Emergent positional faithfulness in novel English blends

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Abstract
We present evidence from ten experiments on novel blend formation showing that adult English speakers have access to positional faithfulness constraints on *heads*, *nouns*, and *proper nouns*, even though the non-blend phonology of English provides no evidence that such constraints are active in the grammar. Our results (a) demonstrate that positional constraints are universally available; (b) confirm that the lexical category *proper noun* has the status of a strong position, which has broader implications for the role of lexical categories in positional neutralization effects; and (c) confirm that strong positions based on salience from non-phonetic sources (such as morphosyntactic, semantic, or psycholinguistic salience) participate in positional neutralization phenomena.

1. Introduction

Positional neutralization effects are a class of phonological phenomena in which contrasts are neutralized in "weak" positions such as unstressed syllables or coda consonants, but maintained in "strong" positions such as stressed syllables or onset consonants. These effects are common in the world's languages, and very similar sets of strong and weak positions recur across languages. However, there is some controversy over the best phonological account of these typological facts.

The earliest approaches to positional neutralization in the Optimality Theory framework (e.g., Beckman 1997, 1999; Casali 1996, 1997; Zoll 1996, 2004) assumed or explicitly proposed that constraints referring to members of a particular inventory of strong (or weak) positions are part of an innate universal constraint set. As with all constraints in classic OT (Prince & Smolensky 1993/2004), particular positional constraints might or might not be ranked high enough in any given language to have observable effects on surface phonological patterns, but on this view, all positional constraints are part of the phonological grammar of all speakers.

Subsequent proposals in phonological theory have, however, made possible an alternative conception of positional neutralization, in which neither a universal set of designated privileged positions, nor an innate inventory of constraints (positional or otherwise), must be universally encoded in the phonological grammar. First, it has been proposed that the reason why some phonological positions are typologically more resistant to neutralization is that they are *phonetically* better able to support contrasts; this leads to a lower likelihood of *phonological* neutralization of contrasts than in non-salient contexts, because the salient contexts are less susceptible to misperception and reanalysis during diachronic transmission (Kochetov 2002, 2003; Barnes 2006; on phonetically-guided sound change, see reviews by Hansson 2008, Garrett

& Johnson 2013). For example, in languages where stressed syllables have greater duration than unstressed syllables, there is more time for articulatory vowel targets to be reached in stressed syllables. This makes them less vulnerable than unstressed syllables to articulatory undershoot, and thus to diachronic reanalysis as undergoing phonological vowel reduction. On this view, it is not necessary for the universal phonological grammar to designate 'stressed syllable' as a strong position with a corresponding set of positional faithfulness constraints while crucially disallowing the same treatment of the position 'unstressed syllable', because even if faithfulness constraints can be relativized to both of these positions, only stressed-syllable faithfulness will ever receive phonetic or diachronic support to be ranked high enough in the grammar to be active in surface phonological patterns.

Second, it has been called into question whether there is a universal set of constraints in the first place. Instead, perhaps each learner induces its own set of constraints on the basis of patterns encountered in the ambient language data during the course of acquisition (Hayes & Wilson 2008; see also Coleman & Pierrehumbert 1997 for a related approach). But on this non-universalist view of constraints, speakers of languages without positional neutralization patterns would not have induced positional constraints when learning their phonology, and so would never be expected to show the effects of such constraints when their phonological grammar is probed. On the strongest interpretation of this model, even a learner that induces one particular positional constraint on the basis of patterns in the data would not necessarily induce other positional constraints, not even other constraints relativized to that same position.

Thus, it is an empirical question whether access to positional-faithfulness constraints is universally available to all (adult) speakers, or whether knowledge of positional-faithfulness constraints only comes about through exposure to relevant patterns of positional neutralization in the ambient language data.

In this paper, we present evidence from *emergent effects* in *novel blend formation* to show that several classes of positional constraints that are active in the grammars of languages other than English, but play no role in English phonology, nevertheless influence English-speakers' performance in a blend-to-definition matching task (Shaw 2013, Author 2014). We begin by replicating Shaw's demonstration of emergent faithfulness to *morphological heads* (versus non-heads), then extend them to two more typologically-motivated non-phonetic strong positions, *nouns* (versus verbs) and *proper nouns* (versus common nouns). As discussed below, there is no evidence from the phonological grammar of English in support of faithfulness constraints specific to these positions, so adult speakers of English could not be using such a constraint in novel blend formation unless it is in fact universally available.

This paper is organized as follows. Section 2 sets the theoretical and empirical stage with the principal themes of this study: positional faithfulness, emergence, and lexical blends. Section 3 zooms in on the particular varieties of positional faithfulness studied here, and lays out the cross-linguistic evidence that segments and stress belonging to morpho-semantic heads, nouns, and proper nouns can resist processes that apply elsewhere. The experiments (which are all systematic variations on the same theme) are motivated, described, and reported in Section 4. Finally, in Section 5, we consider possible sources and implications of these emergent effects.

2. Positional faithfulness, emergence, and lexical blends

This section outlines the theoretical background concerning positional faithfulness constraints, emergent effects, and the relevance of lexical blends to these questions of phonological theory.

2.1 Positional neutralization and positional faithfulness

Many languages are subject to a phonological phenomenon known as *positional neutralization*, in which certain phonological processes, such as obstruent devoicing or vowel reduction, occur only in particular structural positions, such as syllable codas or unstressed syllables (see Trubetzkoy 1939 for early discussion). From the perspective of a constraint-based approach to phonology such as Optimality Theory (Prince & Smolensky 1993/2004), the neutralization of a phonological contrast means that *markedness constraints*, which impose phonological requirements on output (surface) forms, dominate *faithfulness constraints*, which require output forms to preserve the phonological characteristics of their corresponding input (underlying) forms. Conversely, failure to undergo some potential neutralization process shows that the reverse ranking, in which faithfulness constraints dominate markedness constraints, holds in the language. The case of positional neutralization is therefore particularly interesting, because in order for a neutralization process to occur only in some position, the constraints pertaining to that position must be in a markedness >> faithfulness ranking, while the constraints pertaining to material outside that position must be in a faithfulness >> markedness ranking.

Formally, this insight has been implemented by creating special position-specific versions of constraints, such that they are in force only for phonological material that falls within the position in question. In the *positional faithfulness* approach (Beckman 1997, 1999; Casali 1996, 1997), faithfulness constraints have position-specific counterparts that can be ranked high to protect phonological material in the *non-neutralizing* positions. For example, a ranking such as Ident[voice]-Onset >> *ObstruentVoicing >> Ident[voice] protects voiced obstruents in syllable onsets from undergoing devoicing, due to the fact that Ident[voice]-Onset dominates *ObstruentVoicing. However, voiced obstruents in syllable codas are not protected by the high-ranking onset-specific faithfulness constraint, and so they fall prey to the *ObstruentVoicing >> Ident[voice] ranking and undergo devoicing.

An alternative approach is *positional markedness* (Zoll 1996, 2004; Author 2004), in which it is markedness constraints that have positional counterparts, and these refer specifically to the *neutralizing* positions; for the example above, this approach would invoke a constraint such as *ObstruentVoicing-Coda. Although some phenomena are equally amenable to a positional-markedness or a positional-faithfulness treatment, the empirical predictions of the two approaches do not entirely overlap. In Section 5.2 below, we discuss how the present experiments distinguish between them.

2.2 Emergent rankings and emergent constraints

The term *emergent effect* is used in the context of Optimality Theory (Prince & Smolensky 1993/2004) to refer to a situation in which a constraint or a constraint ranking is not usually or generally visible in a language, but reveals itself under particular circumstances. The term originates in the discussion of "emergence of the unmarked" effects by McCarthy & Prince (1994). This is a class of effects in which a relatively low-ranking markedness constraint becomes visible in a specific context where higher-ranked competing constraints are not relevant. For example, a language might tolerate syllable codas in general, because a faithfulness constraint against deleting input segments (Max-IO) is ranked high, and yet the same language might avoid codas in reduplicative copying, because Max-IO does not assign violations when a reduplicant is less than a complete copy of its base. Here, the effects of the relatively low-ranking NoCoda constraint *emerge* in the specific context of reduplicative copying.

Subsequent research has identified cases where constraints or constraint rankings have no discernable effect in first-language (L1) phonology at all, even in specific contexts such as reduplication, but nevertheless display emergent effects when speakers perform non-L1 tasks. Examples include emergent effects in second-language or interlanguage phonology (Broselow, Chen, & Wang 1998; Zhang 2013; Jesney to appear), in laboratory production and perception of non-L1 structures (Davidson 2001, Berent et al. 2007; although see Davidson 2010 for an opposing perspective), in loanword phonology (Jacobs & Gussenhoven 2000; Ito & Mester 2001), and in language games (Author 2008). Emergent effects of this sort are theoretically significant because they reveal phonological knowledge that could not have been learned directly from the L1 ambient language data.

2.3 Lexical blends

Lexical blending is a word-formation process that combines two or more *source words* into a single *blend*, losing some phonological material in the process; e.g., *spoon* + *fork* → *spork* (Pound 1914; Wentworth 1934; Algeo 1978; Bat-El 2006; Renner et al. 2012). The term is defined by different authors to encompass a heterogeneous range of processes, but all definitions include *spork*-like words, which begin like Source Word 1 and end like Source Word 2, and we follow Bat-El (2006) in applying "blend" narrowly to this process. (We are also concerned only with *intentional* blends, not speech errors.) Blends are of interest for our purposes for two main reasons.

First, blending can force a choice of which source word to be unfaithful to. Blend outputs are usually shorter, in segmental and syllabic terms, than the source words together (Gries 2004; Bauer 2012), and cannot have more than one main word stress; thus, *blue* + *green* forces a choice between *bleen* and *breen,* and *mótor* + *hotél* forces a choice between *mótel* and *motél* (Arndt-Lappe & Plag 2013). Much higher levels of unfaithfulness can be obtained through blending than through most other morphological or phonological processes of English; e.g., *breakfast* + *lunch* → *brunch* deletes 7 of the source words' original 12 segments (Gries 2004). The greater magnitude of unfaithfulness available through blending may make it possible to detect effects that would be too faint to see in other contexts, especially if violations add across constraints, as they do in Harmonic Grammar (Legendre, Miyata, & Smolensky 1990; Smolensky & Legendre 2006; Pater 2009).

Second, blending, like a language game or loanword phonology, is a relatively infrequent operation which involves the adaptation by the L1 grammar of something which is consciously felt — and often even intended — to be anomalous (Piñeros 2004, Gries 2012). Blending therefore offers a similar opportunity to observe emergent effects when a grammar which is optimized for L1 phonology is applied in very different circumstances. We know of no way to compare the frequency of blending with that of language games, but studies of neologisms have found blending to be less frequent than borrowing (Algeo 1980; Cannon 1987 via Bauer 1989), and hence less frequent than loanword adaptation. The CELEX lexical database identifies only 59 lemmas as blends out of a sample of 52,447 lemmas (0.11%, using a broader definition of "blend" than ours), and their summed corpus frequency is 896 in a corpus of 18,580,121 words (0.0048%) (Baayen et al. 1995, fields 3 and 23 of file EML.CD). Blending thus creates an arena in which effects of universal phonological constraints which play no role elsewhere in the grammar can emerge (Bat-El 2000).

Our experiments on emergent effects in lexical blends find strong evidence for two subtypes of positional faithfulness: head faithfulness and proper-noun faithfulness. We also find weaker, but still favorable, evidence for a third subtype, noun faithfulness. These three categories of positional faithfulness, and our experimental findings concerning their emergent effects in blend formation, are discussed in the sections that follow.

3. Faithfulness to morphological categories

In her survey of positional neutralization effects, Beckman (1997, 1999) draws a distinction between positions that resist neutralization because they are phonetically salient, including stressed syllables or syllable onsets, and positions that resist neutralization because they are salient for psycholinguistic reasons, such as their importance in lexical access and language processing; namely, roots (see also McCarthy & Prince 1995) and initial syllables. A similar distinction is drawn by Casali (1996, 1997) between positions that are strong because they have salient phonetic cues, and positions that are strong for morphological or morphosyntactic reasons. In the latter category, Casali discusses mainly lexical morphemes (as opposed to functional or grammatical morphemes), and he makes note of the greater degree of semantic content in lexical morphemes as one possible reason for their status as a salient position. Other proposals concerning non-phonetically based strong positions include derivational heads (Revithiadou 1999) and nouns (Author 2001).

In summary, typologically attested strong positions are not always privileged for reasons of greater phonetic salience; some strong positions seem to owe their status to factors including psycholinguistic, morphosyntactic, or semantic salience. This distinction is important because proposals recasting positional neutralization patterns as effects of diachronic transmission (e.g., Kochetov 2002, 2003; Barnes 2006) have focused primarily on phonetically strong positions.

The positions we test in our blend experiments all fall into the class of positions that are privileged for morphological or morpho-semantic reasons rather than phonetic reasons: heads, nouns, and proper nouns. In this section, we review evidence and theoretical background concerning faithfulness to these three categories in order to argue that (1) the typological facts confirm that each of these positions is indeed a "strong" position, but that (2) the non-blend phonology of English does not show positional faithfulness effects in any of them.

3.1 Head faithfulness

As we already mentioned, the fact that blends require truncation of phonological material can be exploited to test positional faithfulness effects. First, we consider the possibility that a morphological head is one of the privileged positions and that the phonological material from a head (both segmental and prosodic) is more likely to be preserved in a blend than the material from a non-head.

One of the earliest proposals for positional faithfulness to heads in OT is due to Revithiadou (1999) who proposed it as a possible alternative to positional faithfulness to another morphological position, the root (McCarthy and Prince, 1995). Revithiadou's proposal was motivated by data from such languages as Greek and Russian, in which the morphological head was claimed to determine the position of the main stress in derived words (also see Roon, 2006). Ussishkin (1999) adopts Revithiadou's HeadFaith constraint to explain a segmental rather than a prosodic effect. Namely, he argues that head faithfulness correctly predicts which segments are more likely to be realized in one type of derivational formation in Hebrew, the deverbal nouns restricted to two syllables by a prosodic shape constraint. Thus, head faithfulness has been previously posited to affect both prosodic and segmental content in morphological derivatives. Shaw (2013) tested whether blend formation in English is sensitive to head faithfulness effects, and found support for the hypothesis that both the segmental makeup of a novel blend as well as its stress pattern are influenced by its head, although she used a somewhat different definition of head than Revithiadou.

In particular, for Revithiadou the morphological head is defined based on formal, syntactic criteria. However, one can also talk about semantic heads of morphological derivatives. Below we briefly review the difference between these two notions of head, and discuss the criteria we will use for determining heads in blends, which are similar to the criteria used by Shaw.

The morphological analogue of a syntactic head is a morpheme that determines the syntactic category and the morphological class (e.g., gender) of a word, and hence its distribution. On theories in which affixation is accomplished in syntax, derivational morphemes and roots typically function as heads unlike most inflectional morphemes (although this view is controversial as discussed in Beard, 1998). A different notion is a *semantic head*, an element that, roughly speaking, expresses the main meaning of the expression. In morphology, semantic heads are typically appealed to in discussion of compounds. In general, there is greater agreement about what constitutes a head of a compound than there is about heads of other derived words. The most common definition of heads in compounds relies on the semantic relation of hyponymy: if the compound as a whole is a hyponym of one of its members, then that member is the semantic head (Allen, 1978). For example, a *sunflower* is a hyponym of *flower*, therefore, *flower* is the semantic head of the compound. One can also apply the formal criterion for headedness to those compounds whose members belong to different lexical categories. In those cases, the member that determines the lexical category of the compound is the syntactic head. However, Guevarra and Scalise (2009) point out that the semantic criterion of headedness is more reliable because the syntactic criterion alone could lead to wrong predictions. For example, in Italian, *rompighiaccio* (break + ice) "icebreaker" cannot be analyzed as being headed by the noun *ghiaccio* "ice" despite having the same syntactic category as "ice". They propose that both the syntactic and the semantic criteria for headedness must be satisfied by the head of a compound. Violation of either one of the two criteria qualifies a compound as exocentric (or headless). On this view, the syntactic and the semantic head must coincide in compounds. Because blends, like compounds, involve a combination of several roots or words, and are sometimes considered to be a type of compounding (Bat-El, 2006), it is reasonable to treat blends in the same way as compounds with respect to headedness.

Because we are interested in head effects, all of our blends will be endocentric. That is, they will all have at least one head that meets both the syntactic and the semantic criteria for headedness. Additionally, we will make a distinction between blends that have just one head vs. blends that have two heads following a similar distinction in compounds between endocentric coordinate and endocentric subordinate/attributive compounds (Bisetto and Scalise, 2005). A coordinate compound is a compound whose members are semantically connected by the logical connector "and" (e.g., *bitter-sweet*, *actor-director)*. When the meaning of such compounds is compositional, they can be said to have two heads. An example of an analogous coordinate blend is *spork*, something that is both a spoon and a fork. On the other hand, a *motel* (*motor* + *hotel*) is a type of hotel, not a type of motor, and *affluenza* (affluence + influenza) is metaphorically a type of a disease, not a type of affluence, and not something that is both an affluence and a disease. Thus, *motel* and *affluenza* have just one head, corresponding to the right-most source word.

As far as we know, no one has previously claimed that head faithfulness affects the phonology of English. If anything, there is some indication from compounds that heads are not privileged when it comes to determining the position of the main stress. It is well-known that English endocentric compounds are right-headed, but that the most prominent stress in a compound falls on the non-head (the Compound Stress Rule, Chomsky and Halle, 1968). More recent work by Plag (2006; Plag et. al. 2008) argues based on evidence from corpus data that the Compound Stress Rule does not hold for as many as half of NN compounds in English, but that the right-word stress cannot be successfully predicted from the semantic relationship between the head and non-head, argument structure, or analogy.

In short, based on the evidence from compounds, there are no visible prosodic effects of head faithfulness in English. We are also not aware of any segmental head-faithfulness effects in English. Our blend experiments test for effects of a head-faithfulness constraint against segmental deletion, MaxSeg-Head, and a head-faithfulness constraint against the removal of main word stress, MaxStress-Head. If we observe special faithfulness to heads in lexical blends, it is reasonable to assume that they were not learned from the lexicon.

3.2 Noun Faithfulness

A second category of positional faithfulness which can be tested in novel blend formation is noun faithfulness (Author 2001). The phonological behavior of nouns and verbs can differ (see, for example, Cohen [1939] 1964; Postal 1968; Kenstowicz & Kisseberth 1977; Myers 2000; Bobalijk 2008). Some noun/verb differences simply involve different default patterns for nouns and verbs (Chomsky & Halle 1968; Lynch 1978; Wolff 1983; Kelly 1992), and therefore do not bear on the question of positional faithfulness. However, when one category shows stronger faithfulness effects than the other, it is cross-linguistically more likely to be nouns than verbs (Author 2011).

In our experiments, we test for evidence of adult English speakers' access to a noun-faithfulness constraint against segmental deletion and a noun-faithfulness constraint against the removal of main word stress, MaxSeg-Noun and MaxStress-Noun respectively. We argue that both of these constraints show true emergent effects in English blends, because high rankings for them cannot have been learned from the non-blend phonology of English.

First, English speakers could not have learned a ranking involving MaxSeg-Noun from exposure to English phonology. While it is true that nouns are on average longer than verbs (by syllable count) in English (Cassidy & Kelly 1991), there are no active alternations involving segment deletion that treat nouns and verbs differently. Furthermore, there is no mandatory maximum size for either nouns or verbs. Thus, no evidence is encountered during the acquisition of English for any crucial ranking involving the constraint MaxSeg-Noun.

Second, English speakers could not have learned a high ranking for MaxStress-Noun on the basis of the non-blend phonology. Nouns and verbs do have different default stress patterns in English (Chomsky & Halle 1968; Ross 1973), but as both of these patterns involve defaults, this is not a matter of faithfulness. If anything, noun stress behavior is *more* predictable (*less* indicative of faithfulness to underlying contrasts) than verb stress behavior. Kelly & Bock (1988: 391), reporting stress data from Francis & Kučera (1982), show that English disyllables used only as nouns have an extremely strong preference for initial stress, with 94% of the 3002 nouns in the Francis & Kučera data showing this pattern. On the other hand, disyllables used only as verbs have a much less-strongly skewed preference: of 1021 verbs, final stress occurred only 69% of the time, with 31% of the verbs actually showing initial stress.

3.3 Proper Noun Faithfulness

The third type of positional-faithfulness effect that we investigate is proper-noun faithfulness. Although phonological differences between proper and common nouns are even less thoroughly studied than those between nouns and verbs, there is typological evidence that proper nouns can have *different* phonological patterns from common nouns, as demonstrated by Sezer (1981) for Turkish and Sugawara (2012) for Japanese. Crucially, there is even evidence from segmental deletion patterns in Canadian French (Walker 1984: 96) and from a syncope process in Jordanian Arabic (Jaber 2011) that proper nouns can show *stronger* faithfulness effects than common nouns. These facts motivate proper noun as a category for which positional faithfulness constraints are relevant.

As discussed in Sections 3.1 and 3.2, previous research provides evidence that neither heads nor nouns show special faithfulness effects in the non-blend phonology of English. However, there has been much less discussion comparing the phonology of proper and common nouns in English. It is therefore necessary to make the case that proper-noun faithfulness effects are emergent in English blends; i.e., that English non-blend phonology does not immunize the class of proper nouns against contrast-neutralizing processes which affect common nouns.

Evidence for this claim comes from pairs of proper and common nouns which are related by zero conversion, e.g., the proper noun *Heather* (derived from the common noun *heather*) or the common noun *rugby* (derived from the proper noun *Rugby*). Proper-noun faithfulness could in principle lead to phonological differences with these pairs. For example, in Jordanian Arabic (Jaber 2011), underlying short high vowels are banned from non-final unstressed open syllables in verbs, adjectives, and common nouns (with potential violations repaired by obligatory deletion), but surface faithfully in proper nouns. The result is that proper-noun/common-noun pairs may differ in phonology, as shown in (1):

(1) Common/proper noun pairs in Jordanian Arabic, showing resistance of proper nouns to open-syllable high-vowel deletion (Jaber 2011).

Proper	Common	Gloss
si.'raadʒ	'ʃraadʒ	'oil lamp'
ʃu.'huud	'ʃhuud	'eyewitness'
su.'dʒhuud	'sdʒuud	'prostration'
si.'haam	'shaam	'arrows'
xu.'luud	'xluud	'eternity'
wu.'ruud	'wruud	'flowers'
zu.'huur	'zhuur	'roses'
ʃa.'faaʔ	'ʃa.fa	'clarity'
du.'çaaʔ	'du.ça	'supplication'
ha.'naaʔ	'ha.na	'happiness'

To test whether ordinary (non-blend) English phonology similarly privileges proper nouns, we sought to replicate Jaber's study for English using lexical databases. First, the CELEX lexical database of British English (Baayen et al. 1995) was searched for all pairs of orthographic one-word noun lemmas (part-of-speech code 1 in Field 4 of the ESL.CD database) which differed only in capitalization of the initial letter, and whose non-initial letters were all lower-case. There were 219 such pairs. For each pair, all pronunciations (Field 6 of EPL.CD) of the capitalized and lower-case members of the pair were collected. In 211 cases (96%), the capitalized and lower-case orthographies had exactly the same pronunciations. In 8 cases, the set of pronunciations for the capitalized orthography differed from the set of pronunciations for the lower-case orthography: *Bar/bar, Job/job*, *Comforter/comforter*, *Aborigine/aborigine*, *Poll/poll*, *Bass/bass*, *Polish/polish*, and *Benedictine/benedictine*. One of these pairs seems to come from a typographical error (*Comforter/comforter*, where one pronunciation is missing the [m])). In at least two others, the orthographic similarity is coincidental (*Job/job* and *Polish/polish*). In none of the 5 remaining pairs could the proper/common difference be characterized as resistance to segmental deletion or stress shift by the proper noun.

A larger sample, with U.S. English (the variety spoken by our participants) but with less-reliable pronunciation data, was provided by combining the orthographies from *Webster's Second International Dictionary* (1934) in the Unix /usr/share/dict/web2 file with pronunciations from the CMU Pronouncing Dictionary (Weide 1998). Orthographic pairs differing in initial capitalization were found in the Webster's database. The orthographies were converted to all upper-case, so that each pair yielded one all-upper-case orthography. The CMU database, which uses all-upper-case orthographies, was searched for all pronunciations associated with each pair's orthography, and reported all of them that were associated with more than one pronunciation. Of the 1515 pairs, 78 had more than one pronunciation. These 78 were sifted to find etymologically-related proper-common pairs, using the current on-line edition of the *Oxford English Dictionary*. Pairs were excluded for the following reasons: 8 involved an abbreviation (e.g., *AVE*); the *OED* did not confirm the existence of the common noun in 11 cases (e.g., *HURON*); and in 27 cases there was no etymological connection between the proper and common noun (e.g., *NICE*). In the remaining 33 cases, a related proper and common noun with that spelling could be confirmed, and that spelling was associated with at least two pronunciations in the CMU database. In 24 of these cases, the difference was only in the pronunciation of an individual sound, e.g., *COLORADO* [kal@radoU / kal@rædoU], *CAYENNE* [keIEn / kaIEn]. The remaining 9 cases showed differences involving segment count (*CONCORD, ORIENTAL*), syllable count (*FEDERAL, NAPOLEON*), location of main word stress (*ANGELICA, GUARANI, NATAL, ROMANCE*), or both length and stress (*BARNARD*). The CMU database did not indicate whether the proper noun had one pronunciation and the common noun had the other, or whether both nouns had both pronunciations, but it is clear that the number of proper-common pairs related by segmental deletion or stress shift is very small.

In short, both database searches found that underlyingly identical proper and common nouns are treated alike by the phonological grammar of English, rather than the proper nouns being immune from processes that affect common nouns (or vice versa). Apparently, any well-formed common noun would be well-formed as a proper noun, and vice versa, without any need for phonological adaptation.

We can ask further: Does English exhibit more subtle effects of the proper/common distinction, which, while not strong enough to cause alternation, could lead a learner to infer a faithfulness difference? We know of only a few, and it is equivocal which they would support, proper-noun faith or common-noun faith. One is hypocoristic formation. We do not know of quantitative data on whether this suite of faithfulness-violating processes is more productive for proper or common nouns, but it is clear that many personal names undergo idiosyncratic changes from which common nouns are exempt, such as *Margaret* > *Peggy* (Bauer 2006:499). Another is inventory and phonotactics. In our databases (CELEX and CMU), there are no common nouns beginning with [Z] or [vl], only proper nouns, which, for an Optimality-Theoretic learner, would indicate greater faithfulness to proper nouns. On the other hand, our databases have no proper nouns beginning with [Tw] or [zl], only common nouns, which would indicate the reverse.

Is there evidence that English learners are especially tolerant of marked structures in proper nouns compared to common ones? The only relevant quantitative study we know of is that of Martin (2007, Ch. 3) on liquid co-occurrence restrictions. This study compared the actual frequency of /l...l/ and /r...r/ sequences to the expected frequency under the hypothesis of no association. In the general vocabularies of Old English, Middle English, and Modern English, about 25% of two-liquid words have the same liquid twice, compared to an expected proportion of about 50%, indicating that English (like other languages Martin considers) has a durable but "soft" bias against identical liquid sequences. Among 20th-Century American baby names, the expected frequency of /l … l/ and /r … r/ in the top 1000 names has been about 50% in every decade, but the actual frequency has been below 20% since the 1930s, and was never more than about 25%. Among brand names for drugs, the expected frequency is again about 50%, but the actual frequency is below 10%. In a database of fantasy role-playing game characters, Martin found that the expected rate was about 45%, but the actual rate is again below 20%. In a database of "unusual baby names", the expected rate is about 50%, but the actual rate is close to zero. Thus, for this particular marked structure, English names are if anything *less* tolerant of marked structures than English is in general. If faithfulness can be learned from probabilistic skews in the lexicon, this one would motivate *common*-noun faithfulness.

To sum up: Although the phonology of some languages accords special faithfulness to proper nouns vis-à-vis common nouns, the non-blend phonology of English does not. It treats underlyingly identical proper and common nouns alike with respect to phonological alternations, and does not seem to be more tolerant of phonological markedness in proper nouns than elsewhere (in some ways, it is *less* tolerant). Greater faithfulness in proper nouns than in underlyingly identical common nouns in English blend formation would therefore be a consequence, not of generalizing to blending a pattern found in ordinary phonology, but rather of a universal predisposition expressing itself in an area where the ordinary phonology does not override it — in Optimality-Theoretic terms, an emergent effect.

4. Experiments

All of our experiments have a similar structure, based on the structure of Experiment 2 in Shaw (2013; Author 2014). The experiments test whether English speakers, in forming blends, are more faithful to material which originates in a source word that is more prominent morphologically. Three different prominent positions were tested: semantic *heads* vs. *non-heads*; *nouns* vs. *verbs*; and *proper nouns* vs. *common nouns*. These were fully crossed with two different kinds of phonological information, *segments* and *main stress*.

4.1 Rationale for segmental experiments

The segmental experiments tested whether English speakers, in forming blends, are more faithful to segments which originate in a morphologically-prominent source word (a head rather than a non-head, a noun rather than a verb, a proper noun rather than a common noun). The experiments exploit what Shaw (2013) calls "ambi-blendable" source-word pairs. The idea is illustrated in (2) for the case of head faithfulness.

(2) Ambi-blendable source-word pair, showing two possible switch points.

piranha	p	ɪ	ɹ	ɑ	n	ə
			↓		↓	
rhino			ɹ	aɪ	n	oʊ

Phonologically, the two source words were chosen so that they could be blended in two different ways depending on which switch point was chosen. The source word pairs were affix-free nouns that shared two consonants surrounding a different stressed vowel; thus, the two candidate blend outputs differed only in their stressed vowel. Because the stressed syllable was non-initial in Word 1 and non-final in Word 2, the blend candidates differed from both of the source words. The earlier switch point preserved less of Word 1 and more of Word 2 than did the later one.

Morphosyntactically, Words 1 and 2 were chosen to create a structural ambiguity in the meaning of the blend such that only one of the two possible parses invoked the relevant Positional Faithfulness constraint. The experimental task was to match the two blend candidates with two definitions that embodied the two possible morphosyntactic parses. The *baboon-bandit* head-faithfulness example is illustrated in (3). The first definition is a semantically coordinating (two-headed) definition, because the hybrid is equally a piranha and a rhino. The second definition has a right-headed subordinating structure, because it defines a kind of rhino, not a kind of piranha.

(3) Experimental task: Which blend goes with which definition?

Blends	Definitions
piranho	Coordinating: A hybrid of a rhino and a piranha.
pirhino	Right-headed: A rhino that is fierce like a piranha.

Our linking hypothesis is that participants match blends to definitions so as to optimize constraint violations for both blend-definition pairs taken together. The tableau in (4) illustrates this. The two candidates in this tableau are the two possible ways to match the definitions with the blends. Each candidate thus consists of two input-output pairs. They differ in their violations of Max-head, a positional version of the usual Max (McCarthy & Prince 1995). In Candidate (a), the right-headed definition – the one that has one head - is matched to the blend that preserves all of Word 2. In Candidate (b), the right-headed definition is matched to the blend that deletes from Word 2, so both of the input-output pairs violate Max-head. Since Candidate (a) and Candidate (b) score alike on non-positional Max (as well as on other constraints, not shown, which do not involve headedness, such as markedness constraints), the outcome of the competition is predicted to be determined by Max-head, which favors Candidate (a).

(4) Head faithfulness prefers Candidate (a) because it matches the right-headed definition – the one that makes Word 2 a head – with the blend that preserves more of Word 2. Italics and underlining show correspondence relations.

				Max-head	Max
Î	a.	*piranha* + rhino (hd)	→ *pir*hino		*a n ə*
		piranha (hd) + rhino (hd)	→ *pira*nho	*ə* ɪ aɪ	*ə* ɪ aɪ
	b.	*piranha* (hd) + rhino (hd)	→ *pir*hino	*a n ə*	*a n ə*
		piranha + rhino (hd)	→ *pira*nho	ɪ aɪ	*ə* ɪ aɪ

The italics and underlining show the correspondence relations between the output segments and the input. In these candidates, the segments constituting the switch point are simultaneously italicized and underlined, indicating that they are faithful correspondents of input segments from both source words (a proposal attributed by Piñeros 1999 to Janda 1986). Candidates which have less overlap are harmonically bounded by Candidates (a) and (b), and so are omitted from the tableau. Depending on assumptions about contiguity constraints (McCarthy & Prince 1995), it could be that Candidates (a) and (b) are less harmonic than corresponding candidates (a') and (b') in which even non-contiguous identical segments are shared (e.g., *piranha* + rhino → *piranho*), as is done by, example, Piñeros (2004), but substituing (a') and (b') for (a) and (b) would not change our predictions: When offered a choice between (a) and (b) (or (a') and (b')), participants are predicted to prefer (a) (or (a')), the head-faithful option.

If *head* is replaced by a different prominent position, such as *noun* or *proper noun*, the theory of Positional Faithfulness predicts the existence of an analogous Positional Faithfulness constraint, which allows the construction of an analogous segmental experiment with an analogous predicted outcome.

4.2 Rationale for stress experiments

The rationale for these experiments is the same as that just described, with faithfulness to stress in place of faithfulness to segments. In each source-word pair, the switch point follows the main-stressed vowel of Word 1, but precedes the main-stressed vowel of Word 2. This forces a choice as to whether the main stress of the blend should precede or follow the switch point. In this experiment, Word 1 is trochaic and Word 2 is iambic, and the participant is offered a trochaic and an iambic blend. An example is shown in (5).

(5) Source word pair, showing two possible stress patterns for the output.

Word 1	Word 2	Stress pattern of blend	
trochaic	iambic	trochaic	iambic
flóunder	sardíne	flóundine	floundíne

The experimental task was to match the trochaic and iambic blends to definitions which create a difference in positional faithfulness, such as coordinating vs. right-headed definitions, as shown in (6).

(6) Experimental task: Which blend goes with which definition?

Blends	Definitions	
flóundine	Coordinating:	A cross between a sardine and a flounder.
floundíne	Right-headed:	A type of sardine eaten by flounder.

Under the linking hypothesis (that definitions are matched so as to optimize constraint violations), the right-headed definition is predicted to be matched preferentially with the iambic blend, which matches the stress of Word 2 and mismatches that of Word 1, as shown in Tableau (7).

(7) Head faithfulness prefers Candidate (a) because it matches the right-headed definition – the one that makes Word 2 a head – with the blend that preserves the stress of Word 2. Italics and underlining show correspondence relations.

			Max-Stress (head)	Max-Stress
Î a.	*flóunder* + sardíne (hd)	→ *flound*íne		*
	flóunder (hd) + sardíne (hd)	→ *flóund*ine	*	*
b.	*flóunder* (hd) + sardíne (hd)	→ *flound*íne	*	*
	flóunder + sardíne (hd)	→ *flóund*ine	*	*

This tableau is parallel to Tableau (4). In Candidate (a), the definition that makes the iambic Word 2 the head is matched with the iambic blend, whereas in Candidate (b), that definition is matched with the trochaic blend, incurring a Max-Stress (head) violation. Max-Stress (head) is a positional version of Max-Stress, which requires the output correspondent of a stress-bearing input segment to bear stress as well (McCarthy 1995, Kager 2000, Alderete 2001, Alber & Plag 2001). Other constraints that are indifferent to stress and headedness do not distinguish between Candidate (a) and Candidate (b), so the decision falls to Max-Stress (head), which favors Candidate (a). Replacing *head* with another strong position leads to analogous predictions in analogous experiments. Table (8) shows the experiments reported in this paper.

(8) Positions and faithfulness constraints tested in the experiments in this paper.

Exp.	Position	Faithfulness	Example	
1	head	segments	*piranha* + rhino	→ *piranho*/*pirhino*
2	head	stress	*flóunder* + sardíne	→ *flóundine*/floundíne
3a	noun	segments	*brood* + ridicule	→ *broodicule*/*bridicule*
4a	noun	stress	*wátch* + chóose	→ *wátchoose*/*watchóose*
3b	noun	segments	*fling* + language	→ *flinguage*/*flanguage*
4b	noun	stress	*blúbber* + babóon	→ *blúbboon*/*blubbóon*
5a	proper noun	segments	*chihuahua* + werewolf	→ *chihuawolf*/*chiwerewolf*
6a	proper noun	stress	*jérsey* + physíque	→ *jérsique*/*jersíque*
5b	proper noun	segments	*chihuahua* + werewolf	→ *chihuawolf*/*chiwerewolf*
6b	proper noun	stress	*jérsey* + physíque	→ *jérsique*/*jersíque*

The definition-matching task (Shaw 2013) is a two-alternative forced-choice task; on each trial, two different blend outputs are presented, and the participant is asked to decide whether (e.g.) the first is coordinating and the second is right-headed, or vice versa. The advantage over a single-interval task is that the two-alternative choice task minimizes response bias (Macmillan & Creelman 2004:179). For instance, if each trial consisted of presenting a single definition and asking for a choice between two possible blend outputs, participants might always prefer the output with initial stress, obscuring subtle differences in the strength of that preference as a function of the headedness of the definition.

4.3 Design and methods

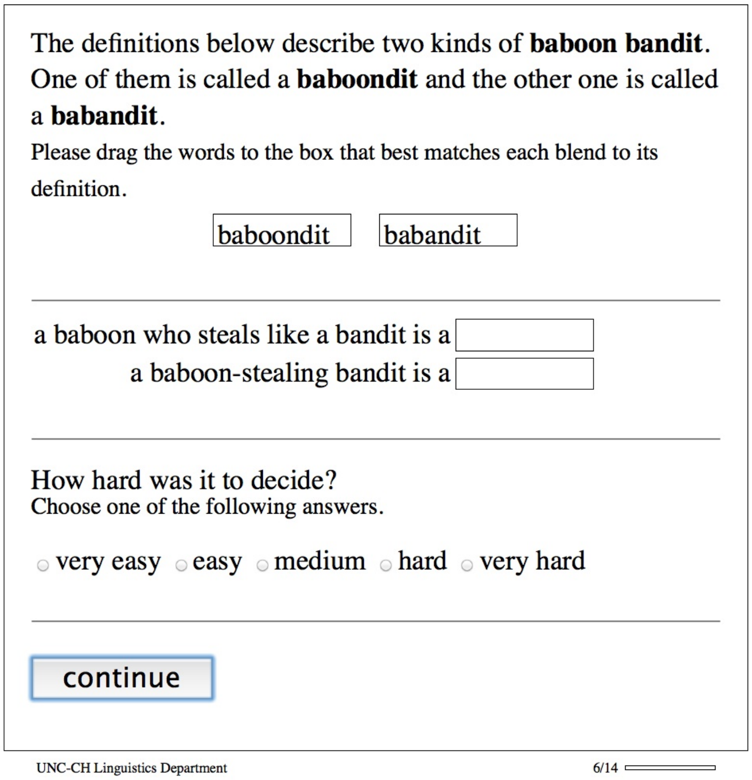
For each experiment, nine source-word pairs with associated candidate blends and definitions were constructed (complete lists are given in Section 4.5). The segmental experiments used written stimuli only. For the stress experiments, each of the two blend candidates (e.g., *flóundine* and *floundíne*) were pronounced by a phonetically-sophisticated female native speaker of American English (the second author) and digitally recorded using an ATR 2500-USB Side Address USB Microphone (Audio Technica Corp.) in a double-walled soundproof chamber (Ray Proof Corp.) at a 44.1-kHz sampling rate in WAV format. Praat (Boersma & Weenink 2013) was then used to edit the stimuli. Stimuli were trimmed so that they began at the first zero crossing preceding the first visible evidence of a signal on the waveform and spectrogram, and so that they ended at the zero crossing following the disappearance of a distinct second formant.

Each token was then scaled to a peak amplitude of ±0.975 of the available dynamic range, and 0.5 s of silence was added to the end. The WAV-format files were converted to the lossily-compressed MP3 and OGG formats using the software *lame* (LAME Project, lame.sourceforge.net), *afconvert* (Apple Computer Corp.), and *Ogg Drop X* (vorbis.com).

The survey was administered as a web-based experiment using a modified version of the Experigen software (Becker 2013). It consisted of four different sections including instructions, an example, the main experiment, and a post-survey questionnaire. The written instructions briefly explained what a blend is, and said that the participants will be asked to match blends with definitions. The response interface was then demonstrated using a practice example. For participants in segmental experiments, the practice example was like a trial of the main experiment, using an extra (tenth) blend pair and with explanatory text on the page. For those in the stress experiments, the practice example familiarized them with the use of stress marks by asking them to match *óbject* and *objéct* with definitions of the noun and the verb. The main experiment then followed. On each trial, participants were shown two blend candidates above two definitions (see Figure 9). In the stress experiments, audio controls below the candidates could be clicked on to play audio of each candidate. Participants indicated their choice by dragging either of the blends into the blank in one of the definitions (this automatically put the other blend into the other blank). A radio-button scale then appeared below the definitions, and participants rated the difficulty of the trial on a five-point scale from "very easy" to "very hard", after which the next trial started.[1] For each source-word pair, there were two ways to order the two blend candidates and two ways to order the two definitions. Four versions of the experiment were used to counterbalance both orders across participants. The order of the trials was randomized individually for each participant. Lastly, in the debriefing questionnaire, participants were asked what, if any, strategy they employed and whether any of the blend pairs were particularly difficult. They were also asked for demographic information such as their handedness, gender, level of education and native language.

1Decision-difficulty ratings were collected in Experiments 1, 2, 3, 4, 5b, and 6b (a) in order to replicate exactly the procedure used in Shaw (2013), and (b) in order to test the hypothesis that positionally-faithful responses would be more likely on trials that evoked stronger intuitions. In analyzing each each experiment, the ratings were z-transformed with respect to their grand mean and standard deviation for all participants in that experiment. The transformed rating was added as a fixed effect in the intercept-only model, and random slopes for rating by item and by participant were added to the random effects. Rated difficulty proved significant or marginally so only in Experiments 3 and 6b, where in fact higher ratings were associated with a lower rate of positionally-faithful responses. It is difficult to conclude anything from such weak and contradictory evidence, but the hypothesis that strong intuitions are associated with positionally-faithful responses was at any rate not supported. Rated familiarity in Experiments 5a and 6a was analyzed the same way; its effect was not significantly different from zero in either experiment. The ratings are not discussed further in this paper.

(9) Appearance of a typical trial in Experiment 1.



4.4 Participants and other details

Participants were recruited using Amazon Mechanical Turk, an on-line labor exchange (Sprouse 2011). They were offered US$1 for completing a “7- to 15-minute survey about how you blend words (should blue+green be ‘bleen’ or "breen”)?”. Across all of the experiments reported in this paper, the average time to complete the experiment, including the post-experiment questionnaire, was 10 minutes 29 seconds.

A participant’s data was excluded from further analysis for any of several reasons: failure to complete all nine test trials, failure to answer every one of the demographic questions, reporting a language other than English as first language, or, in the stress experiments, giving an incorrect response to the practice question (i.e., matching *óbject* and *objéct* to the wrong definitions). The exclusions in each experiment are shown in Table (10).

(10) Participant data collected but excluded from analysis in each experiment, separated out by reasons for exclusion. A single participant may be excluded for more than one reason.

Exp.	Condition	incomplete test	incomplete demographics	non-English first language	failed stress test
1	head/segment	2	3	0	0
2	head/stress	3	5	6	12
3a	noun/segment	5	8	1	0
4a	noun/stress	6	6	1	13
3b	noun/segment	2	1	1	0
4b	noun/stress	3	4	3	6
5a	proper noun/segment	4	5	8	0
6a	proper noun/stress	3	5	3	17
5b	proper noun/segment	1	3	7	0
6b	proper noun/stress	4	2	5	11

Table (11) shows the total number of participants run in each experiment, the number of valid participants remaining after the exclusions, and basic demographic characteristics of the valid participants. No one participated in more than one experiment.

(11) Demographic data for participants in all experiments. "F" = female, "M" = "male", "—" = no response.

		Participants					Birth year		
Exp.	Condition	Total	Valid	F	M	—	Min.	Med.	Max.
1	head/segment	129	123	71	52	0	1942	1983	1995
2	head/stress	132	109	58	49	2	1945	1980	1995
3a	head/segment	127	118	69	50	0	1950	1979	1994
4a	head/stress	144	124	73	65	0	1939	1982	1995
3b	noun/segment	128	124	69	54	3	1949	1982	1995
4b	noun/stress	134	122	62	59	0	1946	1980	1995
5a	proper noun/segment	126	112	59	53	0	1933	1982	1995
6a	proper noun/stress	155	132	63	67	1	1949	1984	1996
5b	proper noun/segment	145	135	80	55	0	1941	1982	1995
6b	proper noun/stress	155	135	77	58	0	1949	1980	1996

4.5 Results

Following Shaw (2013), we analyzed the data in two ways. For the "By-Participant" analysis, the unit of observation was the participant. Since there were nine trials, each participant gave either mostly positionally-faithful responses, or mostly positionally-unfaithful ones. A participant who gave mostly positionally-faithful responses was coded as 1, else as 0. The observed proportion of positionally-faithful responders was compared to the chance level of 0.5 using a one-sided exact binomial test (*binom.test* in the *stats* package of the statistical software *R*; R Core Team, 2014). If the observed proportion significantly exceeded chance, that meant that participants tended to be positionally-faithful responders. The by-participant analyses for all experiments are shown together in Table (12); they will be discussed below in the section devoted to each experiment.

(12) Number of participants in each experiment who gave mostly positionally-faithful vs. mostly not positionally-faithful responses. The confidence intervals and *p*-value are exact binomial.

		Participants with		95% CI			
Exp.	Condition	>4.5 PF	<4.5PF	Min.	Est.	Max.	*p*
1	head/segment	90	33	0.64	0.73	0.81	<0.001
2	head/stress	70	39	0.54	0.64	0.73	0.0039
3a	noun/segment	71	46	0.51	0.61	0.70	0.0261
4a	noun/stress	72	52	0.49	0.58	0.67	0.0876
3b	noun/segment	79	47	0.54	0.63	0.71	0.0055
4b	noun/stress	72	49	0.50	0.60	0.68	0.0451
5a	proper noun/segment	83	29	0.65	0.74	0.82	<0.001
6a	proper noun/stress	86	45	0.57	0.66	0.74	<0.001
5b	proper noun/segment	91	44	0.59	0.67	0.75	<0.001
6b	proper noun/stress	79	56	0.50	0.59	0.67	0.0579

For the "By-Response" analysis, the unit of observation was the individual response. Each response was coded as positionally faithful (1) or not (0). A mixed logistic-regression model was fit using the *lmer* method in the *lme4* package of the statistical software R (Bates, Maechler, & Bolker, 2011). The model had a single fixed term, the intercept, with random intercepts for each participant and each of the nine items. The intercept was compared to its chance level of 0. If the intercept significantly exceeded chance, that meant that responses tended significantly to favor the positionally-faithful association of blends to definitions. The fixed-effects portion of the fitted model for each analysis is shown in Table (13); they, too, will be discussed together with the individual experiments.

(13) Fixed-effects part of the mixed logit model fit to the individual-response data in each experiment. The 95% normal confidence intervals for proportion correct were obtained by constructing an interval of radius 1.96 standard errors around the intercept, then converting it from logits to proportions.

						Pr (corr), 95% CI		
Exp.	Condition	Intercept	s.e.	*z*	*p*	min.	est.	max.
1	head/segment	0.4259	0.0836	5.096	<0.001	0.56	0.60	0.64
2	head/stress	0.3031	0.0842	3.601	<0.001	0.53	0.57	0.61
3a	noun/segment	0.2438	0.2264	1.077	0.281	0.45	0.56	0.66
4a	noun/stress	0.0684	0.0743	0.92	0.357	0.48	0.52	0.55
3b	noun/segment	0.2371	0.2549	0.93	0.352	0.43	0.56	0.67
4b	noun/stress	0.2091	0.0741	2.823	0.0476	0.52	0.55	0.59
5a	proper noun/segment	0.4355	0.1419	3.07	0.0021	0.54	0.61	0.67
6a	proper noun/stress	0.4316	0.0938	4.602	<0.001	0.56	0.60	0.65
5b	proper noun/segment	0.3115	0.1137	2.74	0.0062	0.52	0.58	0.63
6b	proper noun/stress	0.1909	0.0941	2.029	0.0425	0.50	0.55	0.59

4.5.1. Experiments 1 and 2: head faithfulness

Our first experiments were intended to replicate Experiments 1 and 2 of Shaw (2013; Author 2014) and to check that the same results could be achieved using Mechanical Turk participants and the drag-and-drop interface. Experiment 1 investigated head faithfulness to segmental content. There were nine items for this experiment with the eight original items from Shaw (2013)'s Experiment 2 and one additional item of our creation, *piranha* + *rhino*, so that there would be an odd number of items, insuring that each participant would be majority-head-faithful or majority-head-unfaithful. Each blend pair had two definitions, one of which was coordinating and the other of which was right-headed. The definitions were optimized so that their structure was as similar to each other as possible. If one definition contained a source word then the other definition would contain that word as well. The length of the definitions was also made as consistent as possible within each pair. The blends and definitions are given in Table (14).

(14) Source words, blends, and definitions used in Experiment 1.

Source Words		Blend	Definitions	
baboon	bandit	*baboon*dit	COORD	a baboon who steals like a bandit
		*ba*bandit	R-HD	a baboon-stealing bandit
buccaneer	narrator	*buccaneerrator*	COORD	a pirate who tells stories
		*buccan*arrator	R-HD	someone who tells pirate stories
lampoon	punishment	*lampoon*ishment	COORD	punishing someone by printing a lampoon
		*lamp*unishment	R-HD	punishing someone for printing a lampoon

boutique	taxi	*boutixi*	COORD	a taxi with on-board boutique shopping
		boutaxi	R-HD	a taxi to the local boutiques
impala	polecat	*impalcat*	COORD	a hybrid of a polecat and an impala
		impolcat	R-HD	a polecat that hunts impalas
armadillo	dolphin	*armadilphin*	COORD	a hybrid of a dolphin and an armadillo
		armadolphin	R-HD	a dolphin with an armadillo's leathery skin
rhododendron	dandelion	*rhododendelion*	COORD	a cross between a dandelion and a rhododendron
		rhododandelion	R-HD	a dandelion that grows in rhododendron-like clusters
flamingo	mongoose	*flamingoose*	COORD	a hybrid of a mongoose and a flamingo
		flamongoose	R-HD	a mongoose that preys on flamingos
piranha	rhino	*piranho*	COORD	a hybrid of a rhino and a piranha
		pirhino	R-HD	a rhino that is fierce like a piranha

The results in (12) show that participants were significantly more likely than chance to choose a majority of head-faithful responses. The results in (13) show that the definition which made Word 1 a modifier and Word 2 a head was preferentially matched with the blend that preserved more of Word 2, as predicted by head faithfulness.

Experiment 2 focused on head faithfulness to lexical stress. There were also nine items for this experiment with the eight items from Shaw (2013) experiment 1 as well as one item that we created, *lizard* + *gazelle*. The items are shown in Table (15).

(15) Source words, blends, and definitions used in Experiment 2.

Source Words		Blend	Definitions	
zebra	giraffe	*zébraffe*	COORD	a cross between a giraffe and a zebra
		zebráffe	R-HD	a giraffe with zebra stripes
robin	baboon	*róboon*	COORD	a cross between a baboon and a robin
		robóon	R-HD	a baboon with a robin-red chest
turkey	raccoon	*túrcoon*	COORD	a cross between a turkey and a raccoon
		turcóon	R-HD	a raccoon that steals turkey eggs
flounder	sardine	*flóundine*	COORD	a cross between a sardine and a flounder
		floundíne	R-HD	a type of sardine eaten by flounder
bachelor	valet	*báchelet*	COORD	a valet who is also a bachelor
		bachelét	R-HD	a valet who works for a bachelor
bistro	garage	*bístrage*	COORD	a building containing a garage and a bistro
		bistráge	R-HD	the delivery garage of a bistro
pygmy	premier	*pýgmier*	COORD	a leader who is also a pygmy
		pygmíer	R-HD	a leader of the pygmies
raisin	dessert	*ráissert*	COORD	a type of raisin eaten for dessert
		raissért	R-HD	a raisin-filled dessert
lizard	gazelle	*lízelle*	COORD	a hybrid of a gazelle and a lizard
		lizélle	R-HD	a gazelle that is scaly like a lizard

Participants in Experiment 2 were significantly more likely than chance to give a majority of head-faithful responses, as shown in (12). Individual responses were also significantly more likely than chance to be head-faithful, as shown in (13).

The results of Experiments 1 and 2 replicate those of Shaw (2013, Author 2014), confirming that we can find the same pattern of results despite minor differences in experimental procedure (the drag-and-drop interface, and the blanks following rather than preceding the definition) and larger differences in the participant population (anonymous Amazon Mechanical Turk workers rather than personal acquaintances of the experimenter). Having replicated Shaw's head-faith effect, we next ask whether an analogous effect can be found for a different prominent position, nouns.

4.5.2. Experiments 3a,b and 4a,b: noun faithfulness

Experiments 3 and 4 were analogous to Experiments 1 and 2, except that the prominent position was nouns (vs. verbs) rather than heads (vs. non-heads). (The difference between the a and b versions had to do with the lexical category of Word 2, as explained shortly.) Phonologically, the source words were chosen to be blendable in two ways: In Experiment 3, each source-word pair had two possible switch points, e.g., *brood* + *ridicule* could be blended as *broodicule*, switching at the [d] and preserving more of *brood*, or as *bridicule*, switching at the [r] and preserving more of *ridicule.* In Experiment 4, the switch point followed the stress of Word 1 but preceded the stress of Word 2, forcing a choice as to which stress to preserve; e.g., *wátch* + *chóose* could be blended as *wátchoose*, preserving only Word 1's stress, or as *watchóose*, preserving only Word 2's stress.

Morphosyntactically, Word 1 was ambiguous between a noun and a homophonous verb. In order to maximize the distinction between the noun and verb definitions, we chose homophones whose nominal and verbal meanings were as unrelated to each other as possible. For example, *watch* was acceptable, because the meanings of "look at" and "chronometer" are distinct, but *bike* was not, because the verb *bike* and noun *bike* are transparently related. This criterion sharply restricted the set of usable Word 1s, such that we had to use shorter Word 1s than in Experiments 1 and 2. In particular, Word 1 in the stress experiments (Experiments 4a and 4b) was a monosyllable, rather than an iamb as in Experiment 2.

In Experiments 3a and 4a, Word 2 was a verb, and the lexical ambiguity in Word 1 meant that the blend was ambiguous between a subordinating verb-verb structure and a subordinating noun-verb structure (e.g., *brood* + *ridicule* makes the verbs *broodicule* and *bridicule*). In Experiments 3b and 4b, Word 2 was a noun, and the blend was ambiguous between a subordinating verb-noun structure and a subordinating noun-noun structure (e.g., *fling* + *language* makes the nouns *flinguage* and *flanguage*).

For Experiments 3 and 4, right-headed nominal and verbal definitions were created for each source word pair. The definitions were written so that the unambiguous part, corresponding to Word 2, was always stated first, with the subordinate ambiguously verbal or nominal part, corresponding to Word 1, stated second. As in Experiments 1 and 2, the paired definitions were written so that their lengths were as similar as possible. If one definition explicitly used a source word then its counterpart did as well. The blends and definitions used in Experiments 3a and 3b are shown in Tables (16) and (17). Those used in Experiments 4a and 4b are shown in Tables (18) and (19).

(16) Source words, blends, and definitions used in Experiment 3a.

Source Words		Blend	Definitions	
drain	renovate	drainovate	N+V	to renovate the plumbing in your house
		drenovate	V+V	to renovate your house until you bankrupt yourself
drag	regulate	dragulate	N+V	to make rules about what can be worn at a drag show
		dregulate	V+V	to make rules in order to drag a project out
brood	ridicule	broodicule	N+V	to ridicule someone's many children
		bridicule	V+V	to ridicule someone for sulking
creep	reprimand	creeprimand	N+V	to scold someone because they are a creep
		creprimand	V+V	to scold someone when they creep up on you
plot	litigate	plotigate	N+V	to sue a plagiarist over the plot of a novel
		plitigate	V+V	to sue a conspirator when they plot against you
club	liberate	cluberate	N+V	to release someone from a society membership
		cliberate	V+V	to release a captive by bludgeoning their captors
spot	petrify	spotrify	N+V	to turn something to stone just in a few places
		spetrify	V+V	to turn something to stone just by noticing it
storm	terminate	storminate	N+V	to artificially stop a violent storm
		sterminate	V+V	to end a meeting when you storm out of it

(17) Source words, blends, and definitions used in Experiment 3b.

Source Words		Blend	Definitions	
fling	language	flinguage	N+N	sweet words you say during a romantic fling
		flanguage	V+N	words you carelessly fling around when angry
float	latex	floatex	N+N	latex that is used to waterproof a parade float
		flatex	V+N	latex that is light enough to float is called
slip	leprechaun	sliprechaun	N+N	a dainty leprechaun who wears slips
		sleprechaun	V+N	a clumsy leprechaun who often slips
spell	policy	spellicy	N+N	a policy about how to cast a spell
		spolicy	V+N	a policy about how to spell words
clog	laggard	cloggard	N+N	a slow-moving person who wears clogs
		claggard	V+N	a slow-moving person who clogs the stairwell
creep	reptile	creeptile	N+N	a reptile that has a sleazy personality
		creptile	V+N	a reptile that sneaks along the ground
crop	replica	croplica	N+N	an exact duplicate of a farmer's harvest
		creplica	V+N	a duplicate which has been trimmed down
block	licorice	blockorice	N+N	licorice that comes in a block
		blicorice	V+N	licorice likely to block your intestines
grouse	restaurant	grouseterant	N+N	a restaurant where you can eat grouse
		grestaurant	V+N	a restaurant that dissatisfied people grouse about

(18) Source words, blends, and definitions used in Experiment 4a.

Source Words		Blend	Definitions	
watch	choose	wátchoose	N+V	to pick out a watch
		watchóose	V+V	to decide to watch

blubber	boast	blúbboast	N+V to boast of how your crew brought back so much blubber
		blubbóast	V+V to boast of how you made a younger child blubber
ship	prepare	shípare	N+V to prepare a ship for something
		shipáre	V+V to prepare to ship something
trip	repent	trípent	N+V to repent after a trip you took
		tripént	V+V to repent after you trip someone
spell	learn	spéllearn	N+V to learn a magic spell
		spelléarn	V+V to learn to spell
fudge	reject	fúdgect	N+V to refuse to eat any fudge
		fudgéct	V+V to refuse to fudge a calculation
prune	enjoy	prúnejoy	N+V to enjoy dried plums
		prunejóy	V+V to enjoy trimming shrubbery
train	announce	tráinounce	N+V to announce railway arrivals
		trainóunce	V+V to announce that you will be working out
jam	permit	jámit	N+V to permit sweet fruit preserves
		jámít	V+V to permit musicians to improvise

(19) Source words, blends, and definitions used in Experiment 4b.

Source Words		Blend	Definitions
blubber	baboon	blúbboon	N+N a baboon with extra body fat
		blubbóon	V+N a baboon that weeps noisily
spell	alarm	spéllarm	N+N an alarm that beeps when you cast a magic spell
		spellárm	V+N an alarm that beeps when you spell words badly
train	technique *t*	ráinique	N+N a technique for getting seats on a train
		trainíque	V+N a technique that runners use to train
flounder	ordeal	flóundeal	N+N a medieval witchcraft test, trial by flounder
		floundéal	V+N humiliation on the witness stand when you flounder
hail	lamp	háilamp	N+N a signal lamp warning ships of hail
		hailámp	V+N a signal lamp lit to hail a ship
jam	remorse	jámorse	N+N remorse when you ate too much jam
		jamórse	V+N remorse when you didn't jam with your band
bug	brigade	búgade	N+N an organized force that exterminates bugs
		bugáde	V+N an organized force that really bugs people
bowl	delight	bówlight	N+N delight when you make a perfect bowl
		bowlíght	V+N delight when you bowl a perfect game
slug	disgust	slúgust	N+N disgust when you feel a slug on you
		slugúst	V+N disgust that makes you want to slug someone

Participants in all four experiments were more likely than chance to give mostly noun-faithful responses, as shown in Table (12). The tendency was significant at the conventional 0.05 level or above for both of the segmental experiments (3a and 3b) and for the stress experiment in which Word 2 was a noun (4b); it was also marginally significant ($p < 0.10$) for the stress experiment in which Word 2 was a noun (4a). When mixed logit models were fit to the individual responses, however, the intercepts were all numerically positive (i.e., in the predicted direction), but the difference was significant only for Experiment 4b, the stress experiment in which Word 2 was a noun. These results are consistent with the hypothesis that blend formation is influenced by Positional Faithfulness for nouns, but they do not support it strongly.

In Experiments 1 and 2, the ambiguity was structural rather than lexical: The same two source words could be parsed as either a subordinating or a coordinating structure. In Experiments 3 and 4, the reverse was true: The structure was always subordinating, but Word 1 could be interpreted as either a noun or a verb. The strength of the noun-faithfulness effect could therefore depend on the degree of ambiguity of Word 1. Were the Word 1s in Experiments 3 and 4 simply not ambiguous enough in their semantic meaning or syntactic category to show a noun-faithfulness effect? If so, perhaps the most-ambiguous items did exhibit an effect, which was diluted by the less-ambiguous ones. To test this possibility, the Unambiguousness of each Word 1 was quantified as the absolute value of the difference between the natural log of its frequency as a verb and that of its frequency as a noun. (Thus, if the noun and verb were equally frequent, the Unambiguousness was zero, whereas if they differed in frequency (in either direction), the Unambiguousness was greater.) Across all stimuli in the four experiments, Unambiguousness ranged from 0.02 to 4.43, with a mean of 0.97. For each of the four models, Unambiguousness was added as a predictor to the fixed effects, and random slopes were added to the random effects for Unambiguousness by participant and by item. Each augmented model was then compared to the corresponding original model by a likelihood-ratio test using R's *anova* method. In no case did the augmented model fit significantly better than the original; hence, the results do not support the dilution hypothesis.

4.5.3. Experiments 5a,b and 6a,b: proper noun faithfulness

The third set of experiments investigated whether proper nouns are privileged relative to common nouns. As with Experiments 3ab and 4ab, the strategy was to make Word 1 lexically ambiguous, this time between a proper noun and a common noun, and to test whether the definition which made Word 1 a proper noun was preferentially paired with the blend that preserved more of Word 1. Experiments 5ab focused on segmental faithfulness and used the same phonological criteria as Experiments 1 and 3ab (e.g., *BOHEMIAN* + *HUMMUS* could yield either *BOHEMUS*, preserving more of *BOHEMIAN*, or *BOHUMMUS*, preserving more of *HUMMUS*), while Experiments 6ab focused on stress faithfulness and used the same phonological criteria as Experiments 2 and 4ab (e.g., *TÚRKEY* + *TYCÓON* could yield either *TÚRCOON,* preserving the stress of *TURKEY*, or *TURCÓON*, preserving the stress of *TYCOON*). Since the experiment hinges on the ambiguity of Word 1, it was important to make sure that each Word 1 really was ambiguous, i.e., that the proper-noun reading really was known to the average Mechanical Turk worker. A preliminary list of ambiguous proper nouns was drawn up and then winnowed down by having them rated for familiarity by a separate sample of Mechanical Turk workers. The items actually used in the experiments are shown in (20) and (21).

(20) Source words, blends, and definitions used in Experiments 5a and 6a.

Source Words		Blend	Definitions
bohemian	hummus	*bohemmus*	N+n: Dip made by a native Bohemian from the Czech Republic.
		bohummus	n+n: Dip made by an artsy bohemian in Greenwich Village.
soprano	preening	*sopraning*	N+n: Preening by New Jersey mobsters on HBO.
		sopreening	n+n: Preening by female opera singers on stage.
cologne	linen	*colognen*	N+n: Linen made in Cologne, Germany.
		colinen	n+n: Linen scented with cologne.
canary	nursery	*canarsery*	N+n: A nursery in the Canary Islands.
		canursery	n+n: A nursery for canary breeding.
chihuahua	werewolf	*chihuawolf*	N+n: A werewolf who is from Chihuahua, Mexico.
		chiwerewolf	n+n: A werewolf who, in wolf form, resembles a chihuahua.
superior	parrot	*superrot*	N+n: A talking bird native to the shores of Lake Superior.
		suparrot	n+n: An employee who will mindlessly mimic their superior.
independence	pundit	*independit*	N+n: A pundit who lives in Independence, Missouri.
		indepundit	n+n: A pundit who speaks out in support of independence.
crusade	soda	*crusada*	N+n: A bubbly drink brought back to Europe from the Fourth Crusade.
		crusoda	n+n: A sugar-free drink promoted during a health crusade.
narcissus	saucer	*narcisser*	N+n: A saucer with a picture of Narcissus admiring himself.
		narsaucer	n+n: A saucer with a picture of a narcissus plant in bloom.

(21) Source words, blends, and definitions used in Experiment 5b and 6b.

Source Words		Blend	Definitions
turkey	tycoon	*túrcoon*	N+n Someone who made a lot of money in Turkey.
		turcóon	n+n Someone who made a lot of money in turkey.
jersey	physique	*jérsique*	N+n A physique that looks right for New Jersey.
		jersíque	n+n A physique that looks right for a jersey.
sparrow	terrain	*spárrain*	N+n Terrain where you're likely to encounter Captain Jack Sparrow.
		sparráin	n+n Terrain where you're likely to encounter a swamp sparrow.
buffalo	affair	*búffair*	N+n A mysterious affair involving Buffalo, New York.
		buffáir	n+n A mysterious affair involving a buffalo herd.
china	canal	*chínal*	N+n A canal constructed for transport in China.
		chinál	n+n A canal constructed for the transport of china.
hamlet	delay	*hámlay*	N+n A delay caused by agonizing indecision, like in Hamlet.
		hamláy	n+n A delay caused by the slow pace of life in a rural hamlet.
potter	cartel	*póttel*	N+n A monopoly controlling the right to works about Harry Potter.
		pottél	n+n A monopoly controlling the right to work as a potter.
boulder	sedan	*bóuldan*	N+n A kind of sedan made in Boulder, Colorado.
		bouldán	n+n A kind of sedan made to climb over boulders.
homer	dismay	*hómay*	N+n Dismay when you're assigned to read Homer again.
		homáy	n+n Dismay when the other team's batter hits a homer again.

Unlike previous experiments, participants in Experiments 5a and 6a were asked to rate, not how hard each trial was, but how well-known they felt the proper noun that made up each stimulus was. For example, participants were asked "How well-known is Hamlet to people in the US?". The participants gave their answer on a scale of 1 to 7 (as in Steffens et al. 2005), with 1 being labeled as "Known by Almost No One" and 7 being labeled as "Known by Almost Everyone".

The goal of this question was to elicit a rating for how familiar each subject was with the proper nouns used in the stimuli. This functioned as a way of insuring the participants knew that the proper nouns were proper and replaced the question regarding difficulty ("How hard was it to decide?") that the previous experiments asked. To check whether the familiarity-rating question itself was influencing responses, Experiments 5b and 6b used the original difficulty-rating question instead of the familiarity-rating question.

Another difference between Experiments 5 and 6 and the other experiments was the use of capitalization in the stimuli. Since capitalizing only the first letter in a blend could have suggested that it was a proper noun and since not capitalizing any of the letters could have suggested to the participants that it was a common noun, the stimuli were presented in all capital letters.

The results were clear: In three of the four proper-vs.-common-noun experiments, individual participants were significantly more likely than chance to give mostly positionally-faithful responses, and the fourth missed significance by a single participant (see table in 12). In all four experiments, responses were significantly more likely than chance to be positionally faithful (see table in 13). These results are consistent with the hypothesis that blend formation is affected by emergent Positional Faithfulness for proper over common nouns, in both segments and stress.

5. General Discussion

The results of our experiments show that what we have hypothesized to be morphologically strong positions (heads, nouns, and proper nouns) evoke emergent positional-faithfulness effects in English, in the sense that when matching definitions to novel blends speakers are more likely to choose a matching in which the properties of the strong position are preserved. These effects are small, but consistent across all ten experiments, which makes it unlikely that we have observed them by chance. We now consider alternative explanations for these results, the consequences of the findings for linguistic theory, and directions for future work.

5.1. The Positional Markedness alternative

As mentioned above in Section 2.1, an alternative to Positional Faithfulness for explaining the restriction of marked structure to strong positions is Positional Markedness (Zoll 1998, 2004; Author 2004). Shaw et al. (2014) have shown that Positional Markedness can explain the effect of headedness on stress in novel blends, but not its effect on their segments. We will briefly recapitulate and enlarge on their argument to show that it extends to the other positions studied above.

In Tableau (7), let the Positional Faithfulness constraint Max-Stress (head) be replaced with the Positional Markedness constraint Coincide (stress, head), which ignores the stress of the source words and instead penalizes surface stress in the non-head part of the blend. The predicted outcome does not change. This is shown in (22) and (23), following Shaw et al. (2014).

(22) Coincide (stress, head): Assign a violation for every main-stressed syllable nucleus whose underlying correspondent is not in a head.

(23) Positional markedness alternative to Tableau (7). Candidate (a) is preferred because it matches the right-headed definition – the one that makes Word 2 a head – with the blend that situates stress (marked) in the output correspondent of the head (strong).

				Coincide (stress, head)	Max-Stress
Î	a.	flóunder + sardíne (hd)	→ floundíne		*
		flóunder (hd) + sardíne (hd)	→ flóundine		*
	b.	flóunder (hd) + sardíne (hd)	→ floundíne		*
		flóunder + sardíne (hd)	→ flóundine	*	*

Substituting "noun" or "proper noun" for "head" as the positional argument of Coincide generates Positional Markedness alternatives for the other stress experiments. The stress experiments, therefore, do not distinguish Positional Faithfulness from Positional Markedness. However, looking at a wider range of data reveals serious weaknesses in the Positional Markedness account.

First, as Shaw et al. (2014) point out, Positional Markedness theory itself does not allow us to substitute "segment" for "stress" and thereby account for the segmental experiments. The first argument of Coincide is hypothesized to name a marked structure. Zoll (1998) defines Coincide (*x*, *E*) as a local conjunction of **x* with another markedness constraint. A constraint Coincide (segment, head) presupposes the existence of a constraint *segment, penalizing all segments. The existence of such "nihilistic" constraints is argued against by Gouskova (2003) on several empirical and theoretical grounds, such as the complex machinery needed to prevent them from ever being undominated. Second, a grammar in which Coincide (segment, head) is undominated would completely mute all morphemes other than heads. Undominated Coincide (segment, noun) and Coincide (segment, proper noun) would likewise wreak typologically-unsupported havoc. Finally, even the benign-looking non-positional Coincide (stress, *E*) constraints have bizarre typological consequences. A grammar in which Coincide (stress, noun) or Coincide (stress, proper noun) were undominated would have stress only on common or proper nouns. By contrast, the Positional Faithfulness constraints proposed here are typologically benign (for example, Max-Seg (head) is undominated in Jordanian Arabic). Hence we conclude that the effects observed in both the segmental and the stress experiments are due to Positional Faithfulness rather than Positional Markedness.

5.2. Phonetics in phonology

Positional neutralization is at the heart of debate over the role of phonetics in phonology, i.e., the question of why phonological grammars so often make sense in phonetic terms. In one view, phonological grammars are actively shaped by speakers' innate or acquired knowledge of phonetics, which provides an inductive bias that steers acquisition, change, and typology in particular directions (e.g., Stampe 1979; Archangeli & Pulleyblank 1994; Boersma 1998; Steriade 1999, 2001ab; Hayes 1999; Wilson 2006; Kiparsky 2008; Berent 2013). An alternative proposal is that phonological grammars are passively shaped by phonetically-biased distortions in the speaker-to-hearer channel which cause the learner to misperceive speakers' intended utterances (e.g., Ohala 1981, 1993; Hale & Reiss 2000; Blevins 2004; for recent reviews see Hansson 2008; Garrett & Johnson 2013). The channel-bias proposal has the advantage of theoretical parsimony, since it does not require phonetic facts which already exist in the real world to be duplicated in the mind of the speaker (Anderson 1981). The typological fact that, e.g., stressed vowels tend to resist reduction that affects unstressed ones could be due to an inductive bias against grammars that reduce stressed vowels, but it could also be due simply to the easily observable phonetic fact that learners hear stressed vowels more clearly than unstressed ones, and are less likely to mishear them as unstressed (Kochetov 2002, 2003; Barnes 2006). The same argument applies to other "phonetically" strong positions: Inductive and channel bias can both account for the typological facts, but the hypothetical inductive bias recapitulates the known channel bias.

The parsimony advantage for the channel-bias hypothesis is not removed by showing that a positionally-faithful process is productive in a language, because the issue is not whether learners can or cannot acquire a positionally-faithful grammar; all sides agree that they can. If the ambient language reduces only unstressed vowels, the learner will acquire a grammar that encodes that fact. The real issue is whether the learner is equipped with inductive biases that make faithfulness in strong positions easier to learn than faithfulness in weak ones. Phonological learning experiments (“artificial-language” experiments) might offer a more direct test of whether one kind of grammar is easier to learn than another, but their interpretation is complicated by the fact that participants are perceiving the stimuli through a potentially distorting phonetic channel (e.g., they could mishear the unstressed vowels in the lab the way they do in nature, and so have a harder time learning one of the grammars accurately).

Here is where emergent positional faithfulness in morphologically strong positions comes in. We have seen that there are languages in which heads, nouns, and proper nouns resist phonological processes that affect non-heads, verbs, and common nouns; hence, positional-faithfulness theory (Beckman 1999, Author 2001) implies that the universal constraint set contains faithfulness constraints relativized to these strong positions but not to their complements (an inductive bias in favor of positionally-faithful grammars), and thus predicts that the effects of those constraints may emerge in languages where they are not evident in the ordinary phonology, such as English. Given the lack of evidence for head, noun, and proper-noun faithfulness available to the learner of English, the channel-bias hypothesis does not predict that their effects will emerge in English. The fact that positional-faithfulness effects *were* observed in the blend task supports the inductive-bias hypothesis for head, noun, and proper-noun faithfulness. And if there are inductive biases for faithfulness in these positions, it is no longer so unparsimonious to hypothesize inductive biases for faithfulness in other positions.

The present results are consonant with Becker, Nevins, & Levine (2012)'s finding that English speakers, when learning an artificial analogue of German plural formation in which a prefix or suffix is accompanied by a change in the backness of the stressed root vowel, generalized the pattern from root-initial to root-final syllables more readily than the reverse. They interpret these results as emergent initial-syllable faithfulness, a typologically attested pattern (e.g., in Shona) which is absent from (and in some ways contradicted by) ordinary English phonology.

5.3. What makes a position "strong"?

We take results of our experiments to support the idea that positional faithfulness constraints that refer to nouns, heads, and proper nouns are universally available, i.e., they are in the constraint set of adult speakers of every language. We argued that such constraints could not have been learned from the English lexicon, so their emergence in our experiments suggests that they exist prior to or independent of phonological learning. However, we remain agnostic about whether these constraints are part of an innate constraint set or whether they are universally available for another reason. For example, these constraints might be projected from some component of cognition that deals with semantic "salience," in a manner analogous to phonetic inductive grounding as proposed by Hayes (1999) (see also Author (2005) for discussion of constraint induction involving psycholinguistic salience). On this latter view, heads, nouns, and proper nouns are predicted to be more salient (by psycholinguistic criteria such as those described in Beckman 1999, Ch. 2) than non-heads, non-nouns, and common nouns, respectively. Likewise, other salient positions are predicted to have corresponding faithfulness constraints. A position that passes any one of the three tests (asymmetric faithfulness typologically, emergent faithfulness, and psycholinguistic salience) should pass the other two as well.

If positional constraints are derived by freely relativizing existing constraints to prominent positions (Author 2004), a further prediction is made. Prominent positions do not only resist positional neutralization, they also undergo *positional augmentation* (Author 2005), a markedness-driven process that enforces high perceptual salience. For example, Tuyuca enhances the perceptual salience of roots by requiring them to bear (non-contrastive) stress (Barnes 1996). Hence, we expect any prominent position, including heads, nouns, and proper nouns, to spawn corresponding augmentation constraints, which, when ranked above faithfulness, would cause them to undergo positional augmentation. In the long run, we hope that this research program will lead to a general unifying theory of what makes particular positions more salient than their complements, and of what common property unites morphological positions like heads, nouns, and proper nouns with initial syllables, stressed syllables, roots, and other strong positions.

Finally, our results have broader implications for the role of lexical categories in positional neutralization effects. The typological survey in Author (2011) indicates that there is a hierarchy of phonological privilege among the major lexical categories, N > A > V. Our experiment results, together with the phonological analyses of Walker (1984) and Jaber (2011), show that the category N can be further subdivided into proper nouns and common nouns: PrN > cN > A > V. This finding then raises the question of whether verbs or adjectives likewise show differences in phonological privilege among their subcategories. More broadly still, what is the ultimate origin of this hierarchy of phonological privilege? The scale PrN > cN > A > V appears to be a continuum from prototypical rigid designators (PrN) to prototypical predicates (V), and furthermore strongly resembles continuum models of lexical categories that have been proposed for morphosyntactic or semantic reasons (e.g., Ross 1972; Langacker 1987; Croft 1990). This resemblance is striking, but further explorations of the structure and origin of the hierarchy of *phonological* privilege among lexical categories must remain a question for future work.

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