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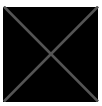
The Effects of Morphological Training on Vocabulary Knowledge: A Reanalysis of Goodwin & Ahn (2013)

Abstract

Several researchers have recommended morphological instruction in English as an effective way to improve students' vocabulary and reading proficiency (Bowers & Cook, 2012; Carlisle, 2010; Nagy, Berninger, & Abbott, 2006). The principal goal of morphological training is to aide students in inferring the meaning of new, unknown "transfer" words in a text. We re-analyzed studies drawn from a recent meta-analysis (Goodwin & Ahn, 2013) on the effectiveness of morphological training in English on vocabulary growth, focusing only on the effects on transfer measures. We found that morphological instruction had a negligible (d = .04) and non-significant effect on such words, failing to meet the principle objective of the training.







The Effects of Morphological Training on Vocabulary Knowledge:

A Reanalysis of Goodwin & Ahn 2013)

Several researchers have claimed that morphological "training" or instruction is an effective way to improve vocabulary and reading proficiency in English as both a first (Bowers & Cook, 2012; Carlisle, 2010; Nagy, Berninger, & Abbott, 2006) and second language (Kieffer & Lesaux, 2012a). Unlike other types of vocabulary instruction that teach a fixed set of target words, morphological training aims to give students knowledge of word parts in order to infer the meaning of new, unknown words that they encounter in text, beyond the words taught in the intervention.

The recommendations for morphological instruction have made their way into the English language arts curriculum in the United States. Standards for the Common Core, for example, include references to the morphological knowledge that students should demonstrate at several grade levels. In grade 8, students are required to know and use "grade-appropriate Greek and Latin affixes and roots" in determining word meaning (National Governors Association Center for Best Practices, 2010).

I review the evidence on the effectiveness of morphological instruction on vocabulary from a recent meta-analysis (Goodwin & Ahn, 2013). Goodwin and Ahn reported a small to moderate effect of instruction on vocabulary (d = .34). This estimate, however, includes test scores both from words taught in the intervention and novel words that were not part of the training. In this analysis, I calculate the effects of instruction on novel words only in order to test the claim that morphological training can help students figure out the meaning of words they have not been directly taught.

Background

What is Morphological Instruction?

According to Goodwin and Ahn (2013), the rationale for morphological instruction is to give students a knowledge of word parts (morphemes) in order to "support literacy tasks," primarily vocabulary but also reading comprehension and spelling.[1] They claim that "[t]hrough morphological analysis, students can infer the pronunciation, meanings, and spelling of many words *beyond those taught*" (p. 258, emphasis added). Baumann, Edwards, Boland, Olejnik, and Kame'enui (2003) state that "the rationale for teaching these strategies lies in the potential power of determining the meanings of *unfamiliar words* by analyzing word parts (roots and affixes) and the syntactic and semantic environment in which a word resides" (p. 452, emphasis added).

Goodwin and Ahn summarize the most common forms of morphological awareness instruction as "identifying morphemes within words, building words from morphemes, learning roots and affix meanings, and highlighting morpheme patterns or rules" (p. 259). They also list some sample classroom activities that might be used in instruction, including:

- Students divide words such as "completely" and "washable" into morphemes, and then create new words from those same morphemes;
- Students circle morpheme patterns in words, and identify Latin, Greek, and Anglo-Saxon roots; and
- Students sort words by suffixes based on categories such as *–ian* for nouns that are people and *–ion* for abstract nouns. (Table 1, p. 260).

Correlational Evidence on Morphological Awareness and Vocabulary Knowledge

Nagy, Berninger, & Abbott (2006) found that morphological awareness was highly correlated with vocabulary knowledge for their elementary and middle school subjects (r = .67 - .83), and was a significant predictor of reading comprehension. Research on second-

language students has found a similarly strong relationship between morphological awareness and other literacy measures (Kieffer & Leseaux, 2012b). This awareness of morphology appears to grow as children move through school. Tylor and Nagy (1989) and Anglin, Miller, and Wakefield (1993) determined that older readers did better on morphological awareness measures than younger readers.

Kieffer and Box (2013) and Levesque, Kieffer, and Deacon (2017) used correlational data to create several path analyses in support of a possible causal role of morphological awareness for other reading outcomes. One of Levesque et al.'s (2017) paths hypothesized that morphological awareness leads to improved vocabulary:

Morphological Awareness —>Vocabulary

Another predicts that morphological awareness leads to better morphological analysis and reading comprehension:

Morphological Awareness —>Morphological Analysis—>Reading Comprehension

The researchers recognized that the correlations between morphological knowledge, vocabulary, and reading comprehension are not evidence of causality. In fact, the relationship between morphological awareness and reading could just as plausibly be depicted by reversing the arrows in Leveque et al.'s path analyses:

Vocabulary —> Morphological Awareness

Reading Comprehension —> Morphological Analysis—>Morphological Awareness

or:

Reading Comprehension —>Morphological Awareness

Reading Comprehension —>Morphological Analysis

Experimental Studies on the Teaching of Morphology

There have been at least three large meta-analyses on morphological training in English done in the past decade. Bowers, Kirby, and Deacon's (2010) meta-analysis provided

effect size estimates from 22 studies. Unfortunately, the researchers did not identify which specific studies contributed to their estimates for the impact of instruction on vocabulary (*d* = .20 - .35) in order to allow for a re-analysis. Two meta-analyses by Goodwin and Ahn, however, did provide sufficient data: one for studies of special education students (Goodwin & Ahn, 2010), and a second for a combined analysis of both special education and mainstream students (Goodwin & Ahn, 2013). I summarize the overall effect sizes for vocabulary from all three meta-analyses in Table 1. Note that there was overlap in the studies used to calculate these effect sizes.

Table 1

Effect Sizes and Number of Comparisons for Meta-Analyses on the Impact of Morphological Instruction on Vocabulary

Meta-Analysis	Vocabulary	Comparisons
Bowers, Kirby, & Deacon (2010)	.20 (vs. Alternative Treatment)	32
	.35 (vs. Controls)	34
Goodwin & Ahn (2010): *Special Education Students*	.40	4
Goodwin & Ahn (2013): *All Students*	.34	9

Three of the four comparisons in Goodwin and Ahn (2010) were from non-English language studies, which they excluded in their 2013 analysis. Since our focus is on English-language instruction, I discuss only studies conducted in English, all taken from Goodwin and Ahn (2013), which looked at the largest number of studies so far.[2]

Reanalysis of Goodwin & Ahn (2013)

Goodwin and Ahn (2013) coded the dependent variables of 30 morphological training studies into seven categories, including morphology, vocabulary, and comprehension. Rather than attempting to classify the measures into these categories themselves, however, they used the original study's classification of its own measures (p. 270). This means that a test classified as a "morphology" measure in one study may have been coded as "vocabulary" in another.

This approach makes it very difficult to determine the precise effects of the instruction. For example, on a definition test of the target words taught during the treatment, we expect that students who studied the words will do better than those who did not study them (Elleman, Lindo, Morphy, & Compton, 2009). And clearly on tests of morphological awareness, such as circling morphemes, adding taught morphemes to nonsense words, or decomposing a word into its constituent morphemes, those who receive morphological instruction can be expected to do better than a group of untrained subjects.

But as noted above, morphological training makes a claim that goes beyond being a superior method of teaching words or teaching morphemic analysis as an end in itself. It aims to help students infer the meanings of new words, those not taught during the treatment. The proper test of this is to give students an unknown word (either in isolation or in a text) and test them on their knowledge of the word's meaning. This measures the "transfer" of morphological knowledge to a larger population of words.

As can be seen in Table 1, Goodwin and Ahn's (2013) meta-analyses reported a small to moderate impact of morphological training on vocabulary measures (d = .34) in nine comparisons. Many of these comparisons, however, classified as "vocabulary" measures that were not true transfer tests. I review those comparisons below, dividing the discussion into studies that were excluded for lack of such a comparison, studies for which Goodwin and

Ahn's (2013) estimate was left unchanged, and studies whose estimates were modified from what appears in Goodwin and Ahn (2013).

Excluded Studies

Two studies (Filippini, 2007; Lesaux, Kieffer, Kelly, & Harris, 2014) lacked any meaningful measure of the effects of morphological training on transfer words, and were excluded from further analysis. Filippini (2007) was an unpublished dissertation, for which Goodwin and Ahn calculated the effect size for vocabulary to be medium to large (d =.62), one of the larger effects reported. Filippini's vocabulary test, however, included only the 56 target words taught during the treatment sessions. There were no transfer words tested.

Lesaux, Kieffer, Kelly, and Harris (2014) gave their middle school subjects extensive training on a variety of strategies to improve academic vocabulary, including morphological analysis. Goodwin and Ahn used an unpublished 2012 conference presentation of the study for their analysis, with a sample size of around 1,500. This appears to be the same study later published with a slightly larger data set (more than 2,000 students) in 2014. Goodwin and Ahn (2013) reported an effect size of .51 for vocabulary, again based on the 2012 version of the study's report. The 2014 version of the paper reported three effect sizes related to the target academic words, all smaller than Goodwin and Ahn's figure: Academic Word Mastery: .41, Academic Word Association: .22, and Academic Word Meaning in Context: .17 (all from Table 3, p. 1182).

Again, none of these three vocabulary tests measured transfer effects. The only measure administered to the students capable of measuring the effects of morphological training on novel words was the SAT-10 Reading Vocabulary test. No results from that test were reported in the published paper.

Studies with Original Estimates

For three of the nine comparisons reported in Goodwin and Ahn's (2013), I used the original effect size estimates. The estimate for Bauman et al. (2003) appears to come mostly from tests of transfer words. For the other two comparisons, very little information on the vocabulary measure was provided by the authors. Parel (2006) used what appears to be a general vocabulary measure not tied to the morphological training curriculum as both a pretest and post-test. Nunes et al. (2006) used a vocabulary measure that may or may not have included taught words (no list of the words taught or words tested was provided). Lacking details of the assessments that would justify excluding them, I kept them in the analysis.

Studies with Modified Estimates

Baumann, Edwards, Font, Tereshinski, Kame'enui, and Olejnik (2002). Baumann et al. examined the effects of a 10-hour intervention with four different groups of fifth graders (N = 88). One group (Morphology Only) received instruction on "morphemic analysis," which included lessons on a set of target words that illustrated different prefixes. The second group (Context Only) was taught how to infer meanings of words from the context, but not from the word itself. A third group (Morphology + Context) got a shorten version of both treatments, and a fourth group (Control) read and discussed an unrelated novel in class.

Baumann et al. gave their subjects 12 separate vocabulary tests: six on the 10 lesson words that illustrated the morphemic or contextual analysis principles of each unit, and six on transfer words, words the students had not previously seen but whose meanings could be inferred using the principles they were taught. Goodwin and Ahn reported the average effect sizes on vocabulary for the Morphology Only students as large (d = .81), and for Morphology + Context as medium to large (d = .66). As with other studies in their analysis, Goodwin and Ahn did not indicate which specific measures were used for any particular outcome.

We would expect the treatment students to do better than the control students on the six tests of the lesson words, especially given they spent 10 hours studying only 10 words. Of the six transfer post-tests, four were given immediately after the treatment, and two as delayed post-tests five weeks later. Author (2016) showed that there can be a sharp drop in scores from an immediate to a delayed post-test for words taught using direct instruction, so delayed scores are the preferred measure of the instruction's long-term impact.

Table 2 shows the average combined effect sizes for the four immediate post-tests and two delayed post-tests on the transfer words for two comparisons: Morphology Only vs. Controls, and Morphology + Context vs. Controls.

Table 2

Immediate versus Delayed Post-Test Results on Vocabulary Transfer Measures in Baumann et al. (2002)

	Morphology Only	Morphology + Context
Immediate Post-Test	.49 (.25)	.33 (.23)
Delayed Post-Test	.05 (.21)	.03 (.22)

The moderate initial impact of morphological training on transfer words faded quickly, such that a little over one month later, there was no practical difference between the trained and untrained students. Baumann and colleagues themselves concluded that the effect of instruction "was restricted to immediate dependent measures" (p. 167).

Bowers and Kirby (2010). Bowers and Kirby studied the effects of morphological training on a group of fourth and fifth grade students ($N = 81$). They gave their subjects two post-tests: "Base Identification" and "Morphological Vocabulary" (p. 521). The Base Identification test required students to identify the base or root word in multi-morphemic

words by circling it for the test examiner. The Morphological Vocabulary test was given immediately after Base Identification, and required students give a definition for the word.

The sequencing of the tests is problematic. Asking students to identify the base word clearly prompts trained students to use their conscious learning to infer the meaning, something they may not do when reading on their own. A better test would have been simply to give students a separate set of words requiring definition first, and then measure knowledge of bases and affixes.

The Morphological Vocabulary measure had three parts: Words Taught, Bases Taught, and Affix Taught, corresponding to whether the word on the test had been taught during the intervention, contained the same base as a word taught, or contained only an affix that was taught. The Morphological Vocabulary assessment was the closest to a transfer test, even though the students' strategies were likely influenced by the sequencing of the tests. Table 3 shows the mean scores and standard deviations for the three parts of the Morphological Vocabulary measure.

Table 3

Morphological Vocabulary Scores from Bowers & Kirby (2010)

Measure	Experimental Mean (SD) $N = 38$	Control Mean (SD) $N = 43$	Effect Size (Cohen's *d*)
Words Taught	10.5 (4.43)	8.84 (3.89)	+.39
Base Taught	6.76 (3.65)	5.75 (2.61)	+.32
Affix Taught	9.55 (5.32)	10.63 (3.95)	-.23

Note: From Table 1, p. 527; maximum score per test = 30.

The relative advantage of the experimental group declines from Words Taught to Bases Taught to Affix Taught, the latter of which had a large, negative effect size. The best measure of transfer are the base and affix scores, since the Words Taught test required no transfer of morphological knowledge. Goodwin and Ahn's overall effect size estimate for all

three Morphological Vocabulary tests was small (d = .16). If we use only the transfer tests (base and affix scores), the effect size difference is minimal (d = .04) and not significantly different from zero.

Lesaux, Kieffer, Faller, and Kelly (2010). Leseaux et al.'s (2010) 54-hour intervention included several types of vocabulary instruction similar to those used in Lesaux et al. (2014), with morphology training being just one component (approximately 13 hours). All of the researcher-created vocabulary assessments given were for the target words. The only non-target word test used was the SAT-10 Reading Vocabulary test. Lesaux et al. reported an effect size of .005 on that measure.

A Revised Estimate of the Studies in Goodwin & Ahn (2013)

Table 4 shows all of the effect sizes for vocabulary used by Goodwin and Ahn (2013), as well as my revised estimates based on my analysis of Bauman et al. (2002) and Bowers and Kirby (2010), and on the effect size for the transfer test reported by Lesaux et al. (2010).

Table 4

Re-Analysis of Goodwin & Ahn (2013) on the Effects of Morphological Training on Vocabulary

Comparisons	Goodwin & Ahn Effect Size (SE)	Transfer Words Effect Size (SE)
Baumann et al. (2003)	.23 (.16)	*.23* *(.16)*
Baumann et al. (2002) (Morphology only)	.66 (.31)	.05 (.21)
Baumann et al. (2002) (Morphology + Context)	.81 (.30)	.03 (.22)
Bowers & Kirby (2010)	.16 (.22)	.04 (.27)
Filippini (2007)	.62 (.31)	--
Leseaux et al. (2010)	.19 (.10)	.005 (.02)
Leseaux et al. (2014)	.51 (.05)	--
Nunes et al. (2006)	.26 (.12)	*.26* *(.12)*
Parel (2006)	.06 (.23)	*.06* *(.23)*
Overall Effect Size	.34 (.08)	.04 (.03)

SE = Standard error. Italics indicate the effect size was the same as in Goodwin and Ahn (2013).

Using *OpenMetaAnalyst* (CEBM, 2012) meta-analysis software, with the continuous random effects option and weighting for study sample size as was done in Goodwin and Ahn (2013), I found that the overall effect size on tests of transfer words was negligible (d = .04) and not significantly different from zero (p = .289).

Discussion

Advocates of morphological instruction argue that teaching roots, prefixes, suffixes will make students more "aware" of words, and that this awareness will allow them to apply that knowledge to novel words they encounter in text. There is little evidence of this in the studies included in Goodwin and Ahn (2013). Our reanalysis found essentially no difference in knowledge of unfamiliar words between those who received instruction and those who did not. When we add to this finding Goodwin and Ahn's (2013) conclusion that morphological training is equally ineffective in improving reading comprehension (d = .09, n.s.), there appears to be little to recommend the practice to teachers.

The negligible gains from morphological awareness instruction were not without cost, however. While instructed students undoubtedly learned more of the taught words than uninstructed students in these interventions, they did so in a very inefficient manner. In Leseaux et al. (2010), for example, out of the 72 academic words students were taught during the 54 hours of instruction, experimental students gained on average 5.4 words more than the control students. This works out to be about one new word for every 10 hours of instruction. Bauman et al. (2002) spent 10 hours teaching a mere 10 target words as part of its morphological training.

Fortunately, teachers do not need to rely on morphological instruction to help their students improve their vocabulary. There is a much easier way, but one that is rarely considered: pleasure reading, also known as "free voluntary reading" (Krashen, 2004). Studies of sustained silent reading and extensive reading programs have found moderate to strong effects for free voluntary reading on both vocabulary development and reading comprehension when compared to traditional instruction (Krashen, 2004; Krashen & Mason, 2017).

What's more, pleasure reading is much more efficient that explicit vocabulary teaching in helping students acquire new words. Author (2019a) found reading to be up to six times faster than direct instruction programs in improving vocabulary growth for middle- and high school students. The efficiency advantage for reading over explicit instruction is also found with young children (Author, 2019b) and second-language students (Mason, 2007; Author, 2016).

Free reading is more enjoyable for students than vocabulary instruction, and a lot less work for the teacher. It deserves to be the next big "intervention" in promoting vocabulary growth.

Notes

1. I do not address the claim here that morphological training is an effective early reading method, as some have advocated (Bowers & Bowers, 2017). I restrict myself in this review to the vocabulary outcomes of the studies only, most of which were with older readers.

2. The two non-English studies in Goodwin and Ahn (2010) that included effect sizes for vocabulary and reading comprehension were Arnbak and Elbro (2000) (Swedish) and Tomesen and Arnoutse (1998) (Dutch). Their results were mixed.

Arnbak and Elbro reported a small to medium effect for morphological instruction on a timed "passage comprehension" test (d =.29). No further information is provided on the test. On the vocabulary measures, the experimental group did much *worse* on a "synonym production test" (d = -.68, p<.05)), and about the same on a general vocabulary measure (d = -.08), and a "homonym production test" (d = .07).

Tomesen and Aarnoutse's experimental group did not do significantly better than the control group on a reading comprehension measure, though there was a medium effect size (d = .40). They did much better on a post-test only "Derivation of Word Meanings Test" (d =

1.52, $p<.05$) that the researchers described as a test that "directly measures the effects of the instructional programme" (p. 116). Details of what this test included were not provided.

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