinguistic skills to reading comprehension in children or ABE students. The children’s literature has yielded mixed results as to the direct and indirect effects (via word reading and/or vocabulary knowledge) of the various metalinguistic skills (in particular morphological awareness) to children’s reading skills (Deacon et al., 2014; Goodwin et al., 2013; Jarmulowicz et al., 2008; Kieffer & Lesaux, 2012). However, the majority of the research supports partial mediation of morphological awareness via word reading (Deacon et al., 2014; Kieffer & Box, 2013) and vocabulary knowledge (Kieffer et al., 2013; Kieffer & Box, 2013; Kieffer & Lesaux, 2012; Nagy et al., 2006) to reading comprehension skills in children. Based on the past research, it was hypothesized that the morphological awareness-reading comprehension relation would be partially mediated by decoding and vocabulary knowledge in ABE students.

The current study addressed two primary research questions:

1. What are the magnitudes of the shared and unique, direct contributions of the metalinguistic skills and vocabulary knowledge to the word reading and reading comprehension skills of ABE students?

2. Do any of the metalinguistic skills exhibit indirect effects on reading comprehension via decoding and vocabulary knowledge mediators?
METHOD

Participants

The participants included 220 native English speaking adults enrolled in ABE classes in Leon County, Florida during the spring and fall semesters of 2014. The sample consisted of 49% females (N = 108) and the participants ranged in age (16-69), with a mean age of 24 (SD = 10.99). The participants represented a range of ethnic backgrounds: 62.3% African American, 26.8% Caucasian, 6.4% Hispanic, 4.0% Mixed, and .5% Asian. Using a self-report measure, 70.0% of the sample self-reported as unemployed and 27.7% of the participants reported having a diagnosed learning disability. The educational backgrounds of the participants also varied: .5% completed below middle school level, 12.2% completed some or all of middle school, 71.4% completed some high school, and 15.9% completed high school. It is important to note that the heterogeneity of this sample is consistent with national ABE programs (Lesgold & Welch-Ross, 2012) and therefore, this is a representative sample of ABE students. Participants were recruited for the study with the understanding that their information would be kept completely confidential and that they could terminate their participation at any time without consequence. Additionally, the participants received a ten-dollar Walmart gift card as compensation for their time.

Measures

An informed consent form was read aloud to the participants to ensure that they understood the nature of the study and the procedures (see Appendix A). A demographic survey addressing age, gender, and educational background was administered (see Appendix B). A battery of 14, individually administered literacy assessments encompassing decoding, phonological awareness, morphological awareness, orthographic knowledge, vocabulary, and
reading comprehension skills was administered (see Appendix C). Multiple measures of each construct were administered to permit the use of latent variables in the analyses.

**Decoding**

Decoding was assessed utilizing two subtests of the Test of Word Reading Efficiency-Second Edition (TOWRE-2) and a subtest of the Wide Range Achievement Test-Fourth Edition (WRAT-4).

**Test of Word Reading Efficiency – Second Edition.** The Phonemic Decoding Efficiency (PDE) and Sight Word Efficiency (SWE) subtests of the TOWRE-2 were administered. The TOWRE-2 is a norm-referenced, individually administered timed test designed to measure word and pseudoword reading accuracy and fluency (Torgesen, Wagner, & Rashotte, 2012). The PDE subtest presents the participant with a list of pseudowords and the participant is prompted to accurately read aloud as many pseudowords as possible in 45 seconds. The SWE subtest presents the participant with a list of real words and the participant is prompted to read aloud as many real words as possible in 45 seconds. The TOWRE-2 was normed on individuals aged 6 to 24 years, 11 months and the alternate forms reliability coefficients exceed .90 for the PDE and SWE subtests.

**Wide Range Achievement Test – Fourth Edition.** The Word Reading subtest of the WRAT-4 was administered. The WRAT-4 is a norm-referenced, individually administered test designed to assess basic word reading, sentence comprehension, spelling, and math skills (Wilkinson & Robertson, 2006). The Word Reading subtest presents participants with words to identify, which increase in difficulty as the test proceeds. Testing is discontinued when 10 consecutive errors are made. The WRAT-4 was normed on individuals aged five to 94 years and the Word Reading subtest has a test-retest reliability of .86.
Phonological Awareness

Phonological awareness was assessed utilizing three subtests of the Comprehensive Test of Phonological Processing – Second Edition (CTOPP-2).

Comprehensive Test of Phonological Processing – Second Edition. The Elision, Blending Words, and Phoneme Isolation subtests of the CTOPP-2 were administered. The CTOPP-2 is an individually administered, norm-referenced assessment of phonological processing skills, including phonological awareness, phonological memory, and rapid naming (Wagner, Torgesen, Rashotte, & Pearson, 2013). The 34-item Elision subtest is a phoneme deletion task that requires the participant to repeat a word presented orally (e.g., blend), and then repeat the word again after eliminating a specific sound (e.g., remove /l/ sound; bend). The 33-item Blending Words subtest assesses the ability to combine sounds to form new words. The participant listens to individually presented, audio-recorded sounds (e.g., t-oi) and then the participant is prompted to combine those sounds and say the newly formed word (e.g., toy). The 32-item Phoneme Isolation subtest requires the participant to isolate and identify individual sounds in words. For example, the examiner presents the word man and explains that it is comprised of three sounds (/m/ /a/ /n/). Next, the examiner prompts the participant to identify the first sound in the word man (/m/). Across all three subtests, testing is discontinued when the participant makes three consecutive errors. The CTOPP-2 was normed on individuals aged four to 24 years, 11 months. The internal consistency coefficients exceed .80 for the three subtests.

Morphological Awareness

We assessed morphological awareness using three experimental tasks that have been previously administered in ABE samples (Tighe & Binder, 2015; Tighe & Schatschneider, in press c). These tasks vary in terms of real word and pseudoword items as well as inflected and
derived items in order to represent a broad conceptualization of the construct of morphological awareness (Apel, Diehm, & Apel, 2013; Kuo & Anderson, 2006; Tighe & Schatschneider, in press c).

**Derived Form Morphology (DMORPH) Task.** This task, adapted from Carlisle (1988, 2000) and Leong (2000) and utilized in Tighe and Binder (2015) and Tighe and Schatschneider (in press c), assesses morphological structure by having participants’ transform root words into derived, complex words. The examiner reads aloud a target root word, which serves as a prime for the participant. Next, the examiner reads a short sentence ending with a blank. The participant is prompted to fill in the blank with the appropriate derived, complex word form of the initially given target root word. For example, “Happy. Money does not buy _____.; “happiness.” A correct response received one point and an incorrect response or no response received zero points. The participants had the task available to them visually to avoid decoding and reading difficulties while listening to the examiner read the test items. Participants were provided with two practice items followed by 28 test items. The Cronbach’s alpha coefficient for the DMORPH was .87 for the sample.

**Derivational Suffix Choice Test.** This test was adapted from Mahony (1994) and Singson et al. (2000) and utilized in Tighe and Schatschneider (in press c). The task was designed to assess an individual’s ability to manipulate morphemes using non-words. Participants were presented with the written form of the task and administered the task aloud to avoid listening, reading, and decoding difficulties as well as to reduce taxing working memory capacity. A sentence was presented with a blank and the participant was asked to select the appropriate answer choice from a list of four choices. For example, “Our teacher taught us how to _____ long words.” The answer choices included: “jitting”, “jittles”, “jittled”, and “jittle”.
The correct answer “jittle”, received one point while an incorrect answer or no answer received zero points. The task included one practice item and 18 test items. The Cronbach’s alpha coefficient for this task was .82 for the sample.

**Morphological Analogy Real Word Task.** This task was adapted from Nunes, Bryant, and Bindman (1997, 2006), Tong, Deacon, Kirby, Cain, and Parrila (2011), and Deacon (2012) and utilized in Tighe and Schatschneider (in press c). The task follows the format of A : B :: C : D, in which participants were presented both visually and orally with a pair of inflected words (either regular or irregular) and the first word of the second pair, “C”. The participant was asked to supply “D”, the second word from the second word pair. An example was: “push : pushed :: lose : ____.”; “lost” (an irregular change from present to past tense). A correct answer elicited one point and an incorrect or no answer resulted in zero points. The task consisted of a two-item practice round followed by 15 items. The Cronbach’s alpha coefficient for this task was .74 for the sample.

**Orthographic Knowledge**

We assessed orthographic knowledge with two commonly used experimental measures: Orthographic Choice Real Word (OCRW) task and Orthographic Choice Pseudoword (OCP) task. The OCRW task assesses mental graphemic representation (MGR) knowledge whereas the OCP task assesses orthographic pattern and rule knowledge. We decided to include tasks of both types of orthographic knowledge to best represent a broad conceptualization of the construct (Apel, 2011).

**Orthographic Choice Real Word Task.** This task, adapted from Olson, Forseberg, Wise, and Rack (1994) and Deacon (2012), measures an individual’s store of MGRs (Apel, 2011). The participant was presented with two alternative spellings of a word (e.g., rane and
rain) and asked to circle the word spelled correctly (e.g., rain). Incorrect response choices are phonologically plausible variations of the correct answer choice. A correct answer elicited one point and an incorrect or no answer resulted in zero points. The task consisted of two practice items followed by 30 test items. The Cronbach’s alpha coefficient for this task was .68 for the sample.

**Orthographic Choice Pseudoword Task.** This task, adapted from Cassar and Treiman (1997) and Apel et al. (2012), assesses knowledge of conventional orthographic patterns and rules. The participant was presented with a pair of pseudowords (e.g., zeg and zzeg) and prompted to circle the pseudoword that most closely resembled a real word (e.g., zeg). In this example, the double consonant zz in zzeg does not conform to traditional English orthographic rules; therefore, zeg is the best answer choice. A correct answer elicited one point and an incorrect or no answer resulted in zero points. The task consisted of two practice items followed by 35 items. The Cronbach’s alpha coefficient for this task was .67 for the sample.

**Vocabulary Knowledge**

Two norm-referenced vocabulary assessments were administered: the Peabody Picture Vocabulary Test-Fourth Edition (PPVT-4) and the Expressive One-Word Picture Vocabulary Test- Fourth Edition (EOWPVT-4).

**Peabody Picture Vocabulary Test – Fourth Edition.** The PPVT-4 is a norm-referenced measure of receptive vocabulary knowledge (Dunn & Dunn, 2007). The participant was presented orally with a word and four pictures and was prompted to select the picture that best matched the meaning of the word presented. The test included two practice items to familiarize participants with the format of the measure. Testing began on a set of 12 items dependent upon the participant’s age (age 10, set 9 was selected as the starting point for this
sample). If more than one error occurred in the initial set, testing continued with an easier set until a basal set was established. Once a basal set was determined, testing proceeded (with sets increasing in difficulty) until eight errors were reached. The test was normed on individuals aged 3-90 and has a split-half reliability of .94.

**Expressive One-Word Picture Vocabulary Test – Fourth Edition.** The EOWPVT-4 is a measure of expressive vocabulary, which refers to words an individual is able to utilize when speaking and/or writing (Martin & Brownell, 2011). The participant was presented with various pictures depicting objects, actions, and concepts. The participant was asked to provide a single-word name for each picture. Testing commenced on item 65 (age 8-0 to 9-11). A basal was established when the participant labeled eight consecutive pictures correctly. Testing continued (with items increasing in difficulty) until a ceiling was reached (six consecutive incorrect responses). This test was normed on individuals aged 2-103 years of age and has a median internal consistency reliability of .95.

**Reading Comprehension**

Reading comprehension was assessed using a timed, norm-referenced assessment, the Test of Silent Reading Efficiency and Comprehension (TOSREC). In addition, the most recent Reading subtest scores of the Test of Adult Basic Education (TABE) were obtained from the ABE centers.

**Test of Silent Reading Efficiency and Comprehension.** The TOSREC is a timed, individually administered measure, which assesses silent reading of connected text for comprehension (Wagner, Torgesen, Rashotte, & Pearson, 2010). Participants were presented with a list of sentences and asked to indicate “yes” or “no” as to the truthfulness of the sentences. The participants were allotted 3 minutes to read silently and respond to as many of the sentences
as possible. The test was normed on individuals in Grades 1-12. The version administered has an alternate forms reliability of .88.

**Test of Adult Basic Education – Reading Subtest (TABE).** The TABE, a nationally administered measure designed specifically for adults enrolled in literacy programs (CTB/McGraw-Hill, 2008), is comprised of five levels: L (literacy, GE = 0-1.9), E (easy, GE = 1.6-3.9), M (medium, GE = 3.6-6.9), D (difficult, GE = 6.6-8.9), and A (advanced, GE = 8.6-12.9). The Reading subtest requires adults to read brief passages and answer multiple-choice questions. The subtest includes narrative and expository texts as well as functional tests (i.e. completing employment applications, reading a newspaper or the yellow pages). The questions increase in difficulty at each level. For example, in the lowest level (L), the participants are asked to recognize letters and sounds, to identify simple vocabulary words, and to match letters. At increasing difficulty levels, participants are asked to interpret graphic information, to recall information, to construct meaning, and to make inferences from text. The Reading subtest contains 50 items. The internal consistency reliability ranges from .88 to .95 across the five levels.

**Procedure**

The 14 tasks were administered to the participants by trained graduate assistants to the participants in two 30 to 40-minute sessions over a two-day time frame. The demographic survey was always administered on the first session of testing. Session one tasks included the PPVT-4, Suffix Choice, OCRW, WRAT-4 Word Reading, and three CTOPP-2 subtests (Elision, Blending Words, and Phoneme Isolation). Session two tasks included the DMORPH, OCP, Analogy Real Word, EOWPVT-4, TOSREC, and two TOWRE-2 subtests (SWE and PDE). The order of the sessions and the order of the tasks within the sessions were counterbalanced to
eliminate time sampling error. Testing took place in a quiet classroom at each ABE center. Participants received a ten-dollar Walmart gift card at the conclusion of the second testing session. Of the 220 participants, 213 completed both days of testing. The participants’ most recent TABE-Reading scores were obtained from the ABE centers.
RESULTS

Checking for Data Issues and Descriptive Statistics

The data set was examined for outliers, skewness, kurtosis, restriction of range, and missing data utilizing Version 22 of the SPSS statistical package (IBM Corp, 2013). Across the 15 measures, a total of 46 univariate outliers were identified and brought to the boundaries of +/- two interquartile ranges. An examination of pairwise variable scatterplots, revealed no bivariate outliers. With the exception of the OCP task, all skewness and kurtosis values fell within an acceptable range (+/- 2), indicating that these variables were normally distributed. The OCP task was leptokurtic, with a kurtosis value of 3.86, and a slight negative skewness value of -1.62. To address this, a logarithmic transformation was applied to the OCP task, which resulted in a kurtosis value of .46 and a skewness value of -.63. Restriction of range was also investigated because ABE students exhibit low reading scores. To examine this, the standard deviations of the standard scores for all norm-referenced assessments were inspected. There was no evidence of restriction of range because all of the norm-referenced assessments exhibited standard deviations close to or above 15 (the appropriate standard deviation based on the norming sample). Because restriction of range was not observed for the norm-referenced assessments, we assumed restriction of range was also a non-issue for the experimental measures. Due to the relatively few missing data points across all measures (N= 58), missing data was handled using full information maximum likelihood estimation (Kline, 2011).

The means and standard deviations for the measures are presented in Table 1. Correlations among the measures and the participants’ ages are reported in Table 2. With the exception of the OCP task, the correlations reveal relatively high, significant positive relationships among the measures (ps < .05). The OCP task was not correlated with the PPVT-4
and the task was weakly to moderately, positively correlated with the other measures ($r$s ranging from .14 to .34). With the exception of the vocabulary tasks, participant age was weakly to moderately, negatively correlated with the other measures ($r$s ranging from -.11 to -.51). This is consistent with past research indicating that older ABE students exhibit lower performance on reading skills (particularly word-level skills) as compared to younger ABE students (MacArthur, Konold, Glutting, & Alamprese, 2012).

**RQ 1: Importance of Metalinguistic Skills to Word Reading and Reading Comprehension**

The first research question addressed the shared and unique, direct contributions of the metalinguistic skills and vocabulary knowledge to ABE students’ word reading and reading comprehension skills. To examine this question, a series of causal indicator models of word reading (see Figures 1-4) and reading comprehension (see Figures 5-8) were built utilizing Version 7.0 of the Mplus statistical package (Muthén & Muthén, 1998-2012). A causal indicator modeling approach represents an alternative to the traditional confirmatory factor analysis (CFA) approach (Bollen & Bauldry, 2011; Bollen & Davis, 2009; Kline, 2011). Causal indicator models reverse causal flow and allow the indicators to “cause” or comprise the latent construct (for a review see Bollen & Bauldry, 2011). In this case, the causal indicators (measures of metalinguistic and vocabulary skills) served as predictors and caused the variability in the outcome latent constructs (word reading and reading comprehension). Causal indicator models appear to have an identification problem because there is no unique set of estimates for the outcome latent constructs (i.e., word reading and reading comprehension). To handle this issue, a multiple indicator, multiple indicator cause (MIMIC) version of a causal indicator model can be specified. MIMIC models stipulate that the model is identified if the outcome latent construct emits arrows to reliable observed indicators of the intended construct (Treiblmaier, Bentler, &
Mair, 2011). Thus, for identification purposes, MIMIC models were utilized in which the word reading and reading comprehension latent constructs included appropriate observed indicators (i.e., multiple, reliable measures of word reading and reading comprehension skills). In addition, scale dependency was handled by fixing one indicator per latent construct to 1.0 for all models. For the purposes of evaluating good model fit, I relied on Hu and Bentler’s (1998) standards: Tucker Lewis Index (TLI) and Comparative Fit Index (CFI) values greater than .95, Root Mean Square Error of Approximation (RMSEA) values less than .08, and Standardized Root Mean Square Residual (SRMR) values of less than .05. Due to the non-nested structure of the reported models, I also provide Akaike Information Criterion (AIC) values, in which models with lower values (differences of 10 or greater between models) are preferred and deemed a more parsimonious fit to the data (Burnham & Anderson, 2004).

**MIMIC Models of Word Reading**

First, the hypothesized, 4-factor MIMIC model of word reading was run, which included latent causal indicators of morphological awareness, phonological awareness, orthographic knowledge, and vocabulary knowledge (Figure 1). For proper model identification, the word reading latent construct included three observed indicators (TOWRE-2 PDE and SWE and WRAT-4 Word Reading subtest). Observed morphological awareness tasks included the DMORPH, Suffix Choice, and Analogy Real Word, observed phonological awareness tasks included the three CTOPP-2 subtests, observed orthographic knowledge tasks included the OCP and OCRW, and observed vocabulary knowledge tasks included the PPVT-4 and EOWPVT-4. With the exception of the OCP task, all measures exhibited high factor loadings (.60 and greater; \( p < .001 \)). Although the four causal indicators accounted for a substantial amount of the shared word reading variance (\( R^2 = .809 \)), the model was not a good fit to the data as evidenced by the
model fit indices ($\chi^2(55) = 228.36, p < .001, \text{CFI} = .908, \text{TLI} = .869, \text{RMSEA} = .120, \text{SRMR} = .056, \text{and AIC} = 6341$) (Figure 1; Table 3). The correlations among the causal indicators were moderate to high ($rs$ ranging from .51 to .85); this may explain why none of the causal indicators emerged as significant unique predictors of adults’ word reading skills ($ps > .05$). A second model, controlling for participant age, led to a greater decrement in overall model fit ($\chi^2(67) = 336.56, p < .001, \text{CFI} = .864, \text{TLI} = .815, \text{RMSEA} = .135, \text{SRMR} = .101, \text{and AIC} = 6336$) (Figure 2; Table 3). Similar to the first model, the causal indicators did not account for unique variance in word reading skills ($ps > .05$); however, age did emerge as a significant, negative predictor of word reading skills ($\beta = -.137, p = .014$). This indicates that after controlling for the four component skills in the model, word reading performance decreases as participant age increases.

It is important to use caution when interpreting the hypothesized MIMIC models of word reading because these models exhibited poor fit to the data. As an attempt to resolve this, I decided to utilize an exploratory, post-hoc modeling approach and to rely on the modification indices as a way to improve model fit. Two notable and theoretically plausible modifications emerged: a. cross-loading the DMORPH task on the morphological awareness and vocabulary knowledge latent constructs (Figure 3); and b. removing the WRAT-4 Word Reading subtest because of the high collinearity with all of the other constructs in the model (Figure 4). I present and interpret both of these post-hoc models in detail below.

**Post-Hoc 4-Factor MIMIC Model of Word Reading I.** The first post-hoc model was identical to the 4-factor hypothesized MIMIC model with the exception that the DMORPH task was allowed to cross-load on the morphological awareness and vocabulary knowledge latent factors (Figure 3). Previous research has indicated that morphological awareness and vocabulary
knowledge are highly correlated ($r = .62$), yet separable constructs in ABE students (Tighe & Schatschneider, in press c) and may be a undimensional construct in children (Muse, 2005; Spencer et al., in press). In particular, the DMORPH task relies on the ability to apply morphological rules (i.e., shifting from *long* to *length*); however, the task also relies on contextual cues in which the participant is prompted to fill in a sentence blank with the proper morphological variant. Thus, participants can also rely on vocabulary knowledge and contextual cues to correctly complete the sentence. In contrast, the Analogy Real Word morphological task did not use contextual cues and the Suffix Choice morphological task used pseudowords exclusively. The use of pseudowords and the absence of contextual cues forces participants to rely more on their awareness of morphemic structure and less on their vocabulary knowledge (Tighe & Schatschneider, in press c).

This model provided reasonable fit to the data as evidenced by the model fit indices ($\chi^2(54) = 151.20, p < .001$, CFI = .948, TLI = .925, RMSEA = .090, SRMR = .044, and AIC = 6266) (Figure 3; Table 3); however, fit was still not acceptable based on the Hu and Bentler (1998) standards. The AIC value of 6266 is much lower than the two previous hypothesized models (AIC = 6341, 6336), indicating that the post-hoc model provided a better fit to the data (Table 3). Factor loadings were all on the appropriate constructs and significant ($ps < .001$). Jointly, the causal indicators accounted for 77% of the word reading variance; however, most likely as a result of the moderate to high correlations among the constructs, none of them accounted for unique word reading variance ($ps > .05$). In separate models without other predictors included, each causal indicator contributed significant variance to word reading skills: morphological awareness ($\beta = 1.03, p < .001, R^2 = .711$), phonological awareness ($\beta = .705, p < .001, R^2 = .497$), orthographic knowledge ($\beta = .765, p < .001, R^2 = .586$), and vocabulary
knowledge ($\beta = .514, p < .001, R^2 = .264$). Thus, all of the causal indicators are important and separable constructs in predicting adults’ word reading skills; however, it is difficult to tease apart the unique aspects of these constructs.

**Post-Hoc 4-Factor MIMIC Model of Word Reading II.** A second exploratory, post-hoc word reading model was run because fit could still be improved from the first post-hoc model (Figure 4). This model was identical to the first post-hoc model with the exception of the removal of the WRAT-4 Word Reading subtest from the word reading latent construct. According to the modification indices, cross-loading the WRAT-4 onto all of the other latent factors would improve the fit of the model. This can also be seen from my correlation matrix (Table 2), in which the WRAT-4 is highly correlated with measures from all of the constructs. The WRAT-4 differed from the other two word reading subtests (TOWRE-2 PDE and SWE) because it included more advanced words and this subtest was not timed. Thus, it was hypothesized that without a time limit the participants could spend longer applying their metalinguistic skills to sound out, to decompose into base words and affixes, and to identify familiar spelling patterns within words to help them recognize complex vocabulary items on the WRAT-4 reading list. In contrast, the two TOWRE-2 subtests focused more on word reading fluency and accuracy in identifying easier items. Therefore, the WRAT-4 was removed from my model and the outcome was considered more of a word reading fluency construct.

This model provided a good fit to the data as evidenced by the model fit indices ($\chi^2(43) = 85.14, p < .001, \text{CFI} = .973, \text{TLI} = .958, \text{RMSEA} = .067, \text{SRMR} = .038$, and $\text{AIC} = 5924$) (Figure 4; Table 3). This post-hoc model exhibited a lower AIC value (5924) than the first post-hoc model ($\text{AIC} = 6266$), which indicates better model fit (Table 3). All factor loadings were on the appropriate constructs and significant ($ps < .001$). Jointly, the predictors accounted for 64%
of the word reading fluency variance. Although none of the causal indicators accounted for significant unique word reading fluency variance, orthographic knowledge contributed an additional 4.2%; morphological awareness contributed an additional 3.4%; and phonological awareness and vocabulary knowledge each contributed an additional 1% controlling for all of the other causal indicators in the model. In separate models without other predictors included, each causal indicator contributed a substantial amount to the word reading fluency variance: morphological awareness ($\beta = .768, p < .001, R^2 = .590$), phonological awareness ($\beta = .657, p < .001, R^2 = .432$), orthographic knowledge ($\beta = .741, p < .001, R^2 = .548$), and vocabulary knowledge ($\beta = .435, p < .001, R^2 = .190$). Although none of the predictors emerged as significant unique predictors, all four skills contributed significant, independent variance when entered in separate word reading models. Moreover, the metalinguistic skills (morphological awareness, phonological awareness, and orthographic knowledge) appear to contribute more variance to word reading skills than vocabulary knowledge in this population.

**MIMIC Models of Reading Comprehension**

First, the hypothesized 5-factor MIMIC model of reading comprehension was run, which included latent causal indicators of decoding, morphological awareness, phonological awareness, orthographic knowledge, and vocabulary knowledge (Figure 5). For proper model identification, the reading comprehension latent construct included two observed indicators (TABE-Reading and TOSREC). The observed decoding measures included the WRAT-4 Word Reading subtest and the two TOWRE-2 subtests, the observed morphological awareness tasks included DMORPH, Suffix Choice, and Analogy Real Word, the observed phonological awareness tasks included the three CTOPP-2 subtests, the observed orthographic knowledge tasks included OCP and OCRW, and the observed vocabulary knowledge tasks included the PPVT-4 and EOWPVT-
4. Once again, with the exception of the OCP task, all measures loaded highly on their respective constructs (.60 and above) and all indicator loadings were significant ($p_s < .001$). The five causal indicators accounted for a substantial amount of the reading comprehension variance ($R^2 = .923$); however, the model was not a good fit to the data as evidenced by the model fit indices ($\chi^2(75) = 255.28, p < .001$, $CFI = .920$, $TLI = .887$, $RMSEA = .105$, $SRMR = .053$, and $AIC = 7196$) (Figure 5; Table 3). Once again, most likely as a result of the moderate to high correlations among the constructs, none of the causal indicators emerged as significant unique predictors of reading comprehension skills ($p_s > .05$). A second model, controlling for participant age, decreased overall model fit ($\chi^2(89) = 372.59, p < .001$, $CFI = .879$, $TLI = .837$, $RMSEA = .120$, $SRMR = .101$, and $AIC = 7197$) (Figure 6; Table 3). In contrast to the word reading results, participant age was not a significant unique predictor of reading comprehension skills ($\beta = .041$, $p = .424$).

Once again, due to the poor model fit of the hypothesized 5-factor MIMIC model, an exploratory, post-hoc approach was utilized in order to gain a clearer understanding of the inter-relationships among the component skills and their relations to reading comprehension. Identical to the word reading models, two post-hoc models of reading comprehension were specified: a. a model which allowed the DMORPH task to cross-load on the morphological awareness and vocabulary knowledge latent constructs; and b. a model that included the cross-loaded DMORPH task and dropped the WRAT-4 word reading subtest from the model. I present and interpret the details of these two post-hoc reading comprehension models below.

**Post-Hoc 5-Factor MIMIC Model of Reading Comprehension I.** The first post-hoc model was identical to the 5-factor hypothesized MIMIC model with the exception that the DMORPH task was allowed to cross-load on the morphological awareness and vocabulary
knowledge latent factors (Figure 7). This model yielded adequate fit to the data as evidenced by the model fit indices ($\chi^2(74) = 178.21, p < .001, \text{CFI} = .953, \text{TLI} = .934, \text{RMSEA} = .080, \text{SRMR} = .043, \text{lower AIC value} = 7212$) (Figure 7; Table 3). The AIC value of 7121 is acceptably lower than the previous two hypothesized models (AIC = 7196, 7197), indicating that the post-hoc model provided a better fit to the data (Table 3). Factor loadings were all on the appropriate constructs and significant ($p$s < .001). Jointly, the five causal indicators accounted for 90% of the variance in reading comprehension. Decoding and vocabulary knowledge contributed significant, unique variance (7.1% and 2.2%, respectively) after controlling for the other predictors in the model. Looking at Figure 7, it appears as though the metalinguistic skills are not significant predictors of reading comprehension; however, high collinearity is still present among the predictor constructs ($r$s ranging from .51 to .85). In separate models without other predictors included, each causal indicator contributed significant variance to reading comprehension: decoding ($\beta = .876, p < .001, R^2 = .771$), morphological awareness ($\beta = .918, p < .001, R^2 = .843$), phonological awareness ($\beta = .710, p < .001, R^2 = .504$), orthographic knowledge ($\beta = .791, p < .001, R^2 = .625$), and vocabulary knowledge ($\beta = .752, p < .001, R^2 = .566$).

Overall, decoding and vocabulary knowledge emerged as the only unique predictors of adults’ reading comprehension skills; however, all of the causal indicators accounted for significant reading comprehension variance when included in separate models.

**Post-Hoc 5-Factor MIMIC Model of Reading Comprehension II.** The second post-hoc model was identical to the first post-hoc model with the exception of the removal of the WRAT-4 Word Reading subtest from the decoding latent construct (Figure 8). This model provided excellent fit to the data as evidenced by the model fit indices ($\chi^2(61) = 105.65, p < .001, \text{CFI} = .977, \text{TLI} = .965, \text{RMSEA} = .058, \text{SRMR} = .037, \text{and AIC} = 6777$) (Figure 8; Table
This post-hoc model exhibited a lower AIC value (6777) than the first post-hoc model (AIC = 7121), which indicates better model fit (Table 3). The factor loadings were all on the appropriate constructs and significant (ps < .001). Jointly, the five causal indicators accounted for 91% of the variance in reading comprehension. Similar to the previous model, decoding and vocabulary knowledge contributed significant, unique variance to reading comprehension (8.1% and 2.6%, respectively) after controlling for the other predictors in the model. In conjunction with the other predictors in the model, the metalinguistic skills did not account for any unique reading comprehension variance; however, all of the predictors contributed significant variance in separate models: decoding ($\beta = .850, p < .001, R^2 = .722$), morphological awareness ($\beta = .918, p < .001, R^2 = .843$), phonological awareness ($\beta = .710, p < .001, R^2 = .504$), orthographic knowledge ($\beta = .791, p < .001, R^2 = .625$), and vocabulary knowledge ($\beta = .752, p < .001, R^2 = .566$). Overall, the five causal indicators accounted for a substantial amount of the reading comprehension variance ($R^2 = .912$); however, decoding and vocabulary knowledge were the only unique predictors of adults’ reading comprehension skills.

**RQ2: Examining Mediators of the Metalinguistic Skills-Reading Comprehension Relations**

The second research question addressed whether decoding and vocabulary knowledge mediated the relations between each metalinguistic skill and reading comprehension. The series of 5-factor MIMIC models revealed that none of the metalinguistic skills exhibited direct, significant relations with reading comprehension after controlling for the other metalinguistic skills, decoding, and vocabulary knowledge. However, based on past theory and research, it is plausible that each metalinguistic skill may have an indirect relation with reading comprehension through decoding and/or vocabulary knowledge mediators. To address this, separate, 3-factor MIMIC models of reading comprehension by metalinguistic skill were run with decoding skills.
and vocabulary knowledge as mediators (Figures 9-11). The observed indicators of the latent constructs for these models were based off of the post-hoc 5-factor MIMIC II model (cross-loaded DMORPH task and elimination of the WRAT-4 Word Reading) because this was the best fitting reading comprehension model. Each model provided the unique, direct effect of the metalinguistic skill to the decoding and vocabulary knowledge mediators as well as the unique, direct effects of the metalinguistic skill, decoding, and vocabulary knowledge to reading comprehension. The indirect effects (via decoding and vocabulary knowledge) of each metalinguistic skill to reading comprehension were also computed using bootstrapped (5,000 iterations) 95% confidence intervals in version 7.0 of Mplus (Muthén & Muthén, 1998-2012). Estimation of bootstrapped confidence intervals for indirect effects is preferred to standard significance values \((p\text{-values})\) because the indirect \((a*b)\) term is not normally distributed at the population level and the bootstrapped confidence intervals can account for this; whereas a z-test or t-test does not (MacKinnon, 2008). Significance is achieved if the 95% confidence interval does not cross 0. Thus, I report overall model fit indices based on the Hu and Bentler (1998) standards, \(p\text{-values}\) for the significance test of all direct effects, and bootstrapped 95% confidence intervals for the significance test of all indirect mediator effects below.

**Decoding and Vocabulary Knowledge Mediator Models**

A series of three models investigated whether decoding and vocabulary knowledge mediated the relations between each metalinguistic skill and reading comprehension (Figures 9-11). The morphological awareness model displayed excellent fit to the data \(\chi^2(21) = 30.57, p = .081, \text{CFI} = .993, \text{TLI} = .988, \text{RMSEA} = .046, \text{SRMR} = .028, \text{and AIC} = 4186\) (Figure 9; Table 4); however, the phonological awareness \(\chi^2(30) = 92.45, p < .001, \text{CFI} = .956, \text{TLI} = .934, \text{RMSEA} = .097, \text{SRMR} = .060, \text{and AIC} = 4920\) and orthographic knowledge \(\chi^2(22) = 94.54, p \)
<.001, CFI = .942, TLI = .905, RMSEA = .122, SRMR = .062, and AIC = 4381) models did not achieve adequate fit based on the Hu and Bentler (1998) standards (Figures 10 and 11, respectively; Table 4). The three models accounted for between 88-92% of the total reading comprehension variance.

Although none of the metalinguistic skills exhibited direct effects on reading comprehension (ps > .05), each metalinguistic skill exhibited significant direct effects on decoding (βs ranging from .70 to .78) and significant indirect effects on reading comprehension via decoding (βs ranging from .40 to .44) (Figures 9-11; see Table 5 for all path estimates, significance values, and confidence intervals). Similarly, each metalinguistic skill exerted significant direct effects on vocabulary knowledge (βs ranging from .53 to .59) and significant indirect effects on reading comprehension via vocabulary (βs ranging from .21 to .28) (Figures 9-11; see Table 5 for all path estimates, significance values, and confidence intervals). Thus, all three of the metalinguistic skills were fully mediated by decoding and vocabulary knowledge, controlling for the direct effects in the model. The magnitudes of the direct and indirect path weights of all three metalinguistic skills to decoding and reading comprehension via decoding were higher than those of the metalinguistic skills to vocabulary knowledge and reading comprehension via vocabulary knowledge (Figures 9-11; Table 5). This indicates that decoding may be a stronger mediator of the metalinguistic skills to reading comprehension than vocabulary knowledge. Decoding and vocabulary knowledge contributed significant, direct effects on reading comprehension in all of the mediation models (ps < .001; Figures 9-11). Morphological awareness was the only metalinguistic skill that exhibited a direct effect on reading comprehension that approached significance (p = .083). Morphological awareness exhibited a high correlation with decoding (r = .85), which may have impacted the significance
of the direct contribution of this skill to reading comprehension. These results extend the findings of the first research question by providing support that the metalinguistic skills are important to reading comprehension (indirectly through decoding and vocabulary knowledge mediators).
DISCUSSION

The purpose of the current study was to investigate the importance of three metalinguistic skills to the word reading and reading comprehension skills of ABE students. The results indicated that the metalinguistic skills and vocabulary knowledge accounted for a large amount of the word reading variance (64-81% across models); however, none of these skills emerged as uniquely predictive of word reading abilities. Similarly, the metalinguistic skills, decoding, and vocabulary knowledge accounted for the majority of the reading comprehension variance (90-93% across models); however, decoding and vocabulary knowledge only emerged as unique predictors in the post-hoc models. Although none of the metalinguistic skills were uniquely predictive of reading comprehension, all three of these skills exerted indirect influences on reading comprehension via decoding and vocabulary knowledge as mediators. These findings have two important implications for the adult literacy field. First, the lack of any significant, direct effects of the metalinguistic skills to word reading and reading comprehension is in contrast to the majority of the findings in the children’s literature (Apel et al., 2012; Deacon, 2012; Kim et al., 2013; Nagy et al., 2003; Roman et al., 2009). This suggests that the inter-relationships and contributions of the component reading skills to reading abilities may differ between these groups. Explanations for possible deviations in the findings are expanded upon in greater detail below. Second, this study highlights the complexity of ABE students’ reading comprehension skills and the intricacies inherent in the inter-relationships and contributions of different component skills to reading comprehension. The findings further our knowledge of building a more comprehensive model of adults’ reading comprehension skills and contribute to our understanding of important component skills to target in future intervention research and instructional practices in ABE programs.
Direct Contributions of the Metalinguistic Skills to Word Reading Skills

A primary aim of the study was to investigate the shared and unique contributions of the three metalinguistic skills and vocabulary knowledge to ABE students’ word reading skills. The best fitting model, post-hoc model II, indicated that jointly the four skills accounted for 64% of the word reading variance (Figure 4); however, none of these skills contributed unique variance to word reading skills. Despite the lack of significant unique effects, in separate models, each metalinguistic skill emerged as a significant predictor of word reading skills, with morphological awareness and orthographic knowledge accounting for the most variance (59% and 55%, respectively). These findings are in contrast to three studies conducted with children, which reported that the three metalinguistic skills emerged as significant predictors of word reading skills after controlling for vocabulary (Deacon, 2012; Kim et al., 2013), RAN (Roman et al., 2009), and participant age (Deacon, 2012; Roman et al., 2009). An additional study reported that only morphological awareness and orthographic knowledge uniquely predicted word reading skills after controlling for phonological awareness, receptive vocabulary, and RAN (Apel et al., 2012). However, the total word reading variance accounted for across these studies (40-82%) aligns with estimates from the current study (64-81% across models; Figures 1-4).

There are a few explanations for the deviations in the predictor uniqueness findings. First, the majority of the children’s research that included all three skills was conducted with early elementary school children (first to third grades; Apel et al., 2012; Deacon, 2012; Kim et al., 2013); however, the mean reading grade equivalency (RGE) of the current ABE sample was higher, approximately a seventh grade level. During the early elementary school years, children are still learning to read and may be relying heavily on metalinguistic information (sounds, spelling patterns, and affixes) to properly decode words (Ehri, 1995, 2005). In contrast, these
adults may be in the reading-to-learn phase, in which higher-order comprehension skills (e.g., inferencing, comprehension monitoring, working memory) may become more important to improving reading skills (Cain & Oakhill, 2007; Oakhill & Cain, 2012). Alternatively, these adults may be compensating for decoding and metalinguistic deficits by relying on whole-word recognition when identifying words presented in isolation and contextual cues when reading connected text (Binder & Borecki, 2008; Read & Ruyter, 1985). Past research on the spelling errors produced by ABE students compared to achievement-matched children has indicated that ABE students are more prone to make phonological and morphological errors as well as guesses on unfamiliar words not semantically related to the target word supplied (e.g., wonder instead of would; Liberman, Rubin, Duques, & Carlisle, 1995; Worthy and Viise, 1996; Viise, 1992). Thus, these types of spelling errors may translate to and be indicative of ABE students’ general deficits in applying metalinguistic skills to decoding unfamiliar words when reading.

Second, the correlations among the three metalinguistic skills ($r$s ranging from .27 to .61) and the correlations among the metalinguistic skills and word reading ($r$s ranging from .40 to .76) were much lower across the children’s studies (Apel et al., 2012; Deacon, 2012; Kim et al., 2013; Roman et al., 2009) compared to the ABE students ($r$s ranging from .55 to .85 for metalinguistic skills; $r$s ranging from .68 to .85 for the metalinguistic skills and decoding across models). These findings indicate that the pattern of correlations among the skills may be greater in the ABE sample; however, the metalinguistic skills still emerged as separable constructs in this population. Because these three metalinguistic skills have not previously been simultaneously investigated in the ABE population, it is not clear whether this pattern of correlations is sample specific or generalizable to ABE students generally. We found that age was significantly, negatively related to word reading skills and this should be followed up with a
larger sample size to investigate potential differences in the contributions of the metalinguistic skills to word reading with different age groups. For instance, the phonological awareness and speeded decoding tasks (in particular pseudoword decoding) exhibited the strongest, negative correlations with age ($r$s ranging from -.32 to -.51; Table 2). This is consistent with past research, which suggests that older ABE students have weaker performance on word-level skills (including phonological awareness; Nanda, Greenberg, & Morris, 2014; MacArthur et al., 2012) and that in general, ABE students compensate for phonological and decoding deficits and instead, rely on contextual and orthographic information (Greenberg et al., 1997, 2002; Thompkins & Binder, 2003). Thus, the metalinguistic skills may exhibit differential relationships with word reading dependent upon age.

Third, many of the children’s studies conducted multiple regression analyses separately by real word and pseudoword reading (Deacon, 2012; Roman et al., 2009) or only included real word reading (Apel et al., 2012; Kim et al., 2013). Overall, the metalinguistic skills were more highly correlated with and accounted for more variance in the real word reading analyses (73-82%) compared to the pseudoword reading analyses (40-75%; Deacon, 2012; Roman et al., 2009). The best fitting model in the current study utilized a latent decoding variable, which included speeded real word and pseudoword tasks. A recent meta-analysis conducted with struggling adult readers reported a stronger relation between real word decoding and reading comprehension ($r = .52$) compared to the moderate relation between pseudoword decoding and reading comprehension ($r = .42$; Tighe & Schatschneider, in press a). Thus, real word and pseudoword decoding may exhibit differential relations with adults’ component skills as well. Future research should include additional measures to examine whether the contributions of the metalinguistic skills differ by latent real word versus pseudoword reading factors.
Direct Contributions of the Metalinguistic Skills to Reading Comprehension

Another primary aim of the study was to examine the shared and unique influences of the three metalinguistic skills to reading comprehension in ABE students. The best fitting model, post-hoc II, revealed that jointly the three metalinguistic skills, decoding and vocabulary knowledge captured 91% of the reading comprehension variance. Decoding and vocabulary knowledge emerged as the only unique contributors to reading comprehension (8.1% and 2.6%, respectively); however, in separate, single predictor models each metalinguistic skill accounted for a large amount of the reading comprehension variance (50-84%). These findings indicate that all of these component skills are important to ABE students’ reading comprehension skills and lend further support to the SVR model in this population (Braze et al., 2007; Sabatini et al., 2010). To more accurately reflect the original SVR model (Gough & Tunmer, 1986; Hoover & Gough, 1990), future studies should also include a listening comprehension factor in order to assess its relations with the other SVR components, metalinguistic skills, and reading comprehension.

Based on the growing evidence of the importance of morphological awareness to reading comprehension in ABE students (Fracasso et al., in press; Herman et al., 2013; Tighe & Binder, 2015; Tighe & Schatschneider, in press a, b; To et al., in press), it was surprising that this finding was not replicated in this study. In a separate, single predictor model, morphological awareness accounted for a substantial amount of the reading comprehension variance (84%). Thus, it appears that morphological awareness is an important contributor; however, the skill exhibits high correlations with the other metalinguistic skills (rs ranging from .80 to .85 across models) and decoding (rs ranging from .79 to .85 across models). In addition, morphological awareness was highly correlated with reading comprehension (r = .81) in this sample. The high correlations
among the constructs make the results difficult to interpret and it is not clear whether these correlations are sample specific or a result of the nature of these constructs in this population.

Although none of the metalinguistic skills emerged as having a significant, direct influence on reading comprehension, there is preliminary evidence that the unique contributions of component skills may vary across ABE students’ reading levels (Tighe & Schatschneider, in press b). Utilizing a multiple quantile regression approach, Tighe and Schatschneider (in press b) investigated the shared and unique contributions of morphological awareness and vocabulary knowledge across five reading comprehension quantiles. The results indicated that morphological awareness had a greater, unique contribution at lower reading levels whereas vocabulary knowledge had a greater, unique contribution at higher reading levels. Thus, it is possible that the contributions of morphological awareness as well as the other metalinguistic skills and SVR component skills may vary as a function of ABE students’ reading level. Further, there is recent evidence of the existence of multiple subgroups of adult learners with different profiles of reading component skills within the same ABE programs (Binder & Lee, 2012; MacArthur et al., 2012; Mellard, Fall, & Mark, 2009; Strucker, Yamamoto, & Kirsch, 2007). This also suggests that the importance of individual component skills may vary as a function of reading level. ABE programs provide a suitable setting to explore differences in the factor structure of component skills and the changing trajectory of the shared and unique contributions of component skills to reading comprehension because multiple grade levels are represented within the same classroom (Lesgold & Welch-Ross, 2012).

To my knowledge, only two studies have investigated the direct contributions of the three metalinguistic skills to reading comprehension in the children’s literature (Apel et al., 2012; Nagy et al., 2003). Apel et al. (2012) reported that none of the metalinguistic skills emerged as
unique predictors of reading comprehension in a small sample of second and third graders \((N = 56);\) morphological awareness approached significance, \(p = .057\). In a larger sample, Nagy et al. (2003) found that morphological awareness was a unique contributor to reading comprehension in at-risk second graders; however, none of the skills emerged as uniquely predictive in at-risk fourth graders. Similar to Tighe and Schatschneider (in press b), these findings indicate that morphological awareness may be more important at earlier grade levels. However, it is difficult to compare between studies because of differences in the covariates, samples, analyses, and measures utilized. Thus, future research needs to investigate further the inter-relationships among the metalinguistic skills and possible direct contributions of these skills to reading comprehension in various samples and grade levels.

**Indirect Contributions of the Metalinguistic Skills to Reading Comprehension**

The final aim of the current study was to explore the unique, indirect contributions of the metalinguistic skills (via decoding and vocabulary knowledge mediators) to reading comprehension in ABE students. Although none of the metalinguistic skills exhibited direct influences on reading comprehension, all three skills were significantly, indirectly related to reading comprehension via decoding and vocabulary knowledge mediators. This is a novel finding because mediation effects for all three metalinguistic skills have not been simultaneously investigated with children or ABE students. However, these findings need to be interpreted with caution because of the high correlations among the constructs and because the phonological awareness and orthographic knowledge mediation models did not achieve acceptable model fit (Figures 10 & 11, Table 5; Hu & Bentler, 1998).

The morphological awareness mediation model provides the most interpretable results because of the excellent model fit statistics (Figure 9; Table 5; Hu & Bentler, 1998) and the
extensive past literature on the indirect influences of morphological awareness to children’s reading comprehension skills (Deacon et al., 2014; Goodwin et al., 2013; Jarmulocwicz et al., 2008; Kieffer et al., 2013; Kieffer & Box, 2013; Kieffer & Lesaux, 2012; Nagy et al., 2006). The majority of the past research supported partial mediation of the morphological awareness-reading comprehension relation via decoding (Deacon et al., 2014; Kieffer & Box, 2013) but more prominently via vocabulary knowledge (Kieffer et al., 2013; Kieffer & Box, 2013; Kieffer & Lesaux, 2012; Nagy et al., 2006). In addition, one study reported that reading vocabulary fully mediated the morphological awareness-reading comprehension relation (Goodwin et al., 2013). The current study did not find a direct effect of morphological awareness; however, despite the high correlations among constructs, the direct morphological awareness path to reading comprehension did approach statistical significance ($p = .083$), and thus, warrants further investigation in this population.

Interestingly, and in contrast to all of the past children’s literature, morphological awareness (in addition to the other two metalinguistic skills), exhibited larger, direct-path weights to decoding (and indirectly to reading comprehension through decoding) compared to the direct-path weights to vocabulary knowledge (and indirectly to reading comprehension through vocabulary). This suggests that ABE students may rely more on metalinguistic skills to promote identification of individual words in order to free up additional cognitive resources (e.g., working memory, inferencing) for comprehending complex text. This finding seems striking because empirical evidence from the SVR model with children has reported a decrease in the importance of word reading skills to reading comprehension and increase in the importance of language skills (e.g., vocabulary knowledge) to reading comprehension at higher grade levels (e.g., middle and high school level; Adlof, Catts, & Little, 2006; Tighe, Wagner, &
Schatschneider, 2015; Tilstra et al., 2009; Verhoeven & van Leeuwe, 2008). The mean RGE of these adults is approximately a seventh grade level; however, it may be the case that the adults have less impoverished oral language skills (e.g., vocabulary knowledge) relative to their decoding skills and therefore, rely less on metalinguistic skills to facilitate accurate comprehension via vocabulary knowledge. Alternatively, the tasks utilized in the current study strictly assessed oral vocabulary knowledge and therefore, did not require the participant to read or explicitly define any of the words. Thus, these tasks are more indicative of vocabulary breadth and may not draw on metalinguistic skills as overtly as tasks that assess vocabulary depth (i.e., reading and definitional vocabulary tasks). Future research should consider including tasks that incorporate vocabulary breadth and depth to assess whether these types of vocabulary are differentially related to metalinguistic skills in this population.

**Educational Implications**

The results of this study have important implications for researchers and practitioners in the ABE field. For both groups, the findings help to build a more informative and comprehensive model of ABE students’ reading comprehension. The five component skills accounted for the majority of the reading comprehension variance (91%) and the metalinguistic skills exerted indirect effects on reading comprehension via decoding and vocabulary knowledge. This indicates that interventions and instructional practices aimed at improving metalinguistic skills may build decoding skills, broaden vocabulary knowledge, and subsequently, increase reading comprehension skills. Past intervention research and meta-analyses, specifically investigating explicit morphological instruction with children (many that were exclusive to struggling readers), has reported growth in vocabulary knowledge (Bowers & Kirby, 2010; Goodwin & Ahn, 2010, 2013; Nunes & Bryant, 2006), word reading (Berninger et
al., 2008; Goodwin & Ahn, 2013; Katz & Carlisle, 2009; Nunes & Bryant, 2006) and reading comprehension skills (Bowers, Kirby, & Deacon, 2010; Goodwin & Ahn, 2010; Katz & Carlisle, 2009). Some of the morphological intervention research has paired or supplemented instruction with the additional metalinguistic skills of phonological awareness (Nunes & Bryant, 2009) and orthographic knowledge (Berninger et al., 2008) and this idea of integrated instruction has been reported as effective to improving multiple literacy outcomes (Bowers et al., 2010; Reed, 2008). Thus, an integrated instructional approach targeting aspects of all three of the metalinguistic skills may also help improve several literacy outcomes for struggling adult readers and should be explored in an ABE context.

**Limitations and Future Directions**

There are a few limitations worth noting. First, and most prominently, the collinearity issue among the constructs limited the interpretability of many of the results. As previously mentioned, the inter-correlations among the metalinguistic constructs appear higher than those noted in the children’s literature (Apel et al., 2012; Deacon, 2012; Kim et al., 2013; Nagy et al., 2003; Roman et al., 2009). In addition, the correlations between the metalinguistic skills (in particular morphological awareness), decoding, and reading comprehension are higher than those noted in other ABE samples (Tighe & Binder, 2015; Tighe and Schatschneider, in press a; To et al., in press). Because no study has simultaneously investigated the three metalinguistic skills, decoding, and vocabulary knowledge within an ABE sample, it is not clear whether these findings are specific to this sample or generalizable to all students in ABE programs. Basing models off of the children’s literature is also difficult because it is not clear that ABE students and children exhibit similar component reading skill profiles (Greenberg et al., 1997, 2002; Nanda et al., 2010; Thompkins & Binder, 2003). Adding further complexity to this issue is the
inherent heterogeneity of the ABE population in terms of age, race and ethnicity, educational background, prevalence of learning disabilities, and English proficiency status (Lesgold & Welch-Ross, 2012). Some recent evidence has suggested that component skills may differ between native and non-native English speaking ABE students (Nanda et al., 2010 Strucker et al., 2007), whereas one study reported the same component skill factor structure regardless of language background (MacArthur, Konold, Glutting, & Alamprese, 2010). Much more research is needed to investigate the factor structure of adults’ component skills and possible variations in component skill profiles by the diverse demographic characteristics and varying reading levels in this population. It would also be helpful to include a direct, multiple group factor structure comparison of component skill between ABE students and children matched on reading achievement-level.

Second, the originally hypothesized word reading and reading comprehension models did not reach adequate model fit in this sample (Hu & Bentler, 1998). The current study utilized many norm-referenced assessments that are commonly administered to children. For instance, the CTOPP-2 and TOWRE-2 are normed on samples only up to age 24. It is not clear whether these norm-referenced assessments exhibit appropriate construct validity in ABE samples (see Greenberg, Pae, Morris, Calhoon, & Nanda, 2009; MacArthur et al., 2010; Nanda et al., 2014; Pae, Greenberg, & Williams, 2012). In addition, both of our experimental orthographic knowledge measures exhibited low reliability estimates (Cronbach’s alphas of .67 and .68) and one of these, the OCP task, revealed ceiling effects. Thus, the orthographic knowledge latent construct may not have been a good indicator of ABE students’ orthographic knowledge. Future research needs to investigate the psychometric properties and appropriateness of using norm-
referenced assessments and experimental orthographic knowledge and morphological awareness measures in this population.

Third, the post-hoc I and II models that achieved acceptable fit to the data accounted for a preponderance of the reading comprehension (90-91%) and word reading (64-77%) variance; however, there remains additional unaccounted for variance in the outcome constructs. For predictors of word reading skills, many of the children’s research has also investigated the contribution of RAN (Apel et al., 2012; Kirby et al., 2003; Roman et al., 2009). It would also be useful to include more untimed measures of word reading because our final post-hoc II model was more of a word reading fluency latent factor. For reading comprehension, the higher-order, cognitive processes of working memory (Seigneuric & Ehrlich, 2005), verbal reasoning (Tighe et al., 2015), comprehension monitoring (Oakhill & Cain, 2012), and inferencing and integration (Oakhill & Cain, 2012) have all been identified as important component skills in the children’s literature. The majority of these component skills have not been assessed with the ABE population (Tighe & Schatschneider, in press a) and should be considered in future research.

**Conclusion**

Despite the limitations, the current study has enhanced the recently growing body of literature on component reading skills of ABE students. Jointly, the three metalinguistic skills and vocabulary knowledge accounted for 64% of ABE students’ word reading skills. In addition, the four skills and decoding accounted for 91% of ABE students’ reading comprehension variance, with decoding and vocabulary knowledge emerging as unique contributors. This study has also provided evidence for significant, indirect effects of phonological awareness, morphological awareness, and orthographic knowledge to reading comprehension via decoding and vocabulary knowledge mediators. These findings suggest the
need to integrate direct, metalinguistic instruction into ABE programs to effectively improve decoding, vocabulary, and subsequently reading comprehension skills. Future research is needed to further our understanding of the inter-relationships among the metalinguistic skills and their relations to multiple word reading and reading comprehension levels of ABE students.
Table 1
*Descriptive Statistics for all Measures*

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Table 2
Correlations Among the Measures

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<td>5. DMor</td>
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<td>6. Suffix</td>
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<td>7. ARW</td>
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<td>8. OCRW</td>
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<td>9. OCPW</td>
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<td>10. Elision</td>
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<td>11. BW</td>
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<td>.27</td>
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<td>.38</td>
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<tr>
<td>13. PPVT</td>
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<td>14. EOWPVT</td>
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<td>15. TABE-R</td>
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<td>16. TOSREC</td>
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</tr>
</tbody>
</table>

Correlations are significant, p < .05. aCorrelations are not significant, p > .05.
Table 3  
*Model Fit Indices for all Word Reading and Reading Comprehension MIMIC Models*

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$(df)</th>
<th>$p$</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA</th>
<th>SRMR</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Word Reading</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Hypothesized 4-Factor</td>
<td>228.36(55)</td>
<td>&lt;.001</td>
<td>.908</td>
<td>.869</td>
<td>.120</td>
<td>.056</td>
<td>6341</td>
</tr>
<tr>
<td>2. Hypothesized (with age)</td>
<td>336.56(67)</td>
<td>&lt;.001</td>
<td>.864</td>
<td>.815</td>
<td>.135</td>
<td>.101</td>
<td>6336</td>
</tr>
<tr>
<td>3. Post-Hoc 4-Factor I</td>
<td>151.20(54)</td>
<td>&lt;.001</td>
<td>.948</td>
<td>.925</td>
<td>.090</td>
<td>.044</td>
<td>6266</td>
</tr>
<tr>
<td>4. Post-Hoc 4-Factor II</td>
<td>85.14(43)</td>
<td>&lt;.001</td>
<td>.973</td>
<td>.958</td>
<td>.067</td>
<td>.038</td>
<td>5924</td>
</tr>
<tr>
<td><strong>Reading Comprehension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Hypothesized 5-Factor</td>
<td>255.28(75)</td>
<td>&lt;.001</td>
<td>.920</td>
<td>.887</td>
<td>.105</td>
<td>.053</td>
<td>7196</td>
</tr>
<tr>
<td>2. Hypothesized (with age)</td>
<td>372.59(89)</td>
<td>&lt;.001</td>
<td>.879</td>
<td>.837</td>
<td>.120</td>
<td>.101</td>
<td>7197</td>
</tr>
<tr>
<td>3. Post-Hoc 4-Factor I</td>
<td>178.21(74)</td>
<td>&lt;.001</td>
<td>.953</td>
<td>.934</td>
<td>.080</td>
<td>.043</td>
<td>7121</td>
</tr>
<tr>
<td>4. Post-Hoc 5-Factor II</td>
<td>105.65(61)</td>
<td>&lt;.001</td>
<td>.977</td>
<td>.965</td>
<td>.058</td>
<td>.037</td>
<td>6777</td>
</tr>
</tbody>
</table>

*Note:* $\chi^2$ = chi-square statistic. df = degrees of freedom. CFI = Comparative Fit Index. TLI = Tucker-Lewis Index. RMSEA = Root Mean Square Error of Approximation. SRMR = Standardized Root Mean Square Residual. AIC = Akaike Information Criterion.
Table 4  
Model Fit Indices for Decoding and Vocabulary Mediation Models

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$(df)</th>
<th>$p$</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA</th>
<th>SRMR</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Morphological Awareness</td>
<td>30.57(21)</td>
<td>.081</td>
<td>.993</td>
<td>.988</td>
<td>.046</td>
<td>.028</td>
<td>4186</td>
</tr>
<tr>
<td>2. Phonological Awareness</td>
<td>92.45(30)</td>
<td>&lt;.001</td>
<td>.956</td>
<td>.934</td>
<td>.097</td>
<td>.060</td>
<td>4920</td>
</tr>
<tr>
<td>3. Orthographic Knowledge</td>
<td>94.54(22)</td>
<td>&lt;.001</td>
<td>.942</td>
<td>.905</td>
<td>.122</td>
<td>.062</td>
<td>4381</td>
</tr>
</tbody>
</table>

Note: $\chi^2$ = chi-square statistic. df = degrees of freedom. CFI = Comparative Fit Index. TLI = Tucker-Lewis Index. RMSEA = Root Mean Square Error of Approximation. SRMR = Standardized Root Mean Square Residual. AIC = Akaike Information Criterion.
Table 5
Path Estimates of the Metalinguistic Skills with Decoding and Vocabulary as Mediators

<table>
<thead>
<tr>
<th>Construct</th>
<th>β</th>
<th>SE</th>
<th>Sig</th>
<th>( R^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Morphological Awareness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Effect on RC</td>
<td>.184</td>
<td>.106</td>
<td>.083</td>
<td>.898</td>
</tr>
<tr>
<td>Direct Effect on Decoding</td>
<td>.780</td>
<td>.038</td>
<td>&lt;.001</td>
<td>.609</td>
</tr>
<tr>
<td>Indirect Effect on RC (a*b)(^1)</td>
<td>.423</td>
<td>.080</td>
<td>[.266, .580](^a)</td>
<td>--</td>
</tr>
<tr>
<td>Direct Effect on Vocabulary</td>
<td>.533</td>
<td>.057</td>
<td>&lt;.001</td>
<td>.284</td>
</tr>
<tr>
<td>Indirect Effect on RC (a*b)(^2)</td>
<td>.211</td>
<td>.043</td>
<td>[.127, .296](^a)</td>
<td>--</td>
</tr>
<tr>
<td><strong>Phonological Awareness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Effect on RC</td>
<td>.010</td>
<td>.094</td>
<td>.912</td>
<td>.884</td>
</tr>
<tr>
<td>Direct Effect on Decoding</td>
<td>.696</td>
<td>.047</td>
<td>&lt;.001</td>
<td>.485</td>
</tr>
<tr>
<td>Indirect Effect on RC (a*b)(^1)</td>
<td>.439</td>
<td>.072</td>
<td>[.298, .581](^a)</td>
<td>--</td>
</tr>
<tr>
<td>Direct Effect on Vocabulary</td>
<td>.585</td>
<td>.055</td>
<td>&lt;.001</td>
<td>.343</td>
</tr>
<tr>
<td>Indirect Effect on RC (a*b)(^2)</td>
<td>.279</td>
<td>.049</td>
<td>[.183, .374](^a)</td>
<td>--</td>
</tr>
<tr>
<td><strong>Orthographic Knowledge</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Direct Effect on RC</td>
<td>.179</td>
<td>.128</td>
<td>.161</td>
<td>.915</td>
</tr>
<tr>
<td>Direct Effect on Decoding</td>
<td>.748</td>
<td>.059</td>
<td>&lt;.001</td>
<td>.559</td>
</tr>
<tr>
<td>Indirect Effect on RC (a*b)(^1)</td>
<td>.401</td>
<td>.105</td>
<td>[.196, .607](^a)</td>
<td>--</td>
</tr>
<tr>
<td>Direct Effect on Vocabulary</td>
<td>.582</td>
<td>.062</td>
<td>&lt;.001</td>
<td>.339</td>
</tr>
<tr>
<td>Indirect Effect on RC (a*b)(^2)</td>
<td>.241</td>
<td>.053</td>
<td>[.138, .345](^a)</td>
<td>--</td>
</tr>
</tbody>
</table>

Note: All mediation models control for the direct effects of decoding and vocabulary knowledge. \(^1\)Decoding mediating the indirect effect. \(^2\)Vocabulary mediating the indirect effect. RC = Reading Comprehension. Because the indirect (a*b) paths are not normally distributed at the population level, bootstrapped 95% confidence intervals are reported instead of \( p \)-values. A significant indirect effect is detected if the 95% confidence interval does not include 0. \(^a\)Statistically significant indirect effect.
Figure 1
Hypothesized 4-Factor MIMIC Model of Word Reading

Figure 2
Hypothesized 4-Factor MIMIC Model of Word Reading Controlling for Age

Figure 3
*Post-Hoc 4-Factor MIMIC Model of Word Reading I*

Figure 4
Post-Hoc 4-Factor MIMIC Model of Word Reading II

Figure 5
Hypothesized 5-Factor MIMIC Model of Reading Comprehension

Note: These are standardized parameter estimates. TABE = Test of Adult Basic Education. TOSREC = Test of Silent Reading Efficiency and Comprehension. WRAT = Word Recognition Achievement Test. PDE = Phonemic Decoding Efficiency. SWE = Sight Word Efficiency. OCP = Orthographic Choice Pseudoword. OCRW = Orthographic Choice Real Word. BW = Blending Words. PI = Phoneme Isolation. PPVT = Peabody Picture Vocabulary Test. EOWPVT = Expressive One-Word Picture Vocabulary Test. Dmor = Derived Form Morphology. ARW = Analogy Real Words.
Figure 6
Hypothesized 5-Factor MIMIC Model of Reading Comprehension Controlling for Age

Note: These are standardized parameter estimates. TABE = Test of Adult Basic Education. TOSREC = Test of Silent Reading Efficiency and Comprehension. WRAT = Word Recognition Achievement Test. PDE = Phonemic Decoding Efficiency. SWE = Sight Word Efficiency. OCP = Orthographic Choice Pseudoword. OCRW = Orthographic Choice Real Word. BW = Blending Words. PI = Phoneme Isolation. PPVT = Peabody Picture Vocabulary Test. EOWPVT = Expressive One-Word Picture Vocabulary Test. Dmor = Derived Form Morphology. ARW = Analogy Real Words.
Figure 7
Post-Hoc 5-Factor MIMIC Model of Reading Comprehension I

Note: These are standardized parameter estimates. TABE = Test of Adult Basic Education. TOSREC = Test of Silent Reading Efficiency and Comprehension. WRAT = Word Recognition Achievement Test. PDE = Phonemic Decoding Efficiency. SWE = Sight Word Efficiency. OCP = Orthographic Choice Pseudoword. OCRW = Orthographic Choice Real Word. BW = Blending Words. PI = Phoneme Isolation. PPVT = Peabody Picture Vocabulary Test. EOWPVT = Expressive One-Word Picture Vocabulary Test. Dmor = Derived Form Morphology. ARW = Analogy Real Words.
Figure 8
Post-Hoc 5-Factor MIMIC Model of Reading Comprehension II

Note: These are standardized parameter estimates. TABE = Test of Adult Basic Education. TOSREC = Test of Silent Reading Efficiency and Comprehension. WRAT = Word Recognition Achievement Test. PDE = Phonemic Decoding Efficiency. SWE = Sight Word Efficiency. OCP = Orthographic Choice Pseudoword. OCRW = Orthographic Choice Real Word. BW = Blending Words. PI = Phoneme Isolation. PPVT = Peabody Picture Vocabulary Test. EOWPVT = Expressive One-Word Picture Vocabulary Test. Dmor = Derived Form Morphology. ARW = Analogy Real Words.
Figure 9
Mediators of the Morphological Awareness-Reading Comprehension Relationship

Note: These are standardized parameter estimates. For model simplicity, the observed indicators of the latent constructs are not depicted.
Figure 10
Mediators of the Phonological Awareness-Reading Comprehension Relationship

Note: These are standardized parameter estimates. For model simplicity, the observed indicators of the latent constructs are not depicted.
Figure 11

Mediators of the Orthographic Knowledge-Reading Comprehension Relationship

Note: These are standardized parameter estimates. For model simplicity, the observed indicators of the latent constructs are not depicted.
APPENDIX A

FLORIDA STATE UNIVERSITY
IRB APPROVAL, RE-APPROVAL AND INFORMED CONSENT FORMS

Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 04/07/2014
To: Elizabeth Tighe
Address: PSYCHOLOGY DEPARTMENT
Dept.: PSYCHOLOGY DEPARTMENT
From: Thomas L. Jacobson, Chair
Re: Use of Human Subjects in Research
Assessing the Importance of Metalinguistic Skills to Word Reading and Reading Comprehension in Adult Basic Education Students

The application that you submitted to this office in regard to the use of human subjects in the research proposal referenced above has been reviewed by the Human Subjects Committee at its meeting on 02/12/2014.

Your project was approved by the Committee.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 02/11/2015 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing, any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Christopher Schatschneider <schatschneider@psy.fsu.edu>,
HSC No. 2014.11927
Re-Approval Form

Office of the Vice President For Research
Human Subjects Committee
P. O. Box 3062742
Tallahassee, Florida 32306-2742
(850) 644-8673 · FAX (850) 644-4392

RE-APPROVAL MEMORANDUM

Date: 12/11/2014
To: Elizabeth Tighe <

Address:

Dept.: PSYCHOLOGY DEPARTMENT
From: Thomas L. Jacobson, Chair

Re: Re-approval of Use of Human subjects in Research:
Assessing the Importance of Metalinguistic Skills to Word Reading and Reading Comprehension in Adult Basic Education Students

Your request to continue the research project listed above involving human subjects has been approved by the Human Subjects Committee. If your project has not been completed by 12/09/2015, you must request renewed approval by the Committee.

If you submitted a proposed consent form with your renewal request, the approved stamped consent form is attached to this re-approval notice. Only the stamped version of the consent form may be used in recruiting of research subjects. You are reminded that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report in writing, any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chairman of your department and/or your major professor are reminded of their responsibility for being informed concerning research projects involving human subjects in their department. They are advised to review the protocols as often as necessary to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

Cc: HSC No. 2014.14280
Informed Consent Form

Title of Study: Assessing the Importance of Metalinguistic Skills to Word Reading and Reading Comprehension in Adult Basic Education Students

You are invited to be in a research study investigating different aspects of words (prefixes, suffixes), sounding out words, word reading, vocabulary knowledge, and reading comprehension. You were selected as a possible participant because we are looking at these skills in adults enrolled in literacy classes. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by Elizabeth Tighe, Department of Psychology, Florida State University. This research is being supervised by Dr. Christopher Schatschneider, Professor of Psychology, Department of Psychology, Florida State University and Associate Director of the Florida Center for Reading Research (FCRR).

Background Information:

The purpose of this study is to investigate adults’ abilities to recognize different words and non-words across a variety of tasks and how these abilities relate to reading comprehension. This study could better inform instructional practice in Adult Basic Education settings.

Procedures:

If you agree to be in this study, we would ask you to do the following things:
You will complete 14 different mini tasks over two-days. The tasks will include reading lists of words, sounding out words, vocabulary and reading comprehension questions. You will be asked to complete analogies, identify pictures, fill in the blanks, and answer multiple-choice type questions. Additionally, you will complete a demographic survey with questions pertaining to your age, ethnicity, gender, and previous schooling information. You will be given 7 tasks the first day and 7 tasks the second day. At the end of the second day, you will receive a $10 Walmart gift card as compensation for your time.

Risks and benefits of being in the Study:

A potential risk is that you may feel discouraged if some of the questions seem to be difficult. There are no grades associated with these tests and the results will be kept confidential and anonymous. These results will not be shared with your classroom teachers and will have no impact on any of your school-related work.

The benefits to participation are that this research will help to understand adults’ reading skills and to better inform classroom instruction in Adult Basic Education programs.

Compensation:
You will receive payment: a $10 Walmart gift card as compensation for your time on the second day of testing, after you have completed the entire battery of tasks.

Confidentiality:

The records of this study will be kept private and confidential to the extent permitted by law. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Florida State University or the Adult Basic Education center. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting these relationships.

TABE Scores

We would like to be granted access to your TABE scores to use in the study. Scores will not be affiliated with your name and only the primary researcher, Elizabeth Tighe, will have access to these scores.

If you approve of scores being released, please sign and print below:

Signature: ______________________________
Print: __________________________________

Contacts and Questions:

The primary researcher conducting this study is Elizabeth Tighe. You may ask any questions you have now. If you have a question later, you are encouraged to contact her at (XXX) XXX-XXX. You can also contact the researcher supervisor, Dr. Christopher Schatschneider at (850) 644-4323, or by email at schatschneider@psy.fsu.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researchers, you are encouraged to contact the FSU IRB at 2010 Levy Street, Research Building B, Suite 276-C, Tallahassee, FL 32306-2742, or 850-644-7900, or by email at humansubjects@magnet.fsu.edu.

You will be given a copy of this information to keep for your records.

Statement of Consent:
I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

________________  _________________
Signature                                           Date

________________  _________________
Print                                               Date

________________  _________________
Signature of Investigator                    Date
APPENDIX B

DEMOGRAPHIC SURVEY

1. What is your age? _________

2. What is your gender? _____Female _____Male

3. What is your ethnicity? (Check all that apply)
   _____Caucasian
   _____Black/African-American
   _____Hispanic/Latino
   _____Native American
   _____Asian/Asian-American
   _____Other Please list ______________________________

4. Are you currently employed? _____Yes _____No

5. Do you enjoy reading? _____Yes _____No

6. Are you currently enrolled in college as an undergraduate (for A.A or B.A)?
   _____Yes, at a four-year college/university, ________________________
   _____Yes, at a two-year community college, ________________________
   _____Withdrew/On a leave of absence
   _____No, I already graduated from college
   _____No, I’ve never attended college
   _____Other (ex. took a college course, online college degree)

7. Have you completed high school? ___ Yes ___No

8. If you did not complete high school at what age did you leave formal schooling? _________

9. Do you plan on attending a 2- or 4-year college? _____Yes _____No

10. Whose class/program are you currently enrolled in at the ABE center (GED, pre-GED)?
    ___________ (list teacher and name of center)

11. What is the highest level of education your parent(s) attained? (Place “M” next to the appropriate line for your mother’s highest level of education and “F” for your father’s highest level of education)
    _____High School, did not graduate (or earlier)
    _____High School graduate
    _____Trade/Business School
    _____Some College, did not graduate
    _____Associate Degree
    _____Bachelors Degree
Some postgraduate education, no advanced degrees
One or more advanced degrees

12. What country did you mainly grow up in? ____________________________
a. If you were not born in the U.S.: 
   what age did you move to the U.S.? ________
   what was the highest grade level you completed in your home country? ________
   what was the highest grade level you completed in the U.S.? ________
b. If you mainly lived in the U.S.: 
   what was the highest grade level you completed? ____________

13. What is your native language? ____________________________
a. If English is not your first language, at what age did you begin learning English? ________
b. In your native language, can you: ___speak fluently ___read ___write

14. If English is not your native language:
   In your native language, did you have:
   difficulty learning how to read? ____Yes ____No
   difficulty learning how to spell? ____Yes ____No

15. When you were learning English (both native and non-native speakers), did you ever have:
   difficulty learning how to read? ____Yes ____No
   difficulty learning how to spell? ____Yes ____No

16. Did you ever repeat any grade(s)? ____Yes ____No Grade(s) ____________________

17. In school, have you ever:
   received specialized reading instruction? ____Yes ____No
   been tutored due to great difficulty with readings? ____Yes ____No

18. Have you ever been formally diagnosed with a learning difficulty (such as a specific learning disability, dyslexia, dysgraphia, AD/HD, etc.)? ____Yes ____No

19. What goals are you hoping to achieve through your Adult Basic Education courses? 
________________________________________________________________________
________________________________________________________________________
APPENDIX C

MORPHOLOGICAL AWARENESS AND ORTHOGRAPHIC KNOWLEDGE MEASURES

Derived Form Morphology (DMORPH) Task

Practice

a. Farm. My uncle is a _____. [Farmer]

b. Help. My sister is always _____. [Helpful]

No-Change Condition

1. Warm. He chose the jacket for its _____. [Warmth]

2. Teach. He was a very good _____. [Teacher]

3. Four. The cyclist came in _____. [Fourth]

4. Remark. The speed of the car was _____. [Remarkable]

5. Reason. Her argument was quite _____. [Reasonable]

6. Final. After trying many times he won the game______. [Finally]

7. Assist. The teacher will give you _____. [Assistance]

Orthographic Change Condition

1. Adventure. The trip sounded _____. [Adventurous]

2. Glory. The view from the hilltop was _____. [Glorious]

3. Happy. Money does not buy ______. [Happiness]

4. Expense. The new car was ______. [Expensive]

5. Noise. The children were very ______. [Noisy]


7. Rely. The babysitter was ______. [Reliable]

Phonological Change Condition
1. Human. The kind man was known for his _____. [Humanity]

2. Equal. Boys and girls are treated with ______. [Equality]

3. Major. He won the vote by a ______. [Majority]

4. Drama. The actress was very ______. [Dramatic]

5. Engine. He works as an ______. [Engineer]

6. Music. He is a talented ______. [Musician]

7. Heal. The mother was worried about her son’s ______. [Health]

*Both Change Condition*

1. Deep. The lake was well known for its ______. [Depth]

2. Produce. The play was a grand ______. [Production]

3. Explain. His excuse was a bad ______. [Explanation]

4. Absorb. She chose the sponge for its ______. [Absorption]

5. Permit. Father refused to give ______. [Permission]

6. Long. They measured the ladder’s ______. [Length]

7. Expand. The company planned an ______. [Expansion]

*Derivational Suffix Choice Test*

*Practice*

Our teacher taught us how to _______ long words.
  a. jittling  b. jittles  c. jittled  d. jittle

*Test Items*

1. _______ makes me happy.
   a. blopness  b. bloply  c. blopish  d. blopable

2. The _______ boy plays soccer.
a. tweagness  b. tweagish  c. tweagment  d. tweagtion

3. The girl dances _______.
   a. spridderish  b. spr riddered  c. spridderly  d. spridding

4. She met her first _______ when she moved out.
   a. benedumptize  b. benedumptify  c. benedumptist  d. benedumptuous

5. I could feel the _______.
   a. froodly  b. froodful  c. frooden  d. froodness

6. What a completely _______ idea.
   a. tribacious  b. tribicism  c. tribacize  d. tribation

7. I admire her _______.
   a. sufilive  b. sufilify  c. sufilation  d. sufilize

8. Where do they _______ the money?
   a. curfamic  b. curfamity  c. curfamate  d. curfamation

9. Please _______.
   a. scriptial  b. scriptize  c. scriptist  d. scriptious

10. We should _______ that money by the end of the year.
    a. relaptification  b. relaptify  c. relaptian  d. relaptable

11. The meeting was very _______.
    a. lorialize  b. lorial  c. lorialism  d. lorify

12. You must _______ them quickly or you’ll ruin the colors
    a. premanicism  b. premanicize  c. premanicity  d. premanic

13. I just heard a _______ story.
    a. dantment  b. dantine  c. danticism  d. dandify
14. Dr. Smith is a famous ________.
   a. cicarist   b. cicarize   c. cicarify   d. cicarial

15. He wants to_______ while he still can.
   a. fidamoration   b. fidamorian   c. fidamoralional   d. fidamorate

16. Can you ________ both sides?
   a. romify   b. romity   c. romious   d. romative

17. He has too much ________.
   a. brinable   b. brinicity   c. brinify   d. brinicious

18. Please try to be as _______ as possible.
   a. progenalism   b. progenalize   c. progenious   d. progenify

**Morphological Analogy Real Word Task**

*Practice*

a. Zip : Zips :: Dog : _____(Dogs)
   b. Shipped : Ship :: Reached : _____ (Reach)

*Test Items*

1. Push : Pushed :: Lose : ______(Lost)
2. Found : Founded :: Wake : ____ (Woke)
3. Sit : Sitting :: Frame : _____(Framing)
4. Yell : Yells :: Teach : _____(Teaches)
5. Cried : Cry :: Drew : _____(Draw)
6. Ponder : Pondered :: Catch : ____ (Caught)
7. Walked : Walk :: Kept : _____(Keep)
8. Pull : Pulled :: Light : _____Lit
9. Treat: Treated :: Stand : _____(Stood)
10. Opening : Open :: Sliding : _____(Slide)
11. Dogs : Dog :: Eyes : _____(Eye)
12. Close : Closed :: Sleep : _____ (Slept)
13. Squeeze : Squeezed :: Fly : _____(Flew)
15. Helped : Help :: Drove : _____(Drive)

**Orthographic Choice Real Word Task**

P1 rane  rain
P2 hurt  hert

1. nostrels  nostrils
2. applause  aplause
3. betwean  between
4. salmon  sammon
5. backword  backward
6. explane  explain
7. stream  streem
8. wagon  wagun
9. arraignment  arrainment
10. absence  absense
11. parashute  parachute
12. adress  address
13. fluoride  flooride
14. calendar  calender
15. separate  
16. camaraderie  
17. arctic  
18. mediocre  
19. disintegrate  
20. counterfeit  
21. amateur  
22. apparent  
23. conscience  
24. dismantle  
25. relevant  
26. rhythm  
27. sergeant  
28. supersede  
29. column  
30. boundary  

Orthographic Choice Pseudoword Task

P1 zegzzeg  
P2 viss viww  
1. abbe akke  
2. ttunos tunoss  
3. latt llat  
4. pomm ppom
<p>| 5. noop   | niip   |
| 6. gance  | ganse  |
| 7. tible  | tibl   |
| 8. ckug   | cug    |
| 9. datch  | dach   |
| 10. sork  | sorc   |
| 11. pibble| pibbel |
| 12. chunce| chunse |
| 13. chacke| chake  |
| 14. krasp | crasp  |
| 15. chank | changk |
| 16. jaat  | jeet   |
| 17. cottle| cottie |
| 18. litch | lich   |
| 19. sarc  | sark   |
| 20. miggle| miggel |
| 21. ckak  | kak    |
| 22. keach | keatch |
| 23. shink | shingk |
| 24. crid  | krid   |
| 25. sek   | seck   |
| 26. sonse | sonce  |</p>
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<td>28. rach</td>
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<td>29. angk</td>
<td>ank</td>
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<td>30. zattle</td>
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<td>31. fark</td>
<td>farc</td>
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<td>32. pance</td>
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<td>33. haak</td>
<td>heek</td>
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<td>34. zuck</td>
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<td>35. zoatch</td>
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REFERENCES


BIOGRAPHICAL SKETCH

Elizabeth Tighe attended Mount Holyoke College, where she majored in psychology and minored in sociology. She worked as an undergraduate research assistant with Dr. Araceli Valle in developmental psychology and Dr. Katherine Binder in cognitive psychology. She also played on the intercollegiate tennis team all four years of college. Elizabeth completed an undergraduate thesis, which received the highest departmental honors and an honorable mention for the Phi Beta Kappa Thesis Award. She graduated summa cum laude and Phi Beta Kappa in May, 2010.

She is currently a doctoral student in the cognitive area of the Psychology Department at Florida State University and is advised by Dr. Christopher Schatschneider. She also works in conjunction with the Florida Center for Reading Research (FCRR) as a Pre-Doctoral Interdisciplinary Research Training (PIRT) Fellow. Elizabeth completed her Master of Science degree in cognitive psychology at Florida State University in December, 2012. She also received a graduate certificate in adult education from Western Kentucky University in May, 2015. Elizabeth’s main research interest is examining the component reading skills of adults enrolled in Adult Basic Education programs. Upon the receipt of her doctoral degree, Elizabeth plans to continue with this line of research as she pursues a postdoctoral research position at the Learning Sciences Institute at Arizona State University with Drs. Carol Connor and Danielle McNamara.