Imageability and Transparency in Morphological Awareness
A Study of How Third-Grade Children Made Lemonade From Lemon

Julie A. Wolter

Morphological awareness has been established as important to literacy success, and as such, it is critical to study factors affecting children’s performance on measures of this skill. Morphological transparency, or the clarity of the sound and letter pattern relationship between base words and their associated morphological forms, has been found to affect morphological awareness performance. An additional factor of imageability, or how clearly a word can be visualized, also could affect such performance. Thus, the purpose of this study was to examine the effect of imageability, as it relates to transparency, on children’s morphological awareness responses. Seventy-two third-grade children completed a morphological awareness production task that included words controlled for transparency and imageability. Results of this mixed design revealed that imageability appeared to interact with transparency and words of high imageability were more readily produced than those of low imageability in conditions of low and high transparency. These results suggest that imageability should be considered when developing morphological awareness tasks aimed at measuring developmental expectations for school-age children. Key words: imageability, literacy, morphological awareness, transparency, vocabulary, word study

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heard in a spoken manner, and the meaning understood in the multimorphemic derivative of lemonade, and these factors have been examined for how they relate to reading and writing success.

One additional factor related to children’s word-naming abilities, but only minimally investigated in the area of morphological awareness, is that of imageability (Dye, Walenski, Prado, Mostofsky, & Ullman, 2013). Imageability refers to how clearly a word’s referent can be visualized or represented with a mental picture. Researchers have established that children more readily learn and access words that are highly imageable than those words without a clear visual referent (e.g., Paivio, Yuille, & Madigan, 1968). For example, the word lemonade is readily imageable and invokes a clear and concrete referent or picture, whereas a word such as freedom is a more abstract concept and may not readily incite a definite or robust mental image.

The purpose of this exploratory study was to determine how word imageability, in relation to the transparency of sound and letter relationships between base words and their morphological derivations, affects school-age students’ performance on a derivational morphological awareness task.

**MORPHOLOGY AND LITERACY**

Morphemes, which are the smallest linguistic units of meaning, include base words and affixes, which can be divided generally into the categories of inflections and derivations. Base words can be considered free in that they can stand on their own (e.g., cow, boy), or they may be bound together as in the case of compound words (e.g., cowboy). In general, inflectional morphology refers to those specific suffixes that modify words to fit a grammatical context, such as to change plurality (e.g., -s in cats), possession (e.g., possessive -s in Tim’s), or tense (e.g., -ed in opened). These types of morphemes often are referred to collectively as grammatical morphology and are generally the first morphemes to develop in the metalinguistic morphological awareness domain (i.e., first grade; Wolter, Wood, & D’zatko 2009). The awareness of derivational morphology refers to the ability to reflect on and manipulate suffixes and prefixes that change the meaning and, typically, the class of a word (e.g., changing the verb teach to the noun teacher). Essentially, the addition of such derivational morphemes result in the creation of a new word for one’s mental lexicon, and as such, derivational morphology has been referred to as lexical morphology (Jarmulowicz & Taran, 2013). This awareness of derivational morphological forms is typically demonstrated later in development and is noted to be actively applied when determining the meaning of multimorphemic words starting in approximately third grade (Kuo & Anderson, 2006).

Morphological awareness, or the explicit metalinguistic ability to reflect actively on how to combine base words and affixes to create or change meaning, is linked directly to vocabulary and literacy success in school-age children with and without language/literacy deficits (e.g., Deacon, Benere, & Pasquarella, 2012; Deacon, Cleave, Baylis, Fraser, Ingram, & Perlmutter, 2014; Nagy, Carlisle, & Goodwin, 2014; Wolter, 2009; Wolter et al., 2009). Children are thought to decompose the morphemes in words to infer vocabulary meaning, which positively influences comprehension of text (e.g., Roman, Kirby, Parrila, Wade-Woolley, & Deacon, 2009). Moreover, children use their knowledge of morphemic structure to aid in reading decoding such as when a sound or letter pattern is part of a predictable familiar suffix (e.g., the suffix -ive pronounced /iβ/ in the word predictive vs. the common nonsuffix pronunciation /aɪv/ in thrive). Finally, morphological awareness can be used to spell words accurately despite variations in their pronunciation (e.g., spelling pays with a plural -s, although pronounced /ˈzeɪs/).

Recent studies and systematic reviews of morphological interventions have found that instruction focused on morphological awareness is associated with improved vocabulary, reading, and spelling success in
school-age students in the early elementary years with and without literacy deficits (Apel & Diehm, 2014; Bowers, Kirby, & Deacon, 2010; Carlisle, 2010; Goodwin & Ahn, 2010). Similarly, elementary students as young as second grade with language impairment have been found to improve their phonological, vocabulary, and literacy skills significantly after completing a morphological awareness intervention program (Wolter & Dilworth, 2014; Wolter & Green, 2013). Thus, morphological awareness appears to be a promising intervention technique to improve the language and literacy success for children with a wide variety of abilities, including those with disorders of literacy and/or spoken language.

Despite the importance of morphological awareness in language and literacy success, limited studies have been conducted regarding factors influencing the processing and development of morphological awareness, specifically in the area of derivational or lexical morphological awareness. Improved knowledge regarding how children process and develop morphological awareness is important to guide evidence-based efforts to cultivate effective assessment instruments and, ultimately, best intervention practices.

**FREQUENCY, TRANSPARENCY, AND MORPHOLOGICAL AWARENESS**

Most researchers agree that input frequency and the transparency in the relationship between the base word and the derived form influence morphological awareness. Researchers have established a morphological frequency effect in that words with frequently occurring morphemes are more readily processed and learned (Carlisle & Katz, 2006; Deacon et al., 2011; Nippold & Sun, 2008). For example, in their study of fifth- and eighth-grade students, Nippold and Sun (2008) found that, in a morphological awareness task, students were more readily able to define derivational multimorphemic words of high frequency than those less frequently occurring in print.

A transparency effect also has been found. That is, the transparency of a relationship between a base word and its morphologically complex form affects children’s processing of words (e.g., Carlisle et al., 2001; Clin, Wade-Woolley, & Heggie, 2009; Deacon & Bryant, 2005; Windsor, 2000). Children have been found to perform better on morphological awareness task items in which the relationship between the base word and the derived form is transparent and pronunciation and spelling of the base word are maintained in the derived form (e.g., _four_ in _fourth_ or _beal_ in _beating_). Conversely, morphological awareness task items with less transparent relationships, such as when there is a shift in the pronunciation and/or spelling of the derived form (e.g., _sign_ in _signal_ and _nature_ in _natural_), appear to be more difficult (e.g., Carlisle et al., 2001; Deacon & Bryant, 2005; Windsor, 2000). Carlisle et al. (2001) found that fourth-grade children with and without literacy deficits were more readily able to generate morphological derivatives for words with a phonologically and orthographically transparent relationship (e.g., _excite_ to _excitement_ than those that included a phonological and/or orthographic change between the base word and the derived form (e.g., _five_ to _fifth_). Similarly, Windsor (2000) found that 10- and 12-year-old children with language and literacy deficits had significantly greater difficulty than peers with typical language literacy development in identifying base words and suffixes in derivations with phonological and orthographic shifts between the base word and the derived from.

Finally, although related to phonological and orthographic transparency, semantic transparency has been studied as a factor affecting children’s production of morphological derivatives. Semantic transparency refers to how the meaning of constituent morphemes is transparently represented in the meaning of the morphologically derived form. For example, the relationship between _teach_ and _teacher_ is semantically transparent as the meaning of _teach_ is evident in the derived form. Although the aforementioned example
is likely also interrelated to the phonological and orthographic transparency between the base word and the derived form, there are examples when semantic transparency could be considered separately. This is the case for the word *strawberry*, where the meaning of the word *straw*, a piece of hay or a plastic tube used to sip a drink, is not transparently related to the multimorphic word. Researchers studying the effects of semantic transparency have found that high transparency appears to positively prime for increased accuracy and quicker response times in word naming compared with semantically opaque controls (e.g., Gonnerman, Seidenberg, & Anderson, 2007; Libben, Gibson, Yoon, & Dominick, 2003). Thus, it appears that semantics plays an additional role when children are processing the transparency of relationships between base words and derived forms and this role appears to warrant consideration in tasks of morphological awareness.

**IMAGEABILITY AND MORPHOLOGICAL AWARENESS**

Finally, given the aforementioned semantic transparency findings, it is not surprising that the additional factor of semantic imageability is emerging in the research on word learning and, more recently, in a study of morphological awareness (Dye et al., 2013). Imageability refers to how easy it is to elicit mental images of a word. According to the dual-coding theory (Paivio, 1991), words that are highly imageable are more readily learned than those words that are more abstract and less imageable. This is sometimes referred to as the imageability effect (Prado & Ullman, 2009). According to the dual-coding theory, both the language and visual systems can be used to store and access words in memory when words represent tangible concepts that are highly imageable. Conversely, words that represent more abstract concepts and are less clearly imageable might be stored and accessed only via the linguistic system.

The imageability effect has been repeatedly supported in the word-naming research in which highly imageable nouns and verbs have been found to be recognized, named, and acquired more readily than less imageable words (e.g., deGroot, 1989; Masterson, Drucks, & Gallienne, 2008; Morrison, Chappell, & Ellis, 1997; Strain, Patterson, & Seidenberg, 1995). Moreover, in a recent meta-analysis of neuroimaging studies, Wang, Conder, Blitzer, and Shinkareva (2010) found a greater involvement of the neural structures associated with the visual perceptual system for processing words with tangible mental imagery and a greater engagement of the neural structures associated with the verbal processing system when processing words that were considered abstract or less imageable. Given this research, it stands to reason that imageability should be considered as it relates to development and performance on measures of morphological awareness.

Research on imageability effects has recently been extended to focus in the area of inflectional morphology. Dye et al. (2013) studied imageability effects in morphological awareness productions of regular and irregular past-tense verbs by school-age children (ages 8–12 years). Children were presented with regular verb pairs (e.g., *fail–failed*) that varied in frequency and imageability. In this task, the base word was given, followed by a sentence with the base word in it, and then the children were asked to use the past-tense form to fill in the missing word in a subsequent sentence (e.g., *fail. Every day I fail an exam. Just like every day, yesterday I ______ an exam. Answer: failed*). Results of this study revealed that, in general, high imageability positively affected children’s ability to produce regular past-tense forms. The production of irregular past-tense forms, however, did not appear to be as affected by imageability. Results of this study suggest that rule-governed words (i.e., morphologically complex words) in which children are required to combine morphemes to create meaning for memory access or storage may be more prone to be affected by word-level factors such as imageability than those that are recalled and stored without compositional processes.
Morphological awareness appears to be affected by factors of frequency, transparency, and imageability, but more research is needed in the area of imageability to determine its effects related to these other input factors. The purpose of this exploratory study was to examine imageability in combination with transparency as it relates to performance on a derivational morphological awareness task in elementary students. The decision was made to focus only on derivational morphology because this area had not been previously studied in imageability studies, and as a process related to the development of one’s mental lexicon, the semantic component of imageability could potentially affect the development of the lexical concept of a word.

The effects of and interactions between orthographic-phonological transparency and imageability were examined directly to determine whether either factor significantly aided or hindered production of derived morphemes in a morphological awareness task appropriate for third-graders. The choice was made to limit this study to the examination of only these two factors, with word frequency and semantic transparency controlled. This decision was made because word frequency and semantic transparency could be relatively easily controlled, and given this was the first exploratory study of its kind, it was believed that a limited finite focus on factors of orthographic-phonological transparency and imageability was needed to allow for clear interpretations.

METHODS

Participants

The 72 children who participated in this study were third-grade students at an elementary school in the Intermountain West. The children ranged in age from 8 years 4 months to 9 years 6 months, with a mean age of 9 years 0 month. The sample included 51.4% female and 48.6% male participants, and the racial and ethnic backgrounds were 81.9% Caucasian, 5.6% Hispanic, 6.9% Asian, 2.8% Native American, 1.4% African American, and 1.4% Pacific Islander. For each child, hearing and cognitive abilities were within typical limits as reported by teachers and documented by school records. Parental and teacher reports were used to determine that there were no concerns about speech, language, or literacy development.

Stimuli and task development

Words of high frequency

Frequency ratings were calculated for base words and the related derived forms using The Educator’s Word Frequency Guide (Zeno, Ivens, Millard, & Duvvuri, 1995), which contains analysis of more than 17 million words from written texts, including texts for grade-school children. This choice of frequency ratings allowed for the matching of expectations to elementary students rather than adult frequency ratings. Consistent with previous studies of morphological awareness task development (e.g., Jarmulowicz, 2006; Larsen & Nippold, 2007; Windsor, 2000), a value of 40 or greater was used to indicate high frequency. As an extra study precaution, high-frequency status was confirmed using the commonly used adult corpus from the American Heritage Word Frequency Book (AHI Corpus; Carroll, Davies, & Richman, 1971). This reference contains more than 5 million words, which includes logarithmic transformations that indicate the frequency of occurrence in adult written language.

Transparency determination

Transparent and less transparent words were defined using Carlisle’s (2004) orthographic-phonological standards, in which transparent words were defined as those that maintained the pronunciation and spelling of the base word in their derived form (e.g., four in fourth or beat in beating) and less transparent words were defined as those that underwent a shift in the pronunciation and potentially the spelling of the
derived form (e.g., nature in natural and heal in health). All words were considered to be semantically transparent in that the meaning of base word was retained in the multimorphemic derivative.

**Imageability determination**

To determine the imageability of base words and derivatives, a survey was initially conducted with 52 third-grade children who were blinded to the purpose of the survey. This group of third graders was separate from those used in the morphological awareness task study and were reported to have typical hearing, cognition, and language literacy abilities according to school records.

Forty-two words consisting of high-frequency base words and their derived transparent and/or less transparent shift forms were included in a survey to determine whether they evoked relatively high or low mental imagery. This definition was based on studies that found concrete words to be highly associated with mental imagery (Goetz, Sadoski, Stricker, White, & Wang, 2007; Paivio et al., 1968; Sadoski, 2005; Sadoski & Paivio, 2001). A 7-point Likert scale was chosen as the survey format, as this was adapted from a corresponding survey developed for adults by Paivio et al. (1968). A rating of 1 was considered low imagery (really fuzzy) and that of 7 was considered high imagery (really clear). Because of the cognitive demands required for third-grade children to understand and judge imageability on a Likert scale, a visual component was included in this survey. A protocol was developed that featured seven black-and-white pictures of cameras of varying clarity to represent the 7-point scale. When looking at the row of images in a left to right fashion, the clearest image was associated with the last or seventh camera and the fuzzyest image was associated with the first camera. Students were asked to “picture the meaning of the word in their mind” and circle the appropriate camera, depending on whether the picture in their mind was “really clear, really fuzzy, or somewhere in between.” Several practice words were demonstrated as a class prior to the administration of the protocol.

Consistent with the findings of Paivio et al. (1968), words with a mean score of 5 or more were considered high imagery and words with a mean score 3 or less were considered low imagery. Results of this survey revealed that a total of 17 words were considered high imagery and 20 words were considered low imagery. The remaining 5 words were scored between 3 and 5 and not categorized as either high or low imagery.

**Final stimuli**

A final set of 12 high-frequency words was chosen from the results of the imageability survey to fill the following four categories: three phonologically orthographically high transparency derived words of high imageability; three phonologically orthographically high transparency derived words with low imageability; three phonologically orthographically low transparency derived words of high imageability; and three phonologically orthographically low transparency derived words of low imageability. The average frequency of the all the words was 53.20 (range = 40.3–62.6). Words in the high transparency/high imageability category had an average frequency rate of 49.92 (range = 40.3–56.7) and an average imageability rate of 6.32 (range = 5.6–6.67). Words in the high transparency/low imageability category had an average frequency rate of 55.28 (range = 48.7–62.6) and an average imageability rate of 2.06 (range = 1.6–2.5). Words in the low transparency/high imageability category had an average frequency rate of 53.7 (range = 47.1–60.1) and an average imageability rate of 6.37 (range = 6.1–6.8). Finally, words in the low transparency/low imageability category had an average frequency rate of 53.9 (range = 43.8–59.9) and an average imageability rate of 2.45 (range = 1.9–2.9).

A one-way analysis of variance (ANOVA) comparison was made for word frequency between words in the four categories of phonologically orthographically transparent derived words of high imageability, phonologically...
orthographically transparent derived words with low imageability, phonologically orthographically low transparency derived words of high imageability, and phonologically orthographically low transparency derived words of low imageability. The groups did not significantly differ by mean word frequency, $F(3, 20) = 0.88, p = .47, \eta_p^2 = 12$. In addition, no significant differences were found between words considered to be highly transparent and those with low transparency in the high imageability condition, $F(1, 10) = 0.05, p = .83, \eta_p^2 = .05$, or low imageability condition, $F(1, 10) = 3.44, p = .09, \eta_p^2 = .26$.

**Morphological awareness production task**

An oral morphological awareness production task was developed by the investigator to incorporate each of the 12 target words (for full task, see Supplemental Digital Content, http://links.lww.com/TLD/A28). Words in the four transparency and imageability conditions were randomly ordered throughout this task. This task was based on Carlisle’s (1995) production task in which a child was given a base word and asked to use the base word to orally complete a sentence (e.g., *farm, Old McDonald is a ______, farmer*). This type of production sentence-context task was used for the following reasons: (a) this classic task is commonly used in research to assess the morphological awareness skills of elementary children; (b) it was similar in form to the task of Dye et al.’s (2013) morphological awareness study focused on imageability, and (c) elementary students have been found to attend to and participate in this type of task better than judgment tasks (Carlisle, 1995).

**Reliability**

Interscorer agreement for the oral morphological awareness production task was conducted by two trained scorers who were blinded to the research question. One hundred percent of the protocols were scored independently. Following the independent scoring, the assigned scores were compared and the calculated interscorer agreement was 98.6%. Discrepancies were resolved through consensus.

**Procedures**

Testing was completed in the second semester of the academic year (February and March). Each child completed the oral morphological awareness production task as part of a series of literacy-related measures from a larger study. Each child was tested individually in a quiet environment. Total testing time for the morphological awareness production task was approximately 10 min and was completed in one sitting.

**RESULTS**

To determine whether an interaction existed between imageability and transparency, a 2 (high and low imageability) $\times$ 2 (high and low transparency) ANOVA was conducted to examine whether these factors affected performance on the morphological awareness production task. A significant interaction effect was found between imageability and transparency, $F(1, 71) = 10.39, p < .05, \eta_p^2 = .13$ (see Table 1 for full ANOVA results). To follow up on this interaction, a series of four paired-sample $t$ tests was conducted to compare the influences of high and low imageability and transparency on the morphological awareness generation task. A Bonferroni adjustment was performed, and the $\alpha$ level was established at .012 (.05/4). With high imageability held constant, no significant difference was found, $t(72) = 1.89, p = .06, d = 0.44$, and the mean number of derivatives correctly generated in the high transparent condition ($M = 2.47, SD = 0.60$) was not significantly different from those derivatives generated in the low transparency condition ($M = 2.25, SD = 0.85$). With low imageability held constant, the mean number of derivatives correctly generated in the high transparency condition ($M = 1.9, SD = 0.97$) was significantly more than those derivatives generated in the low transparency condition ($M = 1.25, SD = 0.72$), $t(72) = 7.03, p < .01, d = 1.66$. With high transparency held constant, the mean number of derivatives produced in the high
Table 1. Analysis of variance summary table for the influence of transparency and imageability on the morphology awareness production task

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>𝜂_p²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transparency (T)</td>
<td>1</td>
<td>16.53</td>
<td>16.53</td>
<td>38.21</td>
<td>.000**</td>
<td>.35</td>
</tr>
<tr>
<td>Imageability (I)</td>
<td>1</td>
<td>39.75</td>
<td>39.75</td>
<td>110.70</td>
<td>.000**</td>
<td>.61</td>
</tr>
<tr>
<td>T × I</td>
<td>1</td>
<td>4.75</td>
<td>4.75</td>
<td>10.39</td>
<td>.002**</td>
<td>.13</td>
</tr>
<tr>
<td>Error (T × I)</td>
<td>71</td>
<td>32.50</td>
<td>.45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**p < .01.

imageability condition (M = 2.5, SD = 0.60) was significantly more than those in the low imageability condition (M = 1.9, SD = 0.97), t(72) = 4.04, p < .01, d = 0.95. Finally, with low transparency held constant, the mean number of derivatives produced in the high imageability condition (M = 2.3, SD = 0.85) was significantly more than those in the low imageability condition (M = 1.25, SD = 0.72), t(72) = 11.03, p < .01, d = 2.56.

DISCUSSION

Results of this study support the hypothesis that word imageability affects performance on a morphological awareness task, and this imageability interacted with the transparency relationship between the base word and the derived form. It was found that significantly more high imageable words were produced by the participating students than low imageable words, in both the high and low transparency (with phonological and/or orthographic shift) conditions, and this finding was consistent with previous morphological awareness research of inflectional morphology (Dye et al., 2013). Students participating in this study appeared to be positively affected by words’ imageability in their ability to complete a morphological awareness task, and it appeared to aid them in their ability to produce morphologically complex words in both transparent and less transparent conditions. The fact that high imageability appeared to aid performance on morphological awareness task items that might be considered challenging, such as when there was a phonological and/or orthographic shift between words, lends support to Paivio’s (1991) dual-coding theory. That is, it supports the theory that children can reflect actively on morphology via both visual and linguistic routes. In addition, this finding corroborates recent evidence in the inflectional morphological awareness literature indicating that children produce words of inflected plurals and past tense more readily in highly imageable conditions than in low imageable conditions (Dye et al., 2013). Moreover, this is the first study I am aware of that documents this finding in a derivational morphological awareness task. As such, it provides evidence for the need for further investigation of this contributing factor.

Although word transparency did not have a significant effect on morphological awareness responses in conditions of high imageability or high transparency, transparency did have a significant effect in the low imageability condition. When words represented a less imageable or abstract concept, the participating children produced words with a high transparency derivational relationship more readily than those with a less transparent one. This finding may also support Paivio’s (1991) dual-coding theory. In other words, the language system may have been singularly tapped without the aid of the visual system when task demands were higher and children could not readily picture a word. That is, because derivatives were abstract and the visual system could not be used as an aid, then perhaps the students used only their knowledge of phonological and orthographic regularities
to produce morphemes that retained the pronunciation and spelling of the base word in the derived form.

In addition, this significant finding of an interaction between transparency and imageability is consistent with related research in the spelling-sound word-naming literature. Strain, Patterson, and Seidenberg (2002) found a significant interaction between spelling-sound consistency and imageability in words that were not necessarily morphologically complex. These researchers tested words that corresponded to the most typical pronunciation of orthographic segments (e.g., the word *pack* has the predictable pronunciation of */æk/* for the letter segment -*ack*), and words classified as having pronunciations inconsistent with typical pronunciations of orthographic segments (e.g., the word *pear* has the unpredictable pronunciation of */ɛr/* for the letter unit -*ear* typically pronounced */ɪr/*). Words were also controlled for high and low imageability. Strain et al. (2002) found that imageability had a greater effect on word-naming accuracy and timing for atypical pronunciations of orthographic segments whereas imageability did not significantly affect the accuracy or timing of naming of words with regular or typical pronunciations.

These findings might be in line with the interaction effect found in the current study in that the words in the low imageability but highly transparent condition had consistent pronunciations between base words and the derived forms, but the pronunciations of the orthographic units were also considered typical (e.g., *reason, reasonable, harm, harmful; require, requirement*). Thus, the strength of interactions between the orthographic-phonological codes could have provided a primary means to access these abstract but transparent morphological relationships.

**Limitations and future research**

One limitation of this study is the restricted number of words used to target the conditions of imageability and transparency. In the initial planning of this study, I was not prepared for how difficult it would be to find words to match all of the conditions. In fact, it was challenging to find frequently occurring base words and their derived forms to fit the category of low transparency and high imageability. Nouns are often the most imageable words, and the nature of derivatives is that a word class is likely changed between the base word and the derived form. As such, simply finding words that were imageable in both the base word and the derived form was difficult and proved even more challenging when limiting word choices to those that include phonological and potentially orthographic shifts between the base word and the derived form. Thus, given the exploratory nature of this study, the protocol was limited to only three targets in each category, which, in turn limited the external validity.

In addition, initial efforts were made to have all low transparency relationships involve both a sound and spelling change. Given the noted imageability challenges, this strict definition of opacity (vs. transparency) could not be accommodated, and it was necessary to use the operational definition of phonological changes, at least, and orthographic changes, potentially, between the base word and the derived form as evidence of low transparency. Given this less strict definition of transparency, it is possible that the participants in this study used their knowledge of orthographic regularities to process derivatives with only a phonological shift (e.g., *music to musician*). Given that this was an oral task where students did not view these words, a phonological shift between derivatives for a less transparent relationship was included as at least one way to attempt to control for that factor. Needless to say, students could have mentally visualized a word and, as such, could have accessed a mental orthographic representation of the word to aid in morphological task performance. Thus, this discrepancy should be taken into consideration when interpreting results of this study.

Another limitation of this study that serves to restrict one’s ability to generalize the findings is the high correlation of multiple
other factors that could potentially affect word complexity in morphological awareness tasks. Given that this study was the first I am aware of to study imageability in derivational morphology in a morphological awareness task, I thought it was important for the methods to be focused on a narrow research question that could be more readily interpreted and answered using a restricted protocol of words. Thus, I selected to manipulate only two factors of a morphological relationship: transparency and imageability. Factors such as frequency, as discussed previously, and others not discussed in the introduction, such as age of acquisition and gender, have been shown to affect accuracy and speed in word-naming tasks (Dye et al., 2013; Monaghan & Ellis, 2002; Strain et al., 2002).

In prior research, Dye et al. (2013), who found a positive influence of imageability on morphological awareness productions, also manipulated and examined how frequency, age of acquisition, and gender influenced naming productions on a morphological awareness task. Their results revealed a developmental trajectory in that imageability preceded frequency effects in early morphological awareness performance, although frequency increasingly positively influenced morphological awareness performance more than imageability later in development. Moreover, imageability appeared to influence girls’ morphological awareness abilities more than boys’ abilities. Thus, these factors need to be considered as potential influences in the study and future research should incorporate and manipulate these factors as part of the research question.

CONCLUSION

Despite the limitations of this study, when considered in light of other related findings, evidence from this mixed design appears to support the hypothesis that imageability interacts with transparency in third-grade children’s performance on a morphological awareness task. High frequency morphological derivatives of words with high imageability appeared to aid in morphological awareness performance, and these words were more readily produced than those of low imageability when children were asked to compose morphologically complex words. However, when imageability referents were not available, other language-processing cues such as the phonological and possibly orthographic transparency of patterns between base words and their derived forms appeared to be used to aid in morphological awareness task performance. Findings such as these, in combination with past and future related research endeavors, should be considered when developing morphological awareness tasks aimed at measuring developmental expectations for school-age children.

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