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LING 491b

# Children's Creative Flapping

[mɛrəl]: Do you spell that *metal, medal, mettle,* or *meddle*?

Leonard Bloomfield, *Language*, 501:

"The real factor of difficulty is the host of irregular spellings which will remain, no matter what values are assigned as regular. Two devices obviously demand to be tried. One is to teach children to read a phonetic transcription, and to turn to traditional writing only after the essential reading habit has been set up…"

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So here it is, the result of much, much labor and even more thinking: my senior essay. Though many have helped me along the way, this essay is, ultimately, my own product, and any errors or omissions contained herein are my own.

Theodore Palenski

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## Introduction:

What do children know about language? How can researches study this implicit knowledge of language? It is not possible to ask children directly, say, what they might know about language. Phonological awareness (and similar veins of metalinguistic knowledge) develops in tandem with literacy skills. In fact, when we really examine what adults seem to know about language, a lot of this metalinguistic knowledge is rendered opaque by the orthographic system. Distinctions are lost when multiple sounds come to be represented by the same letter or vice versa. The little lads are purely LADs—language acquisition devices. Most of the time, it is not even possible to ask adults, those who have fully acquired their language, what they think about language. Instead, researchers must resort to tasks that elicit certain knowledge about language. For children, the whole picture becomes a lot more complicated. Not only must the little LADs—the language acquisition devices—acquire the language, but they also must acquire literacy if they are to be contributing members of a literate society.

Questions about language acquisition and literacy development in children are central to understanding language and literacy on broader levels. If we are to fully understand the nature of a cognitive system, we must also understand how that cognitive system came to be. Thus, language and literacy acquisition research is key. Gauging what young children know, however, is no easy task. Attention span, ability to sit still, unfamiliarity with the experimenter, and so on are all important considerations when conducting research on young children. This is all compounded by the fact that, for so long, language acquisition research was removed almost completely from any work in theoretical linguistics. The speech productions of children were often considered too complicated and variable to be able to draw any substantial, generalizable conclusions. In fact, in *The Sound Pattern of English*, Chomsky and Halle state that acquisition data is “much too complex to be undertaken in a meaningful way” (1968; 331). The process by which children acquire a language (and arrive at a final grammar) is still an area of active research. Apart from this, children are also known to show temporary regressions

in various spheres of development—among them, the cognitive, linguistic, socioemotional, and even physical[1]. It is only recently that language acquisition and theoretical linguistics are starting to take each other into account. There are a growing number of researchers who look towards language acquisition data in order to bolster synchronic (and now, even diachronic—see Hale 2007) research in linguistics. Recently, the main homepage of CHILDES, the Child Language Data Exchange System, a system which allows language acquisition researchers to share collected data online, witnessed its one millionth visitor—no small achievement for a relatively small academic discipline.

Examining the spoken productions of children (either via audio or transcriptions, both of which CHILDES enables access to) is one way of gauging one aspect of children's knowledge about language: namely, what children are able to produce. Many questions remain regarding whether the explanation of what children *cannot* produce lie in the debate between children's perception and production—but this is a topic for another paper. Getting children to elicit certain speech forms, however, is no easy task and often requires direct elicitation in the case of specific research questions. Otherwise, the researcher must wait for the child to (mis-)produce the appropriate forms. On the side of literacy, common research methods involve examining what children are able to read and write. Of course, knowledge of language and knowledge of literacy are intimately connected—the latter inevitably made possible by the former. As Liberman 1992 makes clear, speech is universally acquired and, in a certain sense, more "natural." All typically-developing humans acquire language; only a subset (those so trained or those members of literate societies) acquire literacy. Indeed, a very frequent measure of phonological awareness involves analyses of (mis-)spellings. More often than not, though, analyses of spelling (in its relation to literacy as a whole) are limited to a count of right and wrong answers—whether or not the child has the orthographic form perfectly internalized. as Shankweiler & Lundquist 1992 sets out, this

[1] See Siegel 2004; Gershkoff-Stowe and Thelen 2004; and Marcus, Pinker et al. 1992 for more information on some of the progress made in describing these temporary developmental regressions.

collapses many different types of errors—such as, in the case of less phonetic orthographies , when a spelling corresponds more to the phonological (or phonetic) structure than to its standard orthographic form. The bulk of this paper will look at what could be characterized as misspellings but which, upon closer inspection, have a great deal to say about children's knowledge of language. The paper first presents background information on orthography in general, on English orthography specifically, and on deviations from standard orthography present in children's spelling. The paper will present an overview of the limited research done on this latter subject and will examine some new data as it relates to the phonologically-common process of alveolar flapping in English. Before introducing any strong statements, I must first subject the reader to a battery of assaults of background information. The remaining sections will look at data collected (passively) from a kindergarten classroom, some possible problems associated with said data, some possible experimental extensions, and, finally, possible conclusions.

## Somewhere between Orthography and Phonology

In English, as in most languages, there is interaction in literate adults of orthographic forms (and representations) and phonological representations. This interaction is not new, however. The most obvious way is for old forms which have dropped out of the spoken language to be reintroduced by the lettered. Forms such as *thus, sooth, guise,* and *behest* are all examples of such words with new life—and sound—breathed into them by poets of the eighteenth century (Bloomfield, 487).

While this influence is obvious and direct, orthography can have a more subtle, indirect influence on phonological forms of a language. In English, as in other languages, one such influence is manifested by what are termed *spelling pronunciations*. Words which have historical spellings—ones that reflect earlier pronunciations—can appear with phonological forms more or less consistent with their spellings. In John Jones' *Practical Phonography* of 1701, for example, Jones notes that the

pronunciation of the grapheme sequence *su* should be realized as [ʃ] with some vowel following I in words such as *assume, ensue,* and *sue*. Historically, an old [sj-] gradually became [ʃ], which is current pronunciation of words such as *sugar* and *sure*, words of relatively high frequency (cf. French *sucre, sûr*). The fact that [s] is the realization of the initial consonant in *assume*, *ensue,* and *sue* most likely reflects spelling pronunciations. In old texts, there was a tendency for such words to be spelled with *sh*, the digraph in English that maps solely to [ʃ]: this is evidenced by the possible spellings *shugar* and *sugar* as well as *suited* and *shewtid* (Bloomfield, 488) ("sugar n.", OED Online).

Interferences even more subtle appear in the way in which speakers of a language think about the shapes—phonological, morphological, or otherwise—of words. Taft 2006 shows that pronouncing a word subvocally is probably more influenced by orthography than previously recorded. Segments which do not surface in speech but which are present diachronically, or synchronically in related dialects, may in fact be present, at some level, abstractly. In his study, speakers of Australian English, a non-rhotic dialect of English, were asked to judge whether or not pseudhomophones presented to them were pronounced identically to real words of English. Thus, as an example, presented with the word *soke* would require a "yes" response, since it is homophonous with the real English word *soak*.

The principle stimulus involved pseudohomophones in which the grapheme *r* appears in coda position. These *r*'s are present nowhere on the surface, except perhaps as markers of vowel length[2]. The results indicated that the 18 native speakers of Australian English had more difficult judging the

[2] I am not versed enough in dialects of English to know whether or not there exists any sort of vowel length in any dialect of English. My intuition would say "no," though I cannot be sure. Wikipedia (http://en.wikipedia.org/wiki/Vowel_length#Long_vowels_in_English) says that there may be some sort of length distinction for a few words, such as *ferry~fairy, can*(v.)~*can*(n.), and *cut~cart*. Though, as I am not a native speaker it is impossible for me to know if there are perhaps additional cues which clue the speaker in to the intended form. What knowledge I have of my own non-rhotic dialect does not lend much additional support, as I can think of no minimal pairs, except perhaps *part~pot*, though it would appear as if the former's vowel is mostly unrounded. Another possibility is *father~farther*, though I can't imagine a situation in which these two might ever be confused, except perhaps in an experimental setting. The sentence, "Look! It's [fɑːðə]" out of context, I suppose, is ambiguous.

pseudohomophones such as *cawn* (surfaces identically to *corn*) and *forl* (*fall*) subvocalically. Only when the speakers pronounced the words aloud were the appropriate phonological representations activated which allowed for homophone identification. Thus, Taft concludes that since the pairs are "truly homophonic" (74) only on the surface, this shows that the orthographic *r* might actually be present at some abstract level. Entertaining a thought experiment, if these speakers were illiterate and only ever had access to speakers of their same dialect, it could only be assumed that *cawn* and *corn* would indeed be homophonous in all instances. How one could test this is unclear, as it may very well be that the fastest route to finding a homophone is by determining which words end in the same graphemes.

## English orthography

English, like most other languages with European origin, employs an alphabetic orthography. Whether the alphabet was runic or whether it was the alphabet of the conquering Normans, there are a number of rules that relate graphemes to speech sounds. Thus, both the runic Þ and the modern *th* represent the sound [θ] (or sometimes [ð]). In this case, the correspondence of grapheme to speech-sound is, essentially, one-to-one. For English vowels, this most often is not the case. There are often multiple graphemes that represent the same sound, and the same grapheme can represent different sounds. Even the digraph /gh/ can represent [g] as in *ghost*, [f] as in *rough*, or can indicate vowel quality/length, as in *night*. To the advantage of the person learning to read, however, these alternations are more or less predictable based on syllable position. The same cannot be said for vowels, the problem with which is the fact that conventional orthography was probably fixed in the 15th century, well before the Great Vowel Shift disrupted the previously phonemic quality of English. Beyond this, numerous silent letters exist in English spellings—most of which are historical remnants of how words were once pronounced, as evidenced in *name, knight, gnat, sought,* and *would*.

And so it is that English orthography is unlike the "admirably consistent orthographies of Spanish, Bohemian [Czech], or Finnish"; Bloomfield summarizes the situation nicely: "The real ßassigned as regular." In the final section of his *Language*, he even goes on to offer a perspective for pedagogy: "The difficulty of our spelling greatly delays elementary education, and wastes even much time of adults" (501).

From the structuralist to the generativist perspective we now shift, and Chomsky and Halle offer quite a different perspective. Chomsky and Halle (1968) show, via numerous examples, that English orthography seems to correlate well to what they refer to as *underlying representations*. This seems to equate underlying and orthographic representations. They claim that these underlying representations are "fairly resistant to historical change," and that "a conventional orthography may have a very long useful life, for a wide range of phonetically different dialects" (49). This statement is clarified and expanded upon: "…it will follow that conventional orthography is probably fairly close to optimal for all modern English dialects, as well as for the attested dialects of the past several hundred years" (54). In terms of historical and dialectal variation, then, English orthography may very well be "optimal." However, it is not phonetically transparent—especially to children. Thus, the task of learning English spellings involves a great deal of memorization of spelling alternations and acquiring all of the appropriate phoneme-to-letter correspondences, many of which are not one-to-one. Until all relevant forms are memorized, children are prone to make mistakes while writing and spelling. And instead of simply dismissing incorrect spellings as 'wrong,' I hope to demonstrate that there is the possibility of examining spelling errors, especially developmental spelling errors, more closely. Rarely does any sort of cognitive process show a binary value for correctness. What is correct is simply what is recognized as conventional. There is often a lot of gray area, be it with respect to gradient phonetic processes or developmental spelling, that should not be overlooked.

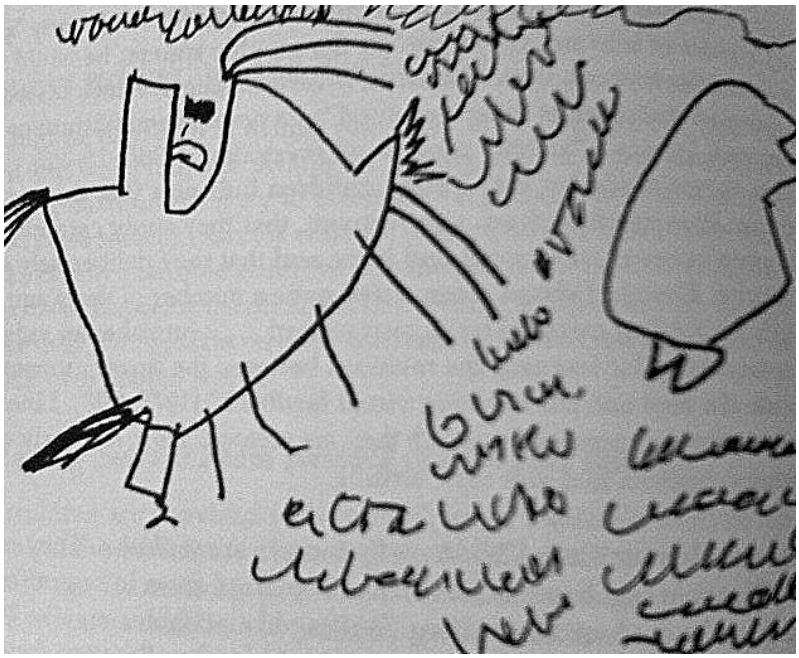
## Children's spelling

Making mistakes, as previously discussed, is part of the learning process. In fact, regressions are seen as a standard component of child development in the literature of today and of the past few decades. Progress and growth are never really linear, especially in the cognitive, emotional, and even linguistic domains. There is a large body of language acquisition research that relies on speech errors that children make to better understand what children can (or cannot) produce. The same thing, I affirm, is possible when viewing errors in children's spellings. It is possible, in a classroom something—an almost completely natural, comfortable environment for a majority of young children—to access information about a child's knowledge of language. The gateway to this knowledge lies not in the manipulation of variables, or in sending a researcher to record days' worth of speech; rather, it lies in something that comes naturally to a lot of children. Given the proper setting, young children who have not yet learned to write will engage in something called creative, or inventive, spelling. That is, children who have not yet learned a language's conventional orthography create their own nonstandard spellings when educators so instruct: "Spell it like it sounds." In this view, orthography is something that must be acquired piece-by-piece, not necessarily word-by-word—and that takes time and practice.

This view of encouraging inventive spelling has its roots in more recent educational reforms that focus on a whole-child approach, as opposed to emphasizing only academic skills. If a child does not yet know how to read, there is little incentive for her to learn to write and spell everything correctly. This might actually be more of a deterrent to a child learning to write. If a child is eager to write, but she is constrained to write those things she knows how to spell, she may only write a small subset of the things she wants to write. She can, however, speak the thought she would like to write, and if she can speak it, she can come up with a way of writing it.

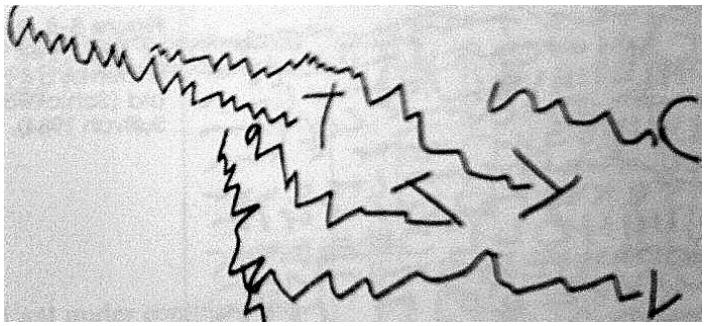
Generally, children who employ creative spelling tend to follow a specific developmental pattern, the basic stages of which will be illustrated below. The first step in learning to write, once a child has the fine motor skills necessary to grip and use a writing utensil, is to begin to differentiate between words and pictures. Young children will begin by drawing a picture and scribbles on the same page which may represent an associated story. No letters or even letter-like characters are present. Often the only way to know whether or not something represents writing is to specifically ask the child; though, in some instances, it is obvious. It is during this period when the child begins to orient herself on the page. That is, she realizes that, for English and other Roman scripts, she must write from left to write and from top to bottom. (Schickendanz, 100).

**Figure 1: Stage 1 (Schickedanz, 100)**



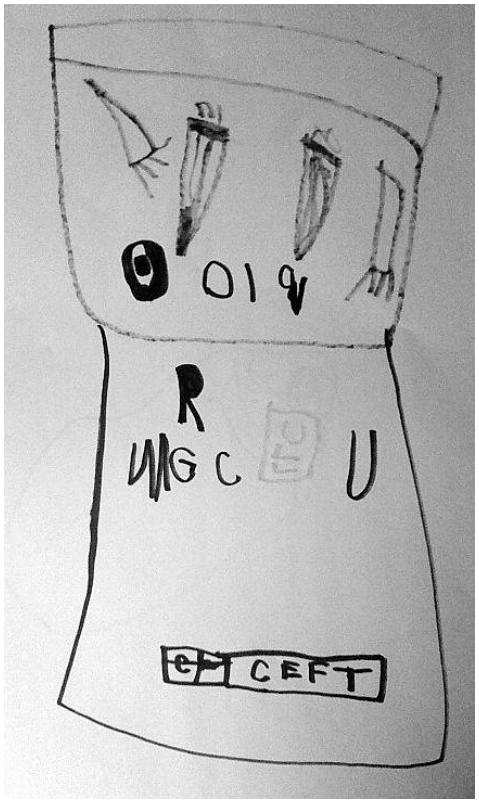
The second step—and *step* is a term loosely-employed here—occurs once children have more experience with orthographic characters. Children will often continue to write scribbles, broken up by the occasional letter, most often the first letter of their first name. This is represented in one such drawing below in **Figure 2**.

**Figure 2: Drawing from child named T (Schickedanz, 103)**



Here what follows is not necessarily anything linear or too consistent across children: what appear are other letters, or letter-like characters. These often appear in a random order and do not indicate any knowledge of words. The child has not yet acquired the full range of phoneme-to-letter correspondences necessary to be a successful speller of English orthography, nor does she have any real knowledge of how to begin to segment a word. The child begins to understand linear order of words; sounds proceed from left to right.

**Figure 3: A drawing of an X-ray by a girl aged 3;9. The letters appear random.**



This next point is the central focus of this thesis. Children, if allowed, will take a growing knowledge of phoneme-to-letter correspondences and spell words "like they sound." This means, most often, an approximation of the phonetic shape of the word. According to (Carol Chomsky, et al.), this represents a happy continuum in the development of literacy skills (Chomsky 1972, 2001). During the language acquisition process, children are not just empty vessels "waiting to be filled with adult spellings" (Chomsky 1973, 47). Chomsky maintains that the "natural order" of literacy education is for the child to write something first and then be able to read it back. Most often, children are taught to read first; they only write once they have acquired the standard orthographic form.

## Creative, or inventive, spelling

The stage on which I focus is the creative spelling stage. The young child seems to be at liberty to write whatever she is able to say. All she must do is find some sort of orthographic representation for it that somehow conforms to an internal representation of the word. Before jumping into any real analysis, it is necessary to describe what little research has been done on creative spelling. Besides the odd article by Carol Chomsky, the only real source of scholarly pursuits into this topic is by Charles Read, in two publications: a paper, "Preschool Children's Knowledge of English Phonology"; and a book, appropriately titled *Children's creative spelling*.

Based on his analysis of many examples of children's spellings he gathered and specifically elicited, Read arrived at the following three conclusions: the first, that children's creative spellings are phonetically "accurate" (Children's creative spelling, 38); the second, that children's creative spellings represent a child-specific classification of speech sounds (most clearly evidence by vowel alternations); and, the third, that children's spellings are evidence of those properties salient to children themselves.

## Creative vowels

Something that goes (almost) unstated is that the sound sequences /ej/, /i/, /aɪ/, /oʊ/ (or /ow/), and /ju/ all happen to be letter names in English. Thus, these are represented as such in their inventive orthographic representations, as in (1)

(1) FAC for [fejs] “face”

LADE for [lejdi] “lady”

MI for [maɪ] “my”

GOWT for [goʊt] “goat”

U for [ju] “you”.

None of these are particularly surprising, and the last example even surfaces in (informal) adult orthographic representations found in mediums of electronic communication—e.g. SMS or email.

Read goes on to explain other variations in the spelling of vowels; one such example is that the sound [ɪ] has two possible representations: I or E, as [ɪ] and [i] are both characterized by the features [+front][-low]. That a child might spell [pɪl] “pill” as PIL or PEL is not surprising. Both are phonetically warranted. The same goes for the triplet [ej], [ɛ], and [æ]: all three are [+front][-high] and have variable spelling as either E or A. In both of these instances, the child is using implicit knowledge of sounds to characterize phonetic similarities. Until the child has learned the conventional spelling, she will use her knowledge of sound-to-grapheme correspondences to best approximate the segment. This need not be a static approximation; phonemes are not some sort of quantifiably discrete units. Left to speaker—or child—judgment, variable orthographic outputs are to be expected.

## Creative nasals

Similarly, nasals that precede stops are frequently omitted in predictable ways. /ŋ/ was most frequently omitted, especially before voiceless stops. /n/ and /m/ were slightly less omitted. This data aligns with the facts of the phonology of English. The cue for nasality in nasal-stop clusters is predominantly in the nasalization of the preceding vowel. For engma, there is no single character to represent it in English orthography—instead, standard orthography dictates that *ng* is the proper orthographic representation. Yet again, this is something that can really only be learned from exposure to orthographic forms[3]. And in all cases of nasal-stop clusters, the place of articulation of nasal consonants assimilates to the place of the consonant that immediately follows. Read found that nasals were omitted about 20% of the time for /m/ and /n/ and 60% of the time for /ŋ/, yielding spellings such as those below in (2) from (Read CCS, 12):

| | | |
|---|---|---|
| (2) | NUBRS | 'numbers' |
| | PLAT | 'plant' |
| | AGRE | 'angry' |

## Creative flapping

Read CCS presents the fact that children have a tendency, when first learning to spell, to spell flaps as orthographic D, as is evidenced in the following spellings in (3) from (Read CCS, 29):

| | | |
|---|---|---|
| (3) | PREDE | 'pretty' |
| | LADR | 'letter' |
| | WOODR | 'water' |

[3] Few are the instances of English words in which the grapheme sequence *ng* is pronounced to the tee. That is, the sequence is almost invariably reduced to engma, such that the segment becomes a digraph. The only examples that come to mind are monomorphemic words in which the grapheme indicates a syllable boundary, as in *finger* or *linger*.

| | |
|---|---|
| BEDR | 'better' |
| FIDI | 'fight-ed' |
| AODOV | 'out of' |
| GADICHANS | 'get a chance' |

In this small sample, collected from a variety of children, Read demonstrates that flapping can occur in a variety of contexts or environments, but offers little clarification as to whether certain environments are to be expected, something that will be explored more below.

## Alternations across the orthography

Read goes into detail about phonologically-conditioned allomorphy as reflected in the spellings of young children. There are somewhat distinct stages, he maintains. Initially, children represent the three allophones orthographically, as evidenced by the following spellings in (4) (CCS, 31):

(4)

| | |
|---|---|
| LAFFT | 'left' |
| HALPT | 'helped' |
| COLD | 'called' |
| STAD | 'stayed' |
| STARTID | 'started' |
| WOTID | 'waited' |

Thus, the child realizes on the orthographic level what is present phonetically on the surface, namely, the allophones [t], [d], and [əd]. This three-way distinction, however, often[4] collapses into a

[4] There is much hesitance to undertake any sort of quantitative analysis—which I fear is due to the high variability in the data set and the difficulties of working with young children who are learning how to spell.

slightly more accurate realization of the orthographic norm, such that forms such as the following in (5) arise (CCS, 31):

(5) FIXD ‘fixed’

PEKD ‘peeked’

Thus, there is but one orthographic realization of three different phonetic forms, -*d*. Even though what surfaces is the affix [-t], has learned the orthographic representation of the past tense affix. So the child progresses through a stage in which she first represents salient phonetic details orthographically; then, she comes to understand there is abstraction involved and that some sounds are not represented on the surface; finally, she realizes the standard orthography, and those phonetic distinctions irrelevant at the level of orthography are ignored. At the final stage, the orthographic representation must gradually converge on a the shared underlying representation. Returning to flapping, I shall now look at the process in greater detail.

## Flapping

When children are first learning to spell, there is an important phonetic fact that they must come to understand, and this relates to a phonological process called *tapping*—or, more traditionally, *flapping*. Flapping is a process of consonant lenition. It is unlike any other process, at least when orthographic representation is considered, because a flap could be represented by either a single or double *t* or *d*. In other words, one single sound has four possible representations in standard orthography. For vowels, this is pretty much on par for the course. What is more common in Standard English orthography, as in the cases of the English plural and past tense suffixes, written *–(e)s* and *–(e)d*, respectively, often regularizes, and several different sounds that represent the same morphological

relation are collapsed into one orthographic representation[5]. In this situation, the child has only to learn to recognize the fact that a segment represents a specific morpheme, either the past tense or the plural morpheme. The orthographic shape is constant, which is in line with the fact that

A problem with flapping is it is often an optional and gradient process. In casual speech, underlying medial /t/, /d/, or /n/ (as in *writer*, *rider*, and *runner*, respectively) surface as flaps when flanked by [+syllabic] segments (and when not followed by a stressed syllable). Typically, the process by which /t/, /d/, /n/ becomes surface [ɾ] is termed intervocalic flapping. The degree to which these coronal segments undergo neutralization, however, is highly variable. One could create a hypothetical minimal triplet that included the following orthographic forms (which are all plausible words):

(6) Underlying forms:

a. /lɪtɹ/ litter, as in *kitty litter;*

b. /lɪdɹ/ lidder, as in *one who covers with lids;*

c. /lɪnɹ/ linner, a blend of *lunch* and *dinner*, similar to *brunch;*

(7) Surface forms (respectively):

d. [l ɪ ɾ ɹ]

e. [l ɪ ɾ ɹ]

f. [l ɪ̃ ɾ ɹ][6]

In (6a-c), the underlying medial consonant is specified for manner of articulation (and voicing) and is preceded by a lax follow and followed by syllabic [ɹ]. All of these instances of flapping can be described by the following rule in (8):

[5] I ignore the past tense written with orthographic –*t*: this is more often the exception than the case.
[6] Since the flap is vocalic in nature, it may also show some degree of nasalization. Whether this results from coarticulation with the nasalized vowel or whether the flap is actually nasalized is something I am not prepared to debate, nor is it of any great importance.

(8) [CORONAL] → [+voice, +flap] / [+syllabic] __[+syllabic, -stress]

Of course, instance (6c) surfaces slightly differently, since in English vowels preceding nasals are heavily nasalized—more so than in other languages and the vowel thus surfaces with nasalization. Since nasalization of vowels is plausibly a cue for a following nasal segment, the flap in (7c) is certainly less similar phonetically to (7a-b) (Hale 110). It may well be possible to distinguish forms (7a-b) via a vowel length distinction, since it is well known that vowels preceding voiced obstruents in English are longer than those that precede their unvoiced counterparts. These phonetic minutiae are largely irrelevant at the level of underlying representation, however, as (degree of) vowel length in English, in addition to pure nasalization of vowels, is largely irrelevant (in terms of contrastive status—that is, vowel length or nasalization is not contrastive in English).[7]

## Representing word-level flaps

The rule stated in (8) could apply to principally two different situations. In the case above, it applies at the level of the word. That is, the environment is contained entirely within the word boundaries. For a child learning two words that surface as approximately the same, such as *metal* and *medal* and, to drive the point home, *meddle* and *mettle*, all of which surface as [mɛɾəl], it is difficult to know if the child has access to the underlying form at all until she begins to spell, at which point the distinction becomes largely orthographic—unless she has been exposed to the most careful speech by her parents or caregivers, such that manner of articulation of medial consonants is always maintained.[8] Since the ultimately underlying representation is probably not set in stone, the variability of this process

[7] This is all hard to state definitively, though, since vowel length and nasalization may contain important cues regarding the voiced/nasal status of a segment following a vowel. That is, learners of English may pick up on the fact that if a vowel is nasalized then it is followed by a nasal segment. In fact, I am almost sure this is the case. Were the nasal cue in the vowel to become so overt and perceptible as to overshadow the following nasal obstruent, speakers may only represent the nasal in the vowel—in the form of a nasalized vowel. This is, essentially, what has happened in French, where nasalized vowels do contrast with their purely (or mostly) oral counterparts.

[8] This is by no means impossible, just unlikely—though nearly impossible to verify.

in young children's speech (and spellings) is understandably cast into doubt. For a form like *metal* [mɛɾəl], is it possible to say that a beginning speller randomly chooses orthographic D or T[9] to represent the spelling? This would be reflected in variable rates of use in a child's spelling. Does the child establish one orthographic representation? Or does the choice of whether a flap is represented by a D or T fluctuate even in the spelling of a single word? If the choice is random—even despite the fact that the D is probably a more phonetically accurate representation of [ɾ] than is T, due to the fact that both share the feature [+voice]—ultimately, it is up to the speller how she represents a word-internal flap in orthography. Thus, this is likely to be uninteresting to anyone concerned with the kind of knowledge young children possess about language. If there is something more consistent about it, this will surely be relevant and interesting.

## Representing beyond-word-level flaps

Things get more interesting when flaps alternate based on the environment—that is, for flaps that are not conditioned locally. There are essentially two triggers of non-word-level flaps: morphological and phrasal. Morphological triggers, for English, are mostly the verbal past tense and present progressive suffixes, /-əd/ and /-ɪŋ/, respectively. Thus, for a verb like *get* [gɛt], whether the underlying unvoiced alveolar stop surfaces depends on the presence of the verbal suffix /-ɪŋ/, in which case the verb surfaces as [gɛɾɪŋ]. The same applies for a verb such as *heated* /hit-əd/ surfacing as [hiɾəd]. And these two morphemes are acquired earlier on in the acquisition process. Preschoolers generally display proficiency in using these morphemes. In fact, the present progressive morpheme is known to be the earliest acquired grammatical morpheme (Berko Gleason & Ratner, 160).

Beyond morphologically-conditioned flapping, flapping also occurs at the level of the phrase, the most salient except of which is when a coronal segment occurs word-finally, such as in *get* [gɛt].

[9] Make it clear that orthographic representations will be presented in capital letters.

Here, the /t/ is not fully articulated; it is most often unreleased. The unreleased stop, however, is merely a surface phenomenon. There is no doubt as to what the underlying segment is. Thus, the final segment of [gɛt̚] cannot be but a voiceless coronal stop. When such a word is followed by an unstressed vowel, this is the environment in which flapping should occur.

Now, this environment frequently occurs in spoken English.

(9) Get a…

(10) Eat it… and so on.

In isolation, all of these words that end in voiceless coronal stops cannot contain a flap, since flapping does not occur in English phrase-finally. Thus, when a flap surfaces, this is evidence for a phrase-level rule at work. We can ask ourselves, "Do creative spellers show evidence for phrase-level flapping rules in their innovative spellings?" That is, do these spellers appeal to surface forms when they spell? Here, the tension is clear. There may be an underlying segment (such as /t/), which is no abstract segment, since in every other environment the /t/ does indeed surface. In a specific environment, however, the /t/ becomes [ɾ] on the surface. Effectively, children have two possible representations to choose from: the underlying and the surface forms. Knowledge of the underlying form requires that knowledge of the phonetic form

## Hypothesis: Of mis-maps and -matches

As stated above, there are three principal conditioning environments for lenition of alveolar stops to flaps: those at the level of the root, those at the level of the word, and those at the level of the phrase. In spoken American English, all surface as flaps. In Standard English orthography, these all surface as either the voiced or voiceless alveolar stop, since there is no written representation for the alveolar flap—a segment specific to certain dialects of English, including American English. If children

indeed begin (and are allowed to continue) to spell phonetically and are more aware of the phonetic qualities of words than adults, and if children are more likely to represent—at least initially—the sound [ɾ] as D, then children have no real basis to spell any word-internal flaps as anything but D, no matter the orthographic representation. At this level, a monomorphemic word such as *butter* can only be represented in the minds of speakers as

(11) [bʌɾəɹ]

since speakers have no evidence to the contrary. That is, the only thing a child has ever heard has been the word produced with a surface flap. In fact, (and in theory), only when she learns the conventional orthography does she learn to which underlying segment to map the flap.[10]

Moving away from the root to the level of the word, complete with the additional morphemes whose structural descriptions feed flapping, children should be less likely to spell these forms with a flap if they appeal to anything but the surface representation. A word like *getting* could be represented as follows in (12):

(12) $[[\text{gɛt}]_{\text{ROOT}}\ \text{-ɪŋ}]_{\text{AFFIX}}$

Something similar transpires in phrase-level flaps, except the process applies not across root boundary, but across word boundary.

In adult phonologies, this flapping rule[11] applies after stress assignment and after the addition of any affixes. Additionally, it must apply at spell-out at the level of IP (Fukaya & Byrd, 2005 and Bermudez-Otero); if there is a phrase juncture, such as any sort of pause, flapping will not apply, as in (13):

[10] On this note, I suppose it is possible that if the child has been exposed to careful pronunciation, she might have internalized a different underlying segment. While this may apply to some tokens, it is implausible to say that the child has *exclusively* heard careful pronunciations of words in which a flap is predicted to surface.

(13) Served hot, asparagus is my favorite vegetable.

[hɔtˀ# ə.spɛ.ɹə.gəs]

In word- and phrase-level instances of flapping, there must necessarily exist competing orthographic representations in the minds of children who employ creative spelling. This is due to the fact that, at times, a word such as *get* is best represented by either GET or GED—[gɛt] or [gɛɾ], respectively.

In my view, there is no reason to assume that orthographic representations of speech need to represent anything but the sounds actually present in the words. The fact that certain orthographies do—such that even phonological alternations like final devoicing in German and Dutch are ignored in standard orthography—adds complexity and forces the speller to ignore phonological alternations for the sake of morphological relatedness. Just as the singular-plural alternation in German *wheel*: [ʀɑt] ~ [ʀɑdəs] requires that a German child learning to write must ignore the voicing contrast (or lack thereof) in coda obstruents in spelling, so the child must come to realize that voicing of unstressed intervocalic alveolar stops is not an accurate indicator of the underlying segment.

In creative spellers' renditions of flaps with conditioning environments contained locally in the root, it is predicted that these by far should most often contain a mismatch between the conventional orthography (in this case orthographic *t(t)*, though underlying [ɾ]) and what creative spellers employ (predicted to be orthographic *d*). Young spellers have no knowledge of the admittedly abstract underlying representation in which something that surfaces as essentially voiced and stop-like is *actually* voiceless.

Beyond this level, the frequency of errors is predicted to decrease quite dramatically. For a form like /gɛt]-ɪŋ/, whether or not the speller realizes that the voiced alveolar segment is underlyingly

[11] I use the term *rule* without endorsing any specific theory of (morpho-)phonology. I do not really care if there are other ways of envisioning the rule, such as a highly rank

voiceless would depend on a number of things: (1) if he can recognize that a form such as [gɛɾɪŋ] actually consists of /gɛt]$_{ROOT}$ -ɪŋ/. Berko-Gleason 1957 details a study of the morphological knowledge of young children (kindergartners and first graders), characterized by the classic “wug” test. She found that children are largely privy to morphological rules in that they are able to generalize such rules to novel forms, something which indicated that these rules were psychological realities, helping to refute the idea that children learn language solely by imitating their parents. (A child cannot imitate something she has never heard before.) The fact that young children learning English know intuitively how to create the plural [wʌgz] from [wʌg] does not imply that children are aware of the morphological operation, per se. Beyond this, it is impossible to know how aware young children are of verb paradigms. Do they automatically know that *get* as the base of [gɛɾɪŋ]? This seems unlikely, as there is now way for a child to know what constitutes a valid phonological alternation represented orthographically. Representing [gɛɾɪŋ] as GEDING is as valid a representation as GETTING to a young child as yet unlearned in the complex orthography of English. Whether or not a child represents the unvoiced alveolar stop also depends on the source of the utterance. If, say, the utterer is pronouncing every underlying voicing distinction carefully, this would lead the child to conform more to conventional orthography. These flaps are predicted to be less common than root-conditioned flaps, though the forms are predicted to be relatively consistent throughout time. That is, if a child represents [gɛɾɪŋ] with medial D, she is expected not to alternate between D and T, as it is likely that the child has certain forms stored holistically (at least at early stages of her development).

Finally, a conditioning environment at the phrase level seems like the least likely source of an orthographic mismap. For one, if the child carefully segments each word from the speech stream and accurately maps a stored form to the form stored in a mental representation, there should be no doubt as to with which orthographic variant to represent the flap that occurs purely at the surface level. At least with root-internal and to some extent word-internal flaps, there is little motivation to posit a

phonological representation other than what surfaces. For phrase-level flaps, however, if the child has any working memory of passed orthographic forms employed, the child should misrepresent the flap in instances that constitute block phonological phrases—a string of phones analyzed holistically. In these cases, however, though the flap may be derived from an underlying /t/, this has no real significance for the speaker of the language.

What is predicted, then, is a decreasing incidence of mis-mapping underlying /t/ to D that surfaces as [r] as the phonological domain of the conditioning environment becomes less local. This prediction rests largely on the idea that young spellers are known to be more sensitive to the phonetic form of a word that surfaces.

# The data

## Background:

The following data comes from the writing journals of the kindergarten class at Calvin Hill Day Care, Inc. and Kitty Lustman Kindergarten. The kindergarten is private; parents apply and the children are admitted, based on various selection criteria. The majority of the children come from middle- and upper-class backgrounds—relatively homogenous in terms of indicators of socioeconomic status. The majority of families are in some way affiliated with Yale University. The child care center itself is not Yale-affiliated, though the building is Yale-owned and the director is a lecturer in the Psychology Department and with the Yale Child Study Center

## Methods

I did not interact with children from whom I received the data, nor did I perform—or have the children perform—any sort of elicitation. All data was collected under the close supervision of the head teacher in the kindergarten, with explicit permission from the director; no journals left the classroom. I went into the classroom to read through writing journals and other examples of children's writing, all of

which the children produced naturally—or mostly naturally. It can be assumed that if a child was persistent enough in asking how to spell a word or asked a variety of teachers, she may have received the conventional spelling as opposed to the response, "Well, how does it sound? What's the first sound? Now, what's the sound after that…" After spending quite a bit of time perusing the journals, decoding what at times seemed like runic inscriptions, I recorded every instance of a coronal stop that occurred in a flap-feeding environment.

Based on the 73 tokens gathered, it is hard to say much of anything. The environment for flapping was well represented. However, it was mostly root-internal flapping that was represented. And for root-internal flapping, there were T/D alternations, as is represented in the pair CHAPDR/CHAPTR, produced by the same child. Flapping occurred variably in this context. Underlying /t/ surfaced as D in 22 of the 50 instances of root-level flapping, as in (14):

(14) CHAPDR

PARDY

COMPUDR[12]

BUDRFLY, etc.

Word-level flapping was not nearly as prevalent. In fact, the only word-level flapping occurred with the present progressive suffix for a total of 12 tokens. And in fact, all of the underlying verbal roots except one surfaced with the underlying grapheme preserved, as in (15)

(15) EATING

[12] Pointed out to me by Matthew Wolf, it is possible to conceive of this as a derived word, though equating *compute* with *computer* seems to be a concept probably more relevant at the advent of computing, as both a field and a word. For me, it is monomorphemic, and I assume it is for the kindergartners of today.

REDING ("reading")

CUTTING

GTING ("getting"), etc.

The one exception was HDING for *hitting*.

At the phrase level, however, there was no evidence for knowledge of flapping. That is, all seven instances of underlying /t/ segments surfaced as T.

(16) GOT A

OUT OF

BROT IN ("brought in")

CAT IS

one instance of "gotta"[13]

## Looking closer: an analysis

In examining the data, the hypothesis stated above does seem to be supported. Spellings of surface flaps as D occur quite regularly at the level of root, only one occurs at the level of the word, and none occur at the level of the phrase. Despite this, the children are known to produce flaps in oral speech in all of these environments. That is, from an informal observation period of the kindergartners,

[13] This is a spelling which could only have been learned if the child knew the orthographic representation.

their speech closely resembled that of my own; no careful speech production (of flaps) was observed to have occurred in a two-hour period.[14]

In analyzing the variance via a single-factor ANOVA test, the p-value of .00226 turned out to show significance of flapping environment as the source of flapping. The amount of data is regrettably small, in terms of overall token and the makeup of the spellers themselves.

## Drawbacks

As is usual, this data is not without complicating factors. It is not really possible to account for any sort of frequency effects. Especially frequent are “got” and “brought” in phrase-level environments. Whether or not higher-frequency words are more likely to be spelled with the orthographic form that surfaces in flap-blocking environments is undeterminable. Additionally, how, precisely, the child envisions or pronounces the word (even sub-vocally) is impossible to determine. That is, the child could very well pronounce a form such as *getting* slowly and carefully, such that the medial coronal segment, which is usually ambisyllabic in regular speech, is produced as if it were at the beginning of a syllable (with possibly aspiration associated with it). Since the children from whom the data was collected are a range of ages, from 5;3 to 6;2, and since the reading journals really are a snapshot of literacy development, there is no possibility of examining these processes as stages along a developmental continuum. Finally, as pointed out to me by Darya Kavitskaya (14 April 2010), flapping is a gradient process in which coronal segments that occur between vowels, as in *butter*, are more likely to be voiced and, thus, more like the voiced coronal stop /d/ in articulation. In the environment in which the coronal segment occurs between a voiceless stop and a vowel, as in *chapter*, there is likely to be produced with a lesser degree of voicing due to coarticulation effects of the preceding voiceless stop. It is entirely

[14] I should note that this observation period, typically called participant observation, is exempt from requiring approval by the Yale Institutional Review Board Human Subjects Committee—so long as approval of the director and head teacher is obtained.

possible that some flaps are more salient on the surface than others. Phillips 2006 also reports flapping that varies with lexical frequency—that is, flaps are more common in words that are more frequently used, since it may be that more commonly used words are ones used in more informal situations in which one expects alveolar flaps to surface (66).

Of course, even beyond these complications, there are a number of potential problems with using data as evidenced by children's spellings. The most obvious one is that even if children represent some level of representation in their spellings, it is impossible to know which. However, what is clear is that children's perceptions (and, thus, representations) of words change as they are exposed to more data. When children learn English orthography, they are learning to connect a mental representation of a string of sounds with an abstract orthographic string of characters. Thus, a word such as *butter* is represented as [bʌɾəɹ]; the medial *t*'s reflect a historical spelling (and one that is still preserved in some dialects—though, most often with aspiration). However, children are not aware of this relationship until they gain adequate exposure to orthographic input. Thus, phonetically accurate spellings of flaps are predicted to occur until one of two things results: the underlying flap maps to the appropriate orthographic symbol, which plausibly happens with sufficient exposure to appropriate spellings; or the two potential representations (in the case of word-final flaps) converge on a single orthographic form.

## Conclusion

Is there a decreasing tendency for children to represent flaps as the scope phonological domain expands from root to phrase level? The results above seem to indicate a positive response, though it is hard to tell, since there is also decreasing frequency of tokens, which makes any conclusion almost impossible to be backed up with (real) statistical certainty. Flaps were relatively frequent at the level of root, with 44% of orthographic /t/ mapped as D in orthography. For word- and phrase-level flapping, however, the only thing that can be said is that flapping was not as frequent or prevalent. The relatively

limited corpus is seen as rather unforgiving. It may very well be that children are more likely to appeal to underlying representations when analyzing multi-morphemic verb forms or verbs that have flaps that alternate at the phrase level.

Going beyond the numbers themselves, following Jesney 2009, there is an important theoretical implication. If children are more consistent in representing what are arguably underlying representations at word- and phrase-levels, this reinforces need for something similar to output-output faithfulness constraints as they exist in some current instantiations of Optimality Theory (Prince & Smolensky 2002). That is, when attempting to spell non-root-level flaps, children refer to either the word in isolation (as in the case of phrase-level flaps) or (non-)derived forms of the word (as in the case of word-level flaps). For a phrase such as "She hit it," the results imply that the child appeals to the word *hit* in isolation, and for a word such as *sitting*, the child appeals to forms such as *sit* or *sits* in conceiving (and spelling) the word. Teasing the effects of possible output-output faithfulness constraints from the effects of having learned the conventional spelling is no easy task, and as the data presented above is relatively small, there is more work to be done. It will be very interesting indeed to see what language acquisition research has to contribute to the burgeoning field of theoretical linguistics, especially when the latter attempts to account for phenomena present in the former. The implications may very well be real and measurable amid the sea of messy data that constitutes the productions of young children. Building off the intuitions in this essay, what follows (in Appendix A) are possible experiments to inform both fields simultaneously and help navigate the stormy seas towards a greater understanding of one of the key things that makes us human: language.

## Appendix A: Looking Ahead

1) Experiment 1, à la Wug Test

    a) A 'Wug'-test-type experiment is very possible. The overall goal would be to see how an individual child represents flaps at the three levels previously mentioned and whether or not this is variable. Thus, the three levels would require a nonce-noun and probably a few nonce verbs to test all three levels. It would be interesting to administer this to a few children and see if they represent flaps different based on the environment. This seems to be the real driving point behind what I'm writing about.

    b) Design stimuli, with novel words, or words children may have heard but have never written. Complicating factor, probably, is how to avoid influencing the pronunciation. The goal is to present the child with a word that ends with a final coronal stop, have her write it in a non-flapping environment, then have her write it in a flapping environment.

    c) The plausible hypothesis: if the child is presented with the stimulus first in the flapping environment, it is much more likely that she will map it to an underlying voiced stop (/d/), as opposed to positing the underlyingly abstract representation /t/. If she hears three initial instances of it in a flapping environment, and then one instance in a non-flapping environment, what happens to the orthography?

2) Experiment 2, Testing Affixability

    a) There are several known words in which a flap is present in the *base* form of a base-derived pair, such as *atom~atomic* and *battle~battalion*.

    b) If there is indeed a base identity effect pressure, a child may spell *atomic* with a D if she has the spelling of the word *atom* in mind. Of course, there also may be bi-directional pressures, such as those posited to exist in cases of paradigm uniformity, that tell the speller to "be consistent."

c) The main problem that might surface with this is the relative complexity of these words; few kindergartners I know produce the words *atomic* or *battalion* regularly, even if they might occasionally produce *atom* or *battle*.

3) Any experiment

a) The one thing most certainly necessary is either increased sample size or a study with greater longevity. That is, how do children who have just begun to spell creatively represent flaps across the different environments? How does this change as the child's experiences become more varied? How does this change as the child learns to read? Next year, as the Seedlings Fellow in the same kindergarten classroom form which I gathered the data, I will be in a position to carry out an albeit informal study—but this will inevitably be informed by the work I have done this year.

# Appendix B: the data

| ROOT | WORD | PHRASE |
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## References

Armington, David. 1997. *The Living Classroom: Writing, reading, and beyond*. Washington, DC: The National Association for the Education of Young Children.

Bloomfield, Leonard. 1956. Language. New York: Henry Holt and Company, Inc.

Berko Gleason, Jean & Nan Bernstein Ratner. 2009. The Development of Language, 7th edn. Boston: Pearson Education, Inc.

Bermúdez-Otero, Ricardo. Word-final prevocalic consonants in English: representation vs derivation. University of Manchester. http://www.bermudez-otero.com/OCP4.pdf

Chomsky, Carol. 1972. Write Now, Read Later. In C. Cazden (Ed.), *Language in Early Childhood Education* (119-126). Washington, DC: The National Association for the Education of Young Children.

Chomsky, Carol. 1973. Reading, Writing, and Phonology. In F. Smith *Psycholinguistics and Reading* (91-104). New York: Holt, Rinehart and Winston.

Chomsky, Carol. 1975. Invented Spelling in the Open Classroom. In W. Von Raffler-Engel & J. Macris (Eds.), *Word: Journal of the International Linguistic Association* (499-518). New York: International Linguistic Association.

Chomsky, Carol. 2001. Stages in Language Development and Reading Exposure. In S. W. Beck & L. B. Oláh (Eds.) *Perspectives on Language and Literacy: Beyond the here and now* (51-76). Cambridge, MA: Harvard Educational Review.

Chomsky, Noam & Morris Halle. 1968. *The Sound Pattern of English*. New York: Harper & Row.

Fikkert, Paula. 2005. Getting Sound Structures in Mind: Acquisition Bridging Linguistics and Psychology? In Anne Cutler (ed.) *Twenty-first Century Psycholinguistics: Four Cornerstones*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Foley, Helen & John Locke. 1971. Young children's knowledge of morphological and phonological rules. *Journal of Communication Disorders 4.* 259-262.

Fukaya, Teruhiko & Dani Byrd. An articulatory examination of word-final flapping at phrase and edges and interiors. *Journal of the International Phonetic Association* 35.1. 45-58.

Gershkoff-Stowe, Lisa & Esther Thelen. 2004. U-Shaped Changes in Behavior: A Dynamic Systems Perspective. *Journal of Cognition and Development* 5(1), 11-36. New Jersey: Lawrence Erlbaum Associates.

Hale, Mark. 2007. Historical linguistics: theory and method. Malden, MA: Blackwell Publishing.

Jesney, Karen. 2009. Uniformity effects as a consequence of learning with lexical constraints. Poster Presented at the KNAW Colloquium on Language Acquisition and Optimality Theory. Amsterdam. July 2009.

Liberman, Alvin M. 1992. The Relation of Speech to Reading and Writing. In Ram Frost and Leonard Katz (eds.) *Orthography, phonology, morphology, and meaning*. New York: Elsevier Science Publishers.

Marcus, Gary F., Steven Pinker, et al. 1992. Overregularization in Language Acquisition. *Monographs of the Society for Research in Child Development*, 57(4.228). http://www.jstor.org/stable/1166115 (11 December 2009.)

Menn, Lise. 1980. Phonological Theory and Child Phonology. In Grace Yeni-Komshian et al. (eds.) *Child Phonology Volume 1: Production*. New York: Academic Press.

Nespor, Marina & Irene Vogel. 1982. Prosodic domains of external sandhi rules. In Harry van der Hurlst & Norval Smith (eds.) *The structure of phonological representations*. Dordrecht: Foris.

Phillips, Betty S. 2006. Word Frequency and Lexical Diffusion. New York: Palgrave MacMillan.

Prince, Alan & Paul Smolensky. 2002. Optimality Theory: Constraint Interaction in Generative Grammar. ROA-537, Rutgers Optimality Archive, http://roa.rutgers.edu/

Read, Charles. 1986. Children's creative spelling. Boston: Routledge & Kegan Paul.

Read, Charles. 2001. Preschool Children's Knowledge of English Phonology. In SW Beck & LB Olah *Perspectives on Language and Literacy: Beyond the here and now*. Cambridge, MA: Harvard Educational Review.

Schickedanz, Judth A. 1999. *Much More Than The ABCs:* The Early Stages of Reading and Writing. Washington, DC: The National Association for the Education of Young Children.

Shankweiler, Donald & Eric Lundquist. 1992. On the relations between learning to spell and learning to read. In Ram Frost and Leonard Katz (eds.) *Orthography, phonology, morphology, and meaning*. New York: Elsevier Science Publishers.

Sénéchal, Monique, Michelle Basque & Tina Leclaire. 2006. Morphological knowledge as revealed in children's spelling accuracy and reports of spelling strategies. *Journal of Experimental Child Psychology 95*. 231-254.

Siegler, Robert S. 2004. U-Shaped Interest in u-Shaped Development—and What It Means. *Journal of Cognition and Development,* 5(1), 1-10. New Jersey: Lawrence Erlbaum Associates.

Taft, Marcus. 2006. "Orthographically influenced abstract phonological representation: evidence from non-rhotic speakers" Journal of Psycholinguistic Research: 35, 1.

Venezky, Richard L. 1967. English orthography: Its graphical structure and its relation to sound. *Reading Research Quarterly*: Vol. 2, No. 3. International Reading Association. Accessed 26/03/2010. http://www.jstor.org/stable/747037

"sugar, n." The Oxford English Dictionary. 2nd ed. 1989. OED Online. Oxford University Press. 4 Apr. 2000 <http://dictionary.oed.com/cgi/entry/50241744>.