The 'nouniness' of attributive adjectives and 'verbiness' of predicative adjectives: Evidence from phonology[1]

WILLEM B. HOLLMANN

Lancaster University

[1] This study contains analysis of existing data available from https://www.english-corpora.org/coca/ [10 December 2019]. I am grateful to two anonymous reviewers and to the Editor, Bernd Kortmann, for their thoughtful comments. Any remaining inaccuracies are of course my own.

ABSTRACT

This paper investigates prototypically attributive vs. predicative adjectives in English in terms of the phonological properties that have been associated especially with nouns vs. verbs in a substantial body of psycholinguistic research (e.g. Kelly 1992) – often ignored in theoretical linguistic work on word classes. Inspired by Berg's (2000, 2009) 'cross-level harmony constraint' the hypothesis I test is that prototypically attributive adjectives not only align more with nouns than with verbs syntactically, semantically and pragmatically, but also phonologically – and likewise for prototypically predicative adjectives and verbs. I analyse the phonological structure of frequent adjectives from the Corpus of Contemporary American English (COCA), and show that the data do indeed support the hypothesis. Berg's 'cross-level harmony constraint' may thus apply not only to the entire word classes noun, verb, and adjective, but also to these two adjectival sub-classes. I discuss several theoretical issues that emerge. The facts are most readily accommodated in a usage-based model, such as Radical Construction Grammar (Croft 2001), where these adjectives are seen as forming two distinct but overlapping classes. Drawing also on recent research by Boyd & Goldberg (2011) and Hao (2015) I explore the possible nature and emergence of these classes in some detail.

Keywords: adjectives, phonology, word classes, acquisition, Radical Construction Grammar

1. INTRODUCTION

Berg (2000) is a critical response to the traditional formal feature-based analysis of word classes, which characterises nouns as [+N, -V], verbs as [-N, +V] and adjectives as [+N, +V]. Berg links this account to Chomsky (e.g. 1981), but see also e.g. Stowell (1981) and Fukui & Speas (1986). Berg interprets these abstract feature matrices as implying that adjectives should be equally similar to (or dissimilar from) nouns and verbs – the so-called 'equidistance hypothesis' (2000: 270). He discusses research that problematises the notion of equidistance and instead mostly points to adjectives being more similar to nouns than to verbs. This research is based on syntax (e.g. Ross 1972 and Comrie 1975), semantics (e.g. Givón 1984) or semantics and pragmatics (e.g. Croft 1991). As is of course well known, these levels of language also lie at the basis, more generally, of most theoretical accounts of lexical categories. For a focus on morphosyntax see e.g. Palmer (1971), Aarts (2007), for a semantically based theory of lexical categories see e.g. Langacker (1987, 2008), for pragmatics see e.g. Thompson (1988), and for certain combinations of those see e.g. Givón (2001; morphosyntax and semantics) and Croft (1991, 2001; semantics and pragmatics).

Berg's study is innovative in that he builds on work in psycholinguistics on phonological cues to lexical categorisation (e.g. Sereno & Jongman 1990, Kelly 1992). He investigates the phonology of English adjectives relative to nouns and verbs, and concludes that adjectives are more similar in this respect, too, to nouns than they are to verbs. In accounting for this, he proposes the 'cross-level harmony constraint' (Berg 2000: 289; see also 2009, Berg & Koops 2010). According to this constraint individual word classes behave to some extent consistently across different levels of analysis – syntax, semantics, pragmatics, and also, he specifically argues, phonology. Berg sees

the 'cross-level harmony constraint' not as inviolable but as a 'soft' constraint, 'to the effect that individual counterexamples cannot disprove it' (2000: 289).

As Berg himself observes, cross-level harmony bears similarity to Anderson's notion of 'structural analogy' (1992, 2006, 2011) between syntax and phonology, a prominent example being the putative existence of heads in both syntactic (phrases and sentences) and phonological structures (syllables). Other functional linguists have made similar proposals, including Ross (1995) and Carstairs-McCarthy (1999). Anderson argues that such structural analogies between syntax and phonology are the natural result of their shared perceptual-cognitive basis (2006: 607). He presents the possible existence of fundamental structural analogies between syntax and phonology as a problem for theories in which Universal Grammar is completely autonomous from general perception and cognition, a position he considers to be exemplified by Carr (2000, 2006; cited by Anderson 2006: 602 and *passim*).

Berg suggests that cross-level harmony is beneficial in processing lexical categories (2000: 289) and may also assist acquisition (Berg & Koops 2010: 46). To see how this might work with respect to syntax and phonology (for pragmatics and semantics see section 2, below), consider that nouns and adjectives often[2] belong to the same noun phrase, while verbs tend to be (part of) separate constituents. i.e. verb phrases; see e.g. [*My **old** friend*] [*arrived punctually*]. The phonological similarity of

[2] Thompson (1988) suggests, on the basis of English and Mandarin Chinese conversational data, that this is the predominant use of adjectives, but Berg cites Croft (1991), in whose counts of adjectives in four languages 'modifying adjectives outnumbered predicate adjectives by around two to one' (*ibid.* 122), as well as the much larger study by Chafe (1982), who also reports that attributive adjectives are considerably more frequent than predicative ones. One difference between these studies and Thompson (1988) is that the latter analyses attributive adjectives occurring in predicate nominals (e.g. *She is an old friend*) as predicative. This will have skewed Thompson's results at least to some extent. Furthermore, her exclusive focus on conversation probably also helps to explain the distribution she describes; see e.g. Biber *et al.* (1999: 506), whose figure 7.1 shows that predicative adjectives are considerably more common in conversation than they are in fiction, news and academic writing.

adjectives to nouns noted by Berg and their dissimilarity from verbs may facilitate parsing utterances into their main constituents as well as producing them (2000: 288–9). Berg obviously focuses here on attributive adjectives. Predicative adjectives are part of the verb phrase ([*My old friend*][*was* ***punctual***]), and so phonological similarity between those adjectives and verbs would also yield processing and acquisition advantages.[3]

With respect to harmony with the pragmatic level, consider that predicative adjectives, like verbs, are used for predication (Croft 1991, 2001). Regarding semantic harmony, finally, following Bolinger (1967), both Wierzbicka (1986) and Croft (1991) have pointed to an association between attributive use and relatively time-stable (what Bolinger calls 'characterizing' or 'classifying') properties, and between predicative use and temporary states (Bolinger's 'occasion').[4] This is parallel to the semantics of nouns, which typically describe time-stable objects, versus verbs, which describe relatively fleeting events (Givón 1984, Croft 1991, 2001).

In a study that sets out to assess the degree of similarity of adjectives to nouns or verbs more precisely than was done by Berg (2000), Hollmann (2014) hypothesises that

[3] One of the reviewers is uncertain how this would be helpful in processing, suggesting that phonological similarity between attributive adjectives and nouns might even cue the interpretation of this adjective as the head noun. This seems unlikely, since attributive adjectives would not normally carry sufficient stress to be interpreted as the head of the NP (see e.g. Quirk *et al.* 1985:1594), whilst their (usual) property semantics would make a nominal analysis unlikely as well.

[4] Smith (2010:731–5) has criticised this semantic analysis, suggesting that 'contra Bhat [1994] and Croft (…) there is not a neat correspondence between pragmatic functions and the contrast between transitory and permanent properties' (*ibid*.:733). But neither Bhat nor Croft (nor Bolinger, for that matter) propose a neat correspondence. Croft, like Bolinger, merely refers to tendencies, while Bhat even says that 'predicative adjectives are ambiguous in naming either a fairly permanent property (…) and in naming a temporary property' (1994:60). Smith, citing Ferris (1993), goes on to state that 'prenominal adjectives with transitory readings are common in English' and that 'an internet search with the keywords *responsible* and *pupil* yields many examples (…) in which *responsible* has a transitory reading even though it occurs prenominally' (2010:733). In both cases Smith provides just two examples, with no further discussion of frequencies of transitory versus permanent meanings. Any future re-examination of the semantics of attribution and predication should be grounded in solid quantitative analysis of empirical (e.g. corpus) data.

if Berg's cross-level harmony constraint is correct, then we may also expect phonological differentiation *within* the category of adjectives: since prototypically attributive adjectives are noun-like they may be phonologically closer to nouns than prototypically predicative adjectives, which are more verb-like.

The present paper sets out to test whether such differentiation exists. I will argue, using data from the Corpus of Contemporary American English (henceforth COCA, Davies 2008–),[5] that there is indeed supporting evidence. Thus, Berg's 'cross-level harmony constraint', originally proposed to help account for certain similarities and dissimilarities between entire lexical categories, appears relevant also for similarities and dissimilarities involving subclasses of a category, namely prototypically attributive and predicative adjectives.

The hypothesis and indeed the paper as a whole assumes a usage-based model of grammar. In this approach, the claim is that when speakers are exposed to items occurring in different constructions with different frequencies, those distributional (dis)preferences may be stored as part of those speakers' grammatical knowledge. The (dis)preferences of adjectives could in principle be stored on an item-by-item basis or as two distinct but overlapping sub-classes in speakers' mental grammars. The question as to which of these scenarios is accurate is impossible to answer conclusively in this paper. However, I will argue in section 4, below, that experimental evidence presented in Boyd & Goldberg's (2011) study of *a*-adjectives (e.g. *asleep, afloat*), which show a strong predicative preference, suggests that these sub-classes may be psychologically real.

[5] COCA is a genre-balanced corpus containing over 560 million words of written and spoken American English from 1990-2017. See the acknowledgement footnote 1, above, for information about access.

The usage-based framework I will adopt in this paper is Radical Construction Grammar (Croft 2001). Whilst other models are available, Radical Construction Grammar includes careful consideration of the noun, verb and adjective categories from a cross-linguistic perspective, which enhances the robustness of the theory, also when applied to a single language.

Croft points out that attributively and predicatively used adjectives instantiate different propositional act functions, viz. modification and predication, respectively. Croft actually reserves the label 'adjective' for the former, using 'predicate adjective' for the latter.[6] There is a long tradition in descriptive English grammar to apply the term 'adjective' equally to both. This is motivated by their morphological and syntactic similarities and their shared property semantics. But whilst the traditional position is to suggest that the two positions are available to (most members of) this category, Croft argues that the distributional facts of occurrence in attributive and predicative constructions, if taken seriously, force us to posit two 'distinct but overlapping classes' (2013: 10).[7] As I have noted, above, experimental evidence from Boyd & Goldberg (2011) may provide some support for the psychological realism of these classes; see section 4, below.

[6] 'Predicate property word' might have been more appropriate in Croft's theory. I will discuss the theory in more detail in section 4, below; suffice it to say here that Croft restricts the labels 'noun', 'verb' and 'adjective' to the three prototypical combinations of semantic class and propositional act function: nouns are object words that refer, verbs are action words that predicate, adjectives are modifying property words, Croft presumably uses the term 'predicate adjective' because of the conventional association between the label 'adjective' and the semantic class of property words. For the same reason, in the remainder of this paper I will continue to refer to 'prototypically attributive adjectives' and 'prototypically predicative adjectives', rather than 'prototypically attributive property words' and 'prototypically predicative property words'.

[7] In fact, Croft (2013:10) suggests that we have two additional sets of overlapping classes: one set based on degree marking (*good, better, best*; *tall, tall-er, tall-est*; *intelligent, more intelligent, most intelligent*) and one based on occurrence with degree modifiers (*a very tall tree, *a very even number*). These will be ignored in this paper.

The remainder of this paper starts (section 2) with additional discussion of Berg (2000), the psycholinguistic literature which was his point of departure, and Hollmann's (2014) study of the phonology of nouns, verbs and adjectives. Section 3 moves on to the method used in the present study, explaining how I collected and analysed the COCA data in order to assess the hypothesis. The analysis itself and discussion of the results are found in section 4. Section 5 is the conclusion.

2. PREVIOUS SCHOLARSHIP

Berg's (2000) analysis of the phonology of English adjectives as compared to nouns and verbs is based on psycholinguistic scholarship dating to the 1980s and 1990s (Kelly & Bock 1988, Sereno & Jongman 1990, Cassidy & Kelly 1991, Kelly 1992, Sereno 1994). Work in this area has continued since, mainly focused on nouns and verbs. Most research has continued to be carried out by psycholinguists, e.g. Monaghan *et al*. (2005), Monaghan *et al.* (2007), Farmer *et al*. (2006), Monaghan *et al.* (2011), Reilly *et al*. (2012), Monaghan *et al.* (2014), Dingemanse *et al.* (2015). Some theoretical linguists, apart from Berg (2000), have engaged with these findings as well; see especially Taylor (2002: 180–5), Don & Erkelens (2007), Hollmann (2012, 2013, 2014), Lohmann (2017).

Berg investigates the three word classes in relation to the following phonological properties:

1. number of syllables
2. final obstruent voicing

3. frontness of the stressed vowel

4. trochaic vs. iambic stress pattern in disyllabic words

The claims emerging from the psycholinguistic literature are that English nouns (1) contain a greater number of syllables, on average, than verbs, (2) have fewer voiced final obstruents than verbs, (3) contain fewer front stressed vowels and (4) are typically trochaic, whilst verbs tend to be iambic.[8]

Berg analyses all nouns, verbs and adjectives in the English part of the CELEX database[9] and finds that for all four parameters adjectives are more similar to nouns than to verbs. As explained in section 1, above, Berg's explanation involves adjective-noun affinities on other levels too and the benefits accruing from these uniformities for language processing – his 'cross-level harmony constraint' (2000: 289).

Berg's study deserves merit for taking the psycholinguistic evidence for the role of phonology seriously. However, his analysis does not include several other parameters found to be relevant in the psycholinguistic research he cites:

5. mean syllable length in phonemes

6. nasal consonants

7. height of the stressed vowel

[8] Berg's analysis also includes the full vs. reduced realisation of *-ate* and *–ed*, see e.g. *to intimate – intimate – the intimate* (2000:278), and verbal *learned* vs. adjectival *my learned colleague* (*ibid.*:279). However, allomorphy with these endings is very rare. As it is therefore not clear that this parameter tells us anything about nouns, adjectives and verbs in general, I will not discuss it any further.

[9] CELEX is short for the Centre for Lexical Information. Founded in 1986 in Nijmegen, the Centre drew on a range of dictionaries and corpora to compile three large databases with lexical information, for English, Dutch and German. One way to access the databases is via http://celex.mpi.nl/ [10 December 2019].

According to the literature, nouns display increased syllable length compared to verbs, contain more nasal consonants and fewer high stressed vowels.

In addition to these seven parameters Hollmann (2012, 2013) suggests that the presence or absence of a final obstruent may play a role too: in his nonce-word production experiment nouns ended in obstruents significantly less often than verbs. There are in fact further parameters that psycholinguists have looked at, conveniently summarised by Lohmann (2017), which I come back to in section 3.2, below, where I discuss the phonological analysis conducted in the present paper.

Hollmann (2014) observes that Berg (2000) does not use any statistical analysis to help determine how similar, exactly, adjectives are to nouns, phonologically speaking, and how dissimilar from verbs. Hollmann (2014) collects his nouns, verbs and adjectives from the 100 million word British National Corpus, which contains speech and writing. He analyses the most frequent nouns, verbs and adjectives in the BNC (n = 117, 84 and 31, respectively) in terms of all eight phonological properties mentioned above, using the method outlined in his (2012, 2013) studies. He finds that Berg is correct in rejecting the equidistance hypothesis, and that adjectives on the whole bear more similarity to nouns than to verbs. Since predicatively used adjectives, whilst certainly less frequent than attributive ones, are nevertheless by no means rare (see for example the ratio of 2: 1, cited in section 1, above, reported by Croft 1991 for four languages) it is perhaps unsurprising that adjectives do not pattern with nouns across the board. Hollmann (2014) suggests that an obvious avenue for further research is the question as to whether prototypically attributive adjectives might pattern phonologically with nouns, with prototypically predicative adjectives patterning with verbs – the hypothesis tested in the present paper.

Before moving on to the methodology, section 3, it is important to ask why word classes may have certain phonological properties, and what evidence previous scholarship offers to support the answer to that question. Psycholinguists have argued that phonological regularities may act as cues to lexical category assignment both in language acquisition and in online processing more generally (Farmer *et al.* 2006, Monaghan *et al.* 2007, Monaghan *et al.* 2011, Reilly *et al.* 2012, Monaghan *et al.* 2014, Dingemanse *et al.* 2015).

In terms of evidence, psycholinguistic and linguistic research that focuses on corpus analysis shows that phonological cues are in principle available to the language user. Recent work in the area of cultural evolution, using an iterated learning paradigm, in which learners are exposed to some data based on an artificial language, which they must reproduce and pass on to the next 'generation' of learners, suggests that over time words with similar meanings but very different phonological representations may develop phonological regularities (see e.g. Winters *et al*. 2015). This indicates that available cues in real language may be used by speakers.

The question as to whether speakers do indeed draw upon existing phonological regularities in real languages is addressed only rarely, but Don & Erkelens (2007) and Hollmann (2012, 2013) offer possible research paradigms. Don & Erkelens (2007) carry out a comprehension experiment using nonce words, designed so as to share phonological similarities to familiar Dutch nouns and verbs. Hollmann (2012, 2013) relies on an experiment in which speakers were asked to produce novel English nouns and verbs, whose phonological properties are then compared to regularities described in the literature.

The present study is based on corpus data, and would therefore ideally be supplemented with a comprehension and/or production study in future. I return to this in the discussion in section 4 and in the conclusion, section 5, below.

3. METHOD

This study analyses phonological differences between prototypically attributive vs. predicative adjectives. In Section 3.1 I explain how I collected the adjectives, section 3.2 covers the analytical methods used.

3.1 Data collection

I use data from COCA, a 560 million word corpus of present-day written and spoken American English. In order to avoid bias due to nominal and verbal phonology I also omit denominal and deverbal adjectives (using the *Oxford English Dictionary* and the *Online Etymology Dictionary* to determine origins).[10]

The compilation of my sample of adjectives was guided by a decision to focus on the most frequent adjectives. The first reason for this is that these may be assumed to have the largest influence on a speaker's mental grammar, including the possible categories of prototypically attributive and prototypically predicative adjectives.

[10] Determining the historical origin of adjectives was not always completely straightforward. One area around which different analyses could be suggested is the question as to whether to consider only derivation processes that occurred in English, or also, in the case of loan words, in donor languages. I have consistently gone back to donor languages, so that *human* is seen as derived from the Latin noun + suffix combination *hōmo* + *-ānus*, and is therefore omitted from the sample, although it entered the language via Anglo-Norman and Middle French adjectival forms *humeigne/humane/humain/humayn* (*OED*, human, *adj*. and *n*.).

The second reason is that there is evidence to suggest that speakers require a fair amount of exposure before they are able to detect adjectival distributional preferences: Hao (2015), cited by Goldberg & Boyd (2015: e192), found that children until the age of ten used *a*-adjectives such as *asleep* and *afloat*, which are restricted to predicative position in adult(-like) speech, in attributive position as frequently as other adjectives, such as *sleepy* and *floating*. Goldberg & Boyd argue that these errors emerge due to a lack of sufficient exposure. The distributional preference in the case of *a*-adjectives is extremely strong. My interest in prototypically attributive vs. predicative adjectives is broader, i.e. I wish to go beyond the relatively few cases in English that are (virtually) restricted to attributive or predicative position. One expects the token frequency needed to learn preferences of adjectives whose distribution is less fixed to be higher than is the case for *a*-adjectives.

In order to obtain the most frequent adjectives I obtained the list of the 5,000 most frequent words in COCA.[11] This list contains 839 adjectives. Of these, 129 are adjectival in origin.[12,13] In order to assess their preference for the attributive or predicative construction, I ran two queries. Using ROUGH as an example, for attributive position I searched for DET ROUGH_j* NOUN. For predicative position I

[11] The list can be downloaded from https://www.wordfrequency.info/free.asp?s=y [accessed 10 December 2019]. The list is not case-sensitive: words whose first letter occurs capitalised and in lower-case formed just a single entry (see https://www.wordfrequency.info/100k_faq.asp [accessed 10 December 2019]).
[12] By this I mean the roots of the forms. Thus, for instance, whilst *golden* derives directly from nominal *gold*, that in turn appears to go back to an adjectival IE base meaning 'yellow', 'originally with reference to the colour of the metal' (*OED*, gold, *n.1* and *adj.*). *United* is derived from *unite* but that goes back to adjectival *ūnus* (*OED,* unite, *v.*).
[13] One reviewer suggests that 'it is claimed that in Proto-Indo-European there was one single class of 'substantives' subsuming nouns and adjectives. That is, adjectives and nouns were the same word class.' It is certainly true that nouns and adjectives were inflected identically, except that for adjectives distinct forms were available for masculine, feminine and neuter gender. The position taken in this paper is that nouns and adjectives were nevertheless not the same, inasmuch as their meanings were distinct. I rely on the same argument here as the one used by Croft in his critique of what he calls 'lumping approaches' (2001:67ff.). It is in fact also not uncommon for PIE grammarians to draw a distinction between nouns and adjectives, despite their formal similarity; see e.g. Ringe (2006), Kapović (2017).

searched for BE ROUGH_j*_.|;|: . (As always with corpus searches, these algorithms were compromises: I could have included also adjective-noun sequences without determiners, predicative constructions with different copulas, *et cetera*. Alternatively, I could have analysed 100, 200 or 500 random tokens of each adjective, and work out its distributional preference based on that. Nevertheless, for the purposes of this study these algorithms seemed adequate.) Finally, I tested for statistically significant differences between attributive and predicative tokens by using the exact binomial test (see e.g. Sheskin 2007), which yielded 119 adjectives with a statistically significant (p <.05) preference for either of the two constructions.[14] (As one of the reviewers notes, the fact that such a large proportion of adjectives have a statistically significant preference provides some justification for asking the research question about the phonological properties of the attributive and predicative groups, compared to those of nouns and verbs.)

The list of prototypically attributive adjectives is as follows:

> other, new, high, small, large, young, long, little, only, major, whole, recent, red, short, single, medical, foreign, common, poor, similar, serious, simple, blue, dark, various, deep, individual, middle, total, senior, critical, very, wild, quick, light, bright, tiny, soft, broad, United, primary, male, strange, Supreme, yellow, prime, unique, ethnic, brown, golden, German, rare, gray, vast, solid, sharp, proper, brief, immediate, double, grand, severe, junior, straight, extreme, alternative, ultimate, minor, relevant, elderly, pale,

[14] In future work in this area, one could perhaps approach prototypicality in a more gradient manner, taking into account the exact degree of adjectives' bias towards either of the two positions. This matter will not be entirely straightforward, however, as bias may not be the only factor: raw frequency may play a role as well. To give an extreme example: a bias of, say, 2:3 may be less easy to perceive in a sample of 10 (where we would have 4 vs. 6 tokens) than in a sample of 1,000 (where there would be 400 vs. 600 tokens). Careful consideration of bias would thus ideally be sensitive to the role of absolute frequencies as well.

round, eager, administrative, maximum, medium, minimum, mild, improved, dried, innovative, dumb, integrated, dense

The prototypically predicative adjectives are:

best, sure, better, strong, free, full, clear, difficult, likely, wrong, ready, nice, necessary, tough, safe, fair, clean, comfortable, sick, slow, equal, gay, glad, smooth, flat, rough, unlikely, blind, scared, naked, uncomfortable, minimal, shy, unfair, cruel[15]

Both lists are ordered from most to least frequent. The median frequency of the prototypically attributive adjectives, above, is 24,389; that of the predicative ones is 21,101. It would have been desirable to control for frequency completely, but that would make it difficult to get a sufficiently large data set of common adjectives to allow for meaningful statistical comparison.

3.2 *Phonological analysis*

All frequent prototypically attributive and predicative adjectives described above were transcribed phonologically, following the *Cambridge English Pronouncing Dictionary* (16th edition).

The forms *United* and *Supreme* cover both capitalised and lower-case spellings (see footnote 11). When capitalised, they will form part of fixed phrases such as *United States* and *Supreme Court*. In these contexts speakers may reduce their pronunciation.

[15] The list does not include any *a*-adjectives, which is unsurprising as these historically often go back to prepositional phrases, such as *asleep* < *a* preposition + *sleep* noun (*OED*, *asleep*, adv. and adj.).

For example, whilst the *Cambridge English Pronouncing Dictionary* renders the first syllable of *united* with a full vowel, when part of *United States* speakers may reduce that vowel to schwa in rapid speech. I have followed the *Cambridge English Pronouncing Dictionary*; a more fine-grained analysis might try to differentiate between ordinary and fixed-phrase usages.

The phonological analyses of the attributive vs. predicative adjectives from COCA followed Hollmann's (2012, 2013) scoring scheme. However, Hollmann (2012, 2013) took as his starting point Monaghan *et al.*'s (2005) summary of the literature specifically on nouns and verbs. Monaghan *et al*. also discuss phonological differences between open and closed class words (2005: 144–6), and some of the parameters in question turn out to be significant also in their subsequent consideration of nouns and verbs in their (CHILDES; MacWhinney 2000)[16] corpus data (see also Monaghan *et al.* 2007). For the sake of completeness they are included here as well.

Lohmann (2017) takes a similarly inclusive approach in his study of conversion processes between English nouns and verbs, which he analyses in terms of 15 parameters. Drawing on his list, with a few adjustments, the parameters I look at are:

(1) Word length in syllables: Nouns have been found to have more syllables, on average, than verbs (see e.g. Monaghan *et al.* 2005). I count the number of syllables of each adjective and assign a score [1, 2, …].

(2) Syllabic complexity: Verbs in child-directed speech have been found to contain more complex syllables than nouns by Monaghan *et al.* (2007), who define this as 'the proportion of phonemes in the word that were consonants' (268). Lohmann (2017)

[16] CHILDES is a repository of first language acquisition data in English and a number of other languages, which can be accessed at https://childes.talkbank.org/ [10 December 2019].

operationalises this parameter differently, as 'the average number of phonemes per syllable for each word'. I treat that as a separate parameter (see 3, below), and follow Monaghan *et al.*'s definition instead. Words are scored on a scale [0-1].

(3) Mean syllable length in phonemes: Compare (2), above. Words are scored on a scale [1- …].

(4) Word onset complexity: Monaghan *et al.* (2005) label this 'onset complexity' but their explanation makes it clear that they only look at word-initial onsets, not all onsets. Shi *et al.* (1998), who Monaghan *et al.* refer to, do not provide any examples to illustrate their notion of onset complexity. Whether word-initial onset complexity, general onset complexity, or perhaps even both would provide the clearest distinction between word classes is an empirical question which should be addressed in future research. For present purposes, I follow Monaghan *et al*.'s interpretation, and Lohmann's (2017) more precise term. Scores represent the number of consonants in the initial onset [0-].

(5) Ratio of reduced vowels: Monaghan *et al.* (2007) find that nouns in their corpus data contain a higher ratio of reduced vowels than verbs. Lohmann (2017) expands on Monaghan *et al*.'s definition by including not only schwas but also syllabic consonants. This adds useful precision, so I follow Lohmann. The scale is [0-1].

(6) Vowel backness of the tonic syllable: According to Sereno & Jongman (1990) and Sereno (1994) frequent nouns tend to have more back vowels than frequent verbs. I score vowel advancement [0, 1, 2], dividing up the vowel space as per Hollmann (2012, 2013).

(7) Average vowel backness: Monaghan *et al.* (2007) report a similar tendency for vowel advancement in all syllables for nouns and verbs in child-directed speech as was described under (6). The scoring method is as in (6).

(8) Average vowel height: Monaghan *et al.* (2005) observe that their nouns on average contain lower vowels than their verbs. Again, I use a scale [0, 1, 2], and again divide the vowel space following Hollmann (2012, 2013).

(9-13) Differences in place of articulation: Monaghan *et al.* (2005), Monaghan *et al.* (2007) and other studies have shown that a number of places of articulation are associated with consonants in nouns and verbs to different degrees, either in general (in which case the scale is [0-1]) or in word-initial position (where the scale is [0, 1]). Nasals (parameter 9) are said to be more common in nouns; velars (10), in verbs; coronals (11), in nouns in Monaghan *et al.*'s (2005) CHILDES data but in verbs in Lohmann's (2017) CELEX data; bilabials (12), in nouns; word-initial bilabials (13), also in nouns. My set of velars was slightly larger than Lohmann's (2017), as I included not only [k, g, ŋ] but also [w] (cf. e.g. Ladefoged & Johnson 2011: 43). My set of coronals was also larger than Lohmann's (2017), who looked at [d, t, ʤ, ʧ, ð, θ, n, l, r, s, z]; I also included [ʃ, ʒ].

(14-15) Approximants and word-initial approximants: Monaghan *et al.* (2007) find more approximants word-initially in verbs than in nouns; Lohmann's (2017) data do not replicate that but he does find more approximants in general in monosyllabic verbs than in monosyllabic nouns. My scales are [0-1] and [0, 1], respectively.

(16-17) Final voicing and final obstruent voicing: Lohmann (2017) does not include either of these but Monaghan *et al.* (2005) mention final voicing in their literature review as a parameter that Kelly (1992) suggests is more common in verbs than in

nouns. Monaghan *et al.* (2005) do not find a significant difference for this parameter, which may be why Lohmann omitted it. However, Monaghan *et al.* use a scale that does not clearly follow from what Kelly suggests: they contrast vowels (scored 0) with voiced consonants (1) and unvoiced consonants (2). Kelly does not seem to include vowels in his consideration, and anyway since voicing is a binary feature it is not clear why Monaghan *et al.* treat this parameter as a three-point scale. Berg (2000), Taylor (2002) and Hollmann (2012, 2013) operationalise this parameter as final obstruent voicing. In this study I aim for comprehensiveness and so include both final voicing in general (with scores of 0 for unvoiced and 1 for voiced) and voiced final obstruents (again with a scale of [0, 1], but with missing values for words that do not end in obstruents.

(18) Presence of a final obstruent: Hollmann (2012, 2013) found more final obstruents in the novel English verbs produced in his experiment than in the novel nouns. The scale used is [0, 1].

(19) Initial stress: A number of studies, including Kelly (1996), have reported that disyllabic nouns tend to have initial stress more often than verbs. Berg (2000) extends that generalisation to trisyllabic words. The scale used here is [0, 1], with the lower value assigned to polysyllabic words with non-initial stress and the higher value to words with stressed first syllables. Monosyllabic words do not receive a score.

Table 1, below, offers a sample analysis of two adjectives from COCA, the first prototypically attributive, the second predicative:

Adjective	Word length	Syllabic complexity	Mean syllable length	Word onset complexity	Reduced vowels	Vowel backness tonic	Vowel backness	Vowel height	Naslas	Velars	Coronals	Bilabials	Word-initial bilabials	Approximants	Word-initial approximants	Final voicing	Final obstruent voicing	Presence final obstruent	Initial stress
major	2	.5	2	1	.5	1	1	1	.5	0	.5	.5	1	0	0	1	-	0	1
glad	1	.75	4	2	0	0	0	2	0	.33	.67	0	0	.33	0	1	1	1	-

Table 1. Phonological analysis of two adjectives from COCA

I analyse the differences between prototypically attributive and predicative adjectives for all 19 phonological parameters using the Mann-Whitney *U*-test. I also calculate the point-biserial correlation coefficient *r*, which sheds light on the effect size of each parameter.

For all significant ($p < .05$) and nearly-significant ($p < .1$) differences, the direction of the pattern in the data was compared to the psycholinguistic literature cited above. For example, the literature suggests that nouns tend to contain more bilabial consonants than verbs. If prototypically attributive adjectives in the present study were found to contain on average 0.18 bilabial consonants, and prototypically predicative adjectives only 0.07, then this would conform to the directionality of the pattern displayed by nouns and verbs. As it happens, these are exactly the values obtained for the adjectives in my study; see section 4, below.

4. Analysis and discussion

The results of the Mann-Whitney U-test and the point-biserial coefficient *r* values are presented in Table 2, below, where * indicates statistical significance at $p < 05$ and [a] indicates $p < .1$.

All four significant differences, viz. word length, nasals, velars and bilabials, support the hypothesis that prototypically attributive adjectives pattern with nouns, and prototypically predicative adjectives with verbs. The effect sizes in three of these cases are only small, but one parameter, bilabials, displays a small-to-medium-sized effect.

Turning to the nearly significant difference in the data, i.e. reduced vowels, this also goes in the expected direction: prototypically attributive adjectives have a higher proportion of reduced vowels than predicative ones, just as nouns have a higher proportion than verbs.

Parameter	Attr mean[17]	Pred mean	*U*	*z*-score	*p*-value	*r*
Word length	1.87	1.63	1181.5	1.68	0.05*	0.15
Syllabic complexity	0.63	0.64	1427	-0.25	0.40	-0.02
Mean syllable length	2.79	2.95	1318.5	-0.88	0.38	-0.08
Word onset complexity	1.06	1.20	1308	-0.94	0.17	-0.09
Reduced vowels	0.18	0.12	1244.5	1.31	0.10 [a]	0.12
Vowel backness tonic	0.96	0.89	1383	0.5	0.31	0.05
Vowel backness	1.05	0.94	1322.5	0.86	0.19	0.08
Vowel height	1.00	0.89	1311	0.92	0.18	0.08
Nasals	0.21	0.13	1195	1.60	0.05*	0.15
Velars	0.08	0.16	1162	-1.79	0.04*	-0.16
Coronals	0.63	0.61	1405.5	0.37	0.36	0.03
Bilabials	0.18	0.07	1110	2.10	0.02*	0.19
Word-initial bilabials	0.24	0.11	1288	1.06	0.15	0.10
Approximants	0.28	0.24	1348	0.71	0.48	0.07
Word-initial approximants	0.17	0.11	1393	0.45	0.65	0.04
Final voicing	0.76	0.77	1456	-0.08	0.47	-0.01
Final obstruent voicing	0.42	0.38	226.5	0.16	0.87	0.02
Presence final obstruent	0.43	0.37	1386	0.49	0.62	0.04
Initial stress	0.79	0.75	276	0.21	0.42	0.03

Table 2. Phonological differences between prototypically attributive and predicative adjectives

[17] Giving mean scores is in fact contentious for variables that are neither of the ratio nor interval type, such as those related to vowel position. However, it is commonly done in psycholinguistic research in this area (see e.g. Monaghan *et al.* 2005, Monaghan *et al.* 2007) so for the sake of comparability I follow this practice.

It may be that the pattern observed in relation to reduced vowels is due to the interaction between syntactic position and prosodic prominence. Predicative position is typically at or towards the end of a sentence, which in English and many other languages is associated with new and important information (see e.g. Halliday 1967: 22, Sperber & Wilson 1986: 216), so these adjectives will tend to be accented. Attributive adjectives, by contrast, are less likely to be accented. Scholars have pointed to cases where they are, e.g. *a SIMILAR case involves the English -teen numbers* (Ladd 2006: 239; capitals original), but the point is that these are exceptions, in which the noun is 'fairly unspecific' (*ibid*.). If attributive adjectives are accented less often, then the higher proportion of reduced vowels may be an unsurprising result of their distribution.[18]

Regardless of how the high proportion of reduced vowels has come about, in a usage-based perspective one could suggest that these high degrees of reduction may be noticed, stored and drawn on by speakers in lexical category assignment in online language processing. One way to test this might be to set up a production experiment similar to the one used by Hollmann (2012, 2013) for nouns and verbs. One could encourage speakers to produce novel English adjectives, to fit into empty attributive or predicative slots in sentences. If the novel attributive adjectives contain more schwas and syllabic consonants than the novel predicative adjectives then that would indicate

[18] One of the reviewers suggests that the relation of syntactic position and prosodic prominence deserves to be explored in relation to other phonological properties as well. Focusing on the ones that display statistically significant differences, word length appears to pattern contrary to what one might expect: unstressed position, if anything, would lead to words being reduced, so predicative adjectives (which will tend to be accented more often) should be longer rather than shorter. Consonants may over time be subject to lenition processes, which may ultimately go to all the way to zero (see e.g. Honeybone 2008). Given that this process tends to apply mostly in non-prominent positions (see e.g. Hopper & Traugott 2003: 156) one might expect the ratio of nasals, velars and bilabials to be higher in predicative adjectives than in attributive ones. This is true for velars, so position might help explain that, but not for nasals and bilabials.

that speakers may have stored this phonological property of these adjectives and actively draw on it in distinguishing between them and prototypically predicative ones. Experimental confirmation of the use speakers make use of phonology would be equally welcome for the four cues for which statistically significant differences were obtained. This must remain as an idea for future research.

The question as to whether distribution itself determines phonology is also worth asking in relation to the four significantly different properties. Of these, word length might seem the most suspect. However, if anything, one would expect prototypically attributive adjectives to be shorter than predicative ones: many authors, going back to Schuchardt (1885) and Zipf (1935), have pointed to the inverse correlation between token frequency and length, and we have seen that the token frequencies of the former in my corpus are a little higher. As regards the remaining significant differences, consonants may over time be subject to lenition processes, which may ultimately go to all the way to zero (see e.g. Honeybone 2008). Given that this process tends to apply mostly in non-prominent positions (see e.g. Hopper & Traugott 2003: 156) one might expect the ratio of nasals, velars and bilabials to be higher in predicative adjectives than in attributive ones. This is true for velars, so position might help explain that, but not for nasals and bilabials. I conclude that distribution appears to play only a limited role in the explanation of the phonological properties of prototypically attributive and predicative adjectives, and that where it does, it is possible, under the usage-based approach adopted here, that speakers store and make use of the phonological patterning.

As regards the non-significant differences, finally, it may be worth noting that these are also mostly in the expected direction, apart from vowel height, (word-initial) approximants, final obstruent voicing and presence of a final obstruent. Monaghan *et*

al.'s (2005) and Lohmann's (2017) results for coronals in nouns and verbs differ, with the pattern in my data in line with the findings of Monaghan *et al.* The *p*-values associated with at least some of the non-significant differences suggest that a larger sample might yield additional significant differences; one might indeed consider the relatively modest sample size as a possible explanation as to why the number of significant results, although all in the expected direction, was relatively low.

Overall, then, the results of this study add weight to Berg's notion of cross-level harmony. As regards the theoretical significance of that finding, I have already pointed to the challenge this notion and Anderson's structural analogies between syntax and phonology (1992, 2006, 2011) pose for a theory of Universal Grammar as existing independently from general perceptual and cognitive mechanisms and abilities (Carr 2000, 2006). I would now like to explore in some detail what the findings might mean for a theory of word classes that does not make such an assumption. I hinted in section 1, above, that Radical Construction Grammar (Croft 2001) is well placed to accommodate the empirical findings of this study.

Radical Construction Grammar defines nouns, verbs and adjectives differently from other theories: rather than focusing on morphosyntactic properties, semantics or pragmatics (compare the approaches referred to in section 1, above) Croft combines pragmatics and semantics. The former is the starting point: Croft argues that of fundamental importance (to speakers, and in this usage-based theory therefore also to grammarians) are propositional act functions (cf. also Searle 1969). The three main ones Croft defines as follows:

> The act of REFERENCE identifies a referent and establishes a cognitive file for that referent, thereby allowing for future referring expressions [which, in turn, are acts of reference as well, AUTHOR'S INITIALS] coreferential with the first referring expression. The act of PREDICATION ascribes something to the referent. (…) The act of MODIFICATION (of referents) functions to enrich a referent's identity by an additional feature of the referent, denoted by the modifier.
>
> (2001: 66; small capitals original)

Propositional act constructions are prototypically headed by lexical items that belong to three main semantic classes: object, property and action words. Croft argues that these classes correspond to 'the commonsense ontology of types of entities' (Croft 1991: 38)[19] and he offers the following detailed semantic decomposition:

	Relationality	Stativity	Transitoriness	Gradability
Objects	Nonrelational	state	permanent	nongradable
Properties	relational	state	permanent	gradable
Actions	relational	process	transitory	nongradable

Table 3. Semantic properties of the lexical semantic classes objects, properties and actions (Croft 2001: 87)

[19] These three classes are compatible with evidence from developmental psychology pertaining to early, pre-linguistic core concepts; see e.g. Baillargeon (1994), Quinn & Eimas, (2000) and Spelke (2003).

Relationality is defined, following Langacker (1987: 214–6) in terms of whether 'a concept inherently requires reference to another concept' (Croft 2001: 87). Stativity distinguishes between states and processes. Croft defines transitoriness in terms of the question as to 'whether the concept represents a transitory state or process or an inherent and permanent state of the entity in question' (2001: 87) and adds that 'only states can be permanent' (i*bid.*). Gradability, finally, is defined as 'whether the entity is gradable along of scalar dimension, such as height' (Croft 2001: 87).

Moving on to the Radical Construction Grammar use of the 'noun', 'verb' and 'adjective' labels, Croft reserves these for the prototypical combinations of the three main propositional act functions: object words that refer are called 'nouns', action words that predicate are labelled 'verbs', and 'adjectives' are property words that modify (cf. also footnote 6, above). Non-prototypical combinations are also possible, but if a speaker uses, for example, an action word to refer, as in ***Running*** *is bad for your knees* (Croft 2001: 89; emphasis added), the gerund *running* is not seen as 'a verb used as a noun', as it may be in certain other approaches. Similarly, a property word that is used to predicate, as in *That cypress is* ***big*** (Croft 2001: 89; emphasis added), is not simply called an 'adjective', but a 'predicate adjective'. As I observed above, in footnote 6, 'predicate property word' might have been even more useful in order to highlight the distinction between it and (prototypical) adjectives, which are modifying property words, but Croft chooses to maintain the link with the more traditional label.

The brief summary, above, displays a crucial characteristic of Radical Construction Grammar: it does not take categories such as noun, verb or adjective to be basic 'building blocks' (Croft 2013) of the grammar — where I intend 'grammar' both in the meaning of the speaker's mental grammar and the linguist's theory of what such

mental grammars look like. Speakers engaged in communication do not normally conceptualise and express objects, actions or properties in isolation. Instead, utterances normally consist of predications about some referent(s), and may contain modification. The building blocks, then, are constructions, such as, in the case of adjectives and predicate adjectives, the attributive noun phrase construction (which allows one to modify a referent) and the subject predicate construction (which allows one to predicate a property of a referent).

In terms of language acquisition, children are usually exposed to utterances containing predications that include one or more referring expressions and possibly one or more modifiers. An example from the MPI-EVA-Manchester Corpus (see Lieven *et al*. 2009), which forms part of the CHILDES database, of an utterance that includes all three propositional act functions is given below:

(1) that one's got an orange hat and that one's got a purple hat

This utterance contains four referring expressions (*that one* 2x, *an orange hat, a purple hat*), two predications (*'s got an orange hat* and *'s got a purple hat*) and two modifiers (*orange* and *purple*).[20]

I would argue that in some cases, the lexical category acquisition process may be facilitated as well by older speakers focusing the child's attention on specific object,

[20] *That* (2x) in this example would in fact also be classified by Croft as a modifier, albeit one of a special type, namely one that specifies the '[d]eictic location of [the] referent' (2013:32; cf. also 1990:256). For the sake of completeness, I note that the function of the coordinating conjunction *and* requires that one go beyond the three major propositional act functions of reference, predication and modification: it is defined as portraying a symmetric relation of an event or proposition to another event or proposition (Croft 2013:32).

action or property words. The following exchange from the same corpus in the CHILDES database illustrates how this may happen for property words:

(2) Mother: Eleanor , <what's that> [/] what's that , darling ?
Child: it's a rainbow .
Mother: and what colors can you see in it ?
Child: red blue and [/] and yellow .

With Croft (2013), I have described prototypically attributive and prototypically predicative adjectives as distinct but overlapping classes. In a Radical Construction Grammar perspective, the overlap is not unexpected: the way in which one may wish to enrich one's description of a referent will typically be in terms of a property (e.g. *an **orange** hat*), and what one might wish to predicate of a referent, although prototypically an action (e.g. *the hat **fell** on the floor*), will not infrequently be a property of that referent (e.g. *that hat is **orange***).

Boyd & Goldberg (2011) report on experimental evidence that suggests that speakers generalise across *a*-adjectives (e.g. *asleep, afloat*) to set up a class of these adjectives, which includes information about their strong preference for predicative position. The evidence comes mainly from an experiment with novel *a*-adjectives, such as *ablim*, which subjects used predicatively more often than novel non-*a*-adjectives, such as *zoopy.* This would be difficult to explain if the distribution of *a*-adjectives was stored purely on an item-by-item basis, without any generalisation and category-formation.

Boyd & Goldberg do note that the predicative preference subjects display for novel *a*-adjectives is significantly weaker than it is for familiar *a*-adjectives (2011: 71

and *passim*). They speculate 'that membership in the *a*-adjective category is gradient, and the degree of dispreference that an adjective shows for attributive use is directly proportional to the degree to which it is viewed as an *a*-adjective' (Boyd & Goldberg 2011: 71). They suggest that speakers' knowledge of *a*-adjectives may include the morphological fact that they consist of *a-* followed by 'a semantically related stem' (Boyd & Goldberg 2011: 61), such as *sleep* or *float*, which is of course missing in the case of novel forms such as *ablim*; compare **blim*.

Based on the experimental evidence provided by Boyd & Goldberg (2011), I suggest that the distinct but overlapping classes of prototypically attributive and predicative adjectives may be psychologically real as well. Like *a*-adjectives, they each appear to have certain phonological properties, which may help in their categorisation. Moreover, these phonological properties seem to be aligned with those of the head of the constituent they typically appear in, viz. noun phrases and verb phrases. *A*-adjectives, with their specific phonology, morphology, and very strong distributional preference, may be a salient sub-class of the category of prototypically predicative adjectives.

Given the high number of adjectives that may occur to a greater or lesser extent in both modification and predication constructions, the acquisition of these classes presumably presents a challenge. The work by Hao (2015), reported on by Goldberg & Boyd (2015), offers an indication of the magnitude of this challenge and provides an insight into when, in the language acquisition process, these categories might emerge.

As was mentioned in section 3.1, above, up until the age of 10 children do not properly restrict *a*-adjectives to predicative use. If *a*-adjectives are extreme and rather salient instances of the prototypically predicative class, then their distribution may be

easier to acquire than that of adjectives that have a less strong preference for one position or the other. We know that children 'tend to pick up on the most frequent nouns, verbs and adjectives first, and then extend their range' (Clark 2004: 472), and at least some *a*-adjectives are very frequent, e.g. *afraid* and *alive*, which occur 27,727 and 24,184 times, respectively, in COCA, ranking them sixteenth and twenty-first among the most frequent adjectives in the corpus. This should enhance the ease of acquisition of their distribution. Bearing all this in mind I would like to suggest very tentatively that the prototypically attributive and prototypically predicative categories emerge quite late. Up until approximately the age of 10 English-speaking children may have one large, undifferentiated category of adjectives. Only at that age may they begin to differentiate between the two classes, possibly starting with salient cases such as *a*-adjectives, followed by other adjectives which may not share equally prominent phonological and/or morphological characteristics but are frequent and have strong distributional preferences. Examples might be *other*, the most frequent adjective of all in COCA, which in my searches yields 63,123 attributive tokens as against 25 predicative ones, and *only*, which in my COCA searches occurs 1,093 times attributively but never predicatively. As the prototypically attributive and predicative categories expand, speakers will make more and more of the phonological generalisations that are described in the present paper. These generalisations may in turn assist in acquisition and in processing more generally (see section 2, above, for references), although the modest effect sizes suggest that speakers cannot rely on phonology too much.

5. Conclusion

This paper set out to test the hypothesis that attributive adjectives phonologically pattern with nouns, while predicative adjectives pattern with verbs.

The data set, based on the most frequent adjectives from COCA, was subjected to statistical analysis to distinguish between prototypically attributive and prototypically predicative ones. Phonological analysis yielded support for the hypothesis: prototypically attributive and predicative adjectives display significant differences for word length, proportion of nasals, velars and bilabials, and a trend for reduced vowels – all in the direction predicted by the hypothesis. All effect sizes were small, apart from bilabials, which showed a small-to-medium-sized effect.

The first conclusion to emerge from the study, then, is that there is evidence for Berg's (2000) cross-level harmony, which may facilitate language processing, not only at the level of the traditional word classes nouns, verbs and adjectives but also for these two classes of adjectives.

Anderson has discussed his similar concept of structural analogies between syntax and phonology (1992, 2006, 2011) in the context of the debate around the nature of Universal Grammar, and has suggested that the analogy exists because syntax and phonology share the same perceptual-cognitive basis (2006: 607). The present study may be interpreted as additional evidence against a theory of Universal Grammar as existing independently from general perceptual and cognitive mechanisms and abilities, a position which Anderson (2006) ascribes to Carr (2000, 2006).

Whilst the findings from the present study challenge an autonomous conception of Universal Grammar, they are not incompatible with all linguistic theories. I have suggested, using a Radical Construction Grammar perspective (Croft 2001), that the

prototypically attributive and predicative adjectives might emerge as classes from exposure to utterances containing relevant modification and predication constructions. These classes overlap substantially, but their emergence may start from extreme and salient examples, such as so-called *a*-adjectives (see e.g. Boyd & Goldberg 2011) in the case of prototypically predicative adjectives, and highly frequent and almost exclusively attributive adjectives such as *only* and *other* in the case of prototypically attributive ones. As the number of prototypically attributive and predicative adjectives in a speaker's mental grammars increases, so will the likelihood that they will crystallise into distinct but overlapping classes, partly based on the phonological similarities described here.

Hao's (2015) study on *a*-adjectives provides a possible clue as to the complexity and timeline of the acquisition process of the two overlapping categories. Briefly, the age of acquisition would probably be around 10 years or older. More research will be needed to add further support and precision to this.

Additional research would be welcome also in relation to a range of other issues and questions. Firstly, I noted that corpus-based studies, which make up most of the literature on phonological properties of word classes thus far, can point to the availability of these regularities as cues to lexical categorisation. However, in order to confirm whether speakers do in fact make use of them, comprehension and/or production experiments are needed, possibly based on the nonce word paradigms developed by Don & Erkelens (2007) and Hollmann (2012, 2013).

Another avenue for future research would be to test some predictions that may arise from the current proposal, that there is partially phonologically defined distinction between prototypically attributive and predicative adjective classes in English. One such

prediction might be that the more evenly distributed a given adjective is between attributive and predicative contexts, the more 'neutral' its phonological identity should be with respect to word length, ratio of nasals, velars and bilabials, and perhaps reduced vowels. This prediction could be tested through corpus analysis or again in comprehension or production tasks with nonce words. If corpus data are used, the challenge will be to identify enough adjectives that are not derived from other word classes, especially nouns and verbs.

In addition to lending support to cross-level harmony and to a theoretical conception of grammar such as Radical Construction Grammar, in which categories such as word classes and possible sub-classes emerge from exposure and usage, this study has another theoretical implication. Berg (2000), Taylor (2002), Don & Erkelens (2007), Hollmann (2012, 2013, 2014) and Lohmann (2017) all consider the phonological level in their analysis of word classes. Other theoretical linguistic work on this topic tends to emphasise either distribution or meaning – a state of affairs that is lamented by Kelly, who argues that it is unwise for linguists to make *a priori* assumptions about what level will be most relevant to lexical categorisation (1992: 362–3; see also Hollmann 2012, 2013, 2014). The findings of the present paper suggest that Kelly's lament, more than two-and-a-half decades on, still deserves to be addressed more widely, in any theorising on lexical categorisation that aspires to having a solid connection with our understanding of language acquisition, processing and cultural evolution.

Author's address:
Department of Linguistics & English Language
Lancaster University
Lancaster, LA1 4YL
United Kingdom
E-mail: w.hollmann@lancaster.ac.uk

REFERENCES

Aarts, Bas. 2007. *Syntactic gradience: The nature of grammatical indeterminacy.* Oxford: Oxford University Press.

Albright, Adam. 2008. How many grammars am I holding up? Discovering phonological differences between word classes. In Charles B. Chang & Hannah J. Haynie (eds.), *Proceedings of the 26th West Coast Conference on Formal Linguistics*, 1–20. Somerville, MA: Cascadilla Press.

Anderson, John M. 1992. *Linguistic representation.* Berlin / New York: Mouton de Gruyter.

Anderson, John M. 2006. Structural analogy and universal grammar. *Lingua* 116, 601–33.

Anderson, John M. 2011. *Phonology-syntax analogies*. Oxford: Oxford University Press.

Baillargeon, Renée. 1994. How do infants learn about the physical world? *Current Directions in Psychological Science* 3, 133–40.

Berg, Thomas. 2000. The position of adjectives on the noun-verb continuum. *English Language and Linguistics* 4, 269–93.

Berg, Thomas. 2009. *Structure in language: A dynamic perspective.* New York: Routledge.

Berg, Thomas & Christian Koops. 2010. The interplay of left- and right-branching effects: A phonotactic analysis of Korean syllable structure. *Lingua* 120, 35–49.

Bhat, Darbhe Narayana Shankara. 2004. *The adjectival category: Criteria for differentiation and identification*. Amsterdam/Philadelphia: John Benjamins.

Biber, Douglas, Stieg Johannson, Geoffrey Leech, Susan Conrad & Edward Finegan. 1999. *Longman grammar of spoken and written English*. New York: Longman.

Bolinger, Dwight. 1967. Adjectives in English: Attribution and predication. *Lingua* 18, 1–34.

Boyd, Jeremy K. & Adele E. Goldberg. 2011. Learning what not to say: Categorization and statistical preemption in *a*-adjective production. *Language* 87, 1–29.

Carr, Philip. 2000. Scientific realism, sociophonetic variation, and innate endowments in phonology. In Noel Burton-Roberts, Philip Carr & Gerard Docherty (eds.), *Phonological knowledge: Conceptual and empirical issues*, 67–104. Oxford: Oxford University Press.

Carr, Philip. 2006. Universal grammar and syntax/phonology parallelisms. *Lingua* 116, 634–56.

Carstairs-McCarthy, Andrew. 1999. *The origins of complex language: An inquiry into the evolutionary beginnings of sentences, syllables, and truth*. Oxford: Oxford University Press.

Cassidy, Kimberly W. & Michael H. Kelly. 1991. Phonological information for grammatical category assignment. *Journal of Memory and Language* 30, 348–69.

Chafe, Wallace. 1982. Integration and involvement in speaking, writing, and oral literature. In Deborah Tannen (ed.), *Spoken and written language. Exploring orality and literacy*, 35–53. Norwood, NJ: Ablex.

Chomsky, Noam. 1970. Remarks on nominalization. In Roderick A. Jacobs & Peter S. Rosenbaum (eds.), *Readings in English transformational grammar*, 184–221. Waltham, MA: Ginn.

Chomsky, Noam. 1981. *Lectures on government and binding*. Dordrecht: Foris.

Clark, Eve V. 2004. How language acquisition builds on cognitive development. *Trends in Cognitive Sciences* 8, 472–8.

Cohen, Jacob. 1988. *Statistical power analysis for the behavioural sciences*. 2nd edn. New York: Academic Press.

Comrie, Bernard. 1975. Polite plurals and predicate agreement. *Language* 51, 406–18.

Croft, William. 1990. A conceptual framework for grammatical categories (or, a taxonomy of propositional acts). *Journal of Semantics* 7, 245–79.

Croft, William. 1991. *Syntactic categories and grammatical relations: The cognitive organization of information*. Chicago: University of Chicago Press.

Croft, William. 2001. *Radical construction grammar*. Oxford: Oxford University Press.

Croft, William. 2003. *Typology and universals*. 2nd edn. Cambridge: Cambridge University Press.

Croft, William. 2013. Morphosyntax. MS, Albuquerque, University of New Mexico.

Davies, Mark. 2008– . The Corpus of Contemporary American English (COCA): 560 million words, 1990–present. Available at https: //corpus.byu.edu/coca/ [accessed 15 June 2019].

Dingemanse, Mark, Damián E. Blasi, Gary Lupyan, Morten H. Christiansen & Padraic Monaghan. 2015. Arbitrariness, iconicity and systematicity in language. *Trends in Cognitive Sciences* 19, 603–15.

Don, Jan & Marian Erkelens. 2008. Possible phonological cues in categorial acquisition: Evidence from adult categorization. *Studies in Language* 32, 670–82.

Du Bois, John W. 1985. Competing motivations. In John Haiman (ed.), *Iconicity in syntax*, 343–65. Amsterdam: John Benjamins.

Farmer, Thomas A., Morten H. Christiansen & Padraic Monaghan. 2006. Phonological typicality influences on-line sentence comprehension. *PNAS* 103, 12203–08.

Ferris, Connor. 1993. *The meaning of syntax: A study in the adjectives of English*. London: Longman.

Fukui, Naoki & Margaret Speas. 1986. Specifiers and projections. *MIT Working Papers in Linguistics* 8, 128–72.

Givón, Talmy. 1984. *Syntax. A functional-typological introduction*. Amsterdam: John Benjamins.

Givón, Talmy. 2001. *Syntax. An introduction. Volume I*. Amsterdam: John Benjamins.

Goldberg, Adele E. & Jeremy K. Boyd. 2015. *A*-adjectives, statistical pre-emption, and the evidence: Reply to Yang (2015). *Language* 91, e194–7.

Halliday, M.A.K. 1967. *Intonation and grammar in British English*. The Hague: Mouton.

Han, Myae. 2007. Individual differences in play style and literacy: A bioecological perspective. In Kathleen A. Roskos & James F. Christie (eds.), *Play and literacy in early childhood: Research from multiple perspectives*, 119–32. New York / London: Routledge.

Hao, Jessica. 2015. Abstraction versus restriction in syntactic learning: An examination of children's acquisition of the *a*-adjective restriction. Unpublished senior thesis, Princeton, NJ: Princeton University.

Hollmann, Willem B. 2012. Word classes: Towards a more comprehensive usage-based account. *Studies in Language* 36, 671–98.

Hollmann, Willem B. 2013. Nouns and verbs in Cognitive Grammar: Where is the 'sound' evidence? *Cognitive Linguistics* 24, 275–308.

Hollmann, Willem B. 2014. What do adjectives sound like? *Proceedings of the Annual Meeting of the Japanese Cognitive Linguistics Association* 14, 749–54.

Honeybone, Patrick. 2008. Lenition, weakening and consonantal strength: Tracing concepts through the history of phonology. In Joaquim Brandão de Carvalho, Tobias Scheer & Philippe Ségéral (eds.), *Lenition and fortition*, 9–93. Berlin: Mouton de Gruyter.

Hopper, Paul J. & Elizabeth Closs Traugott. 2003. *Grammaticalization*. 2nd edn. Cambridge: Cambridge University Press.

Kapović, Mate. 2017. Proto-Indo-European morphology. In Mate Kapović (ed.), *The Indo-European languages*. Routledge Handbooks Online. Available at https://www.routledgehandbooks.com/doi/10.4324/9781315678559.ch3 [accessed 15 June 2019].

Kelly, Michael H. 1992. Using sound to solve syntactic problems: The role of phonology in grammatical category assignments. *Psychological Review* 99, 349–64.

Kelly, Michael H. 1996. The role of phonology in grammatical category assignment. In James L. Morgan & Katherine Demuth (eds.), *From signal to syntax*, 249–62. Hillsdale, NJ: Erlbaum.

Kelly, Michael H. & J. Kathryn Bock 1988. Stress in time. *Journal of Experimental Psychology: Human Perception and Performance* 14, 389–403.

Ladd, D. Robert. 2008. *Intonational phonology*. 2nd edn. Cambridge: Cambridge University Press.

Ladefoged, Peter & Keith Johnson. 2011. *A course in phonetics*. 6th edn. Boston, MA: Wadsworth.

Langacker, Ronald W. 1987. *Foundations of cognitive grammar*, Vol. 1, *Theoretical prerequisites*. Stanford: Stanford University Press.

Langacker, Ronald W. 2008. *Cognitive grammar*: *A basic introduction.* Oxford: Oxford University Press.

Lieven, Elena, Dorothé Salomo & Michael Tomasello. 2009. Two-year-old children's production of multiword utterances: A usage-based analysis. *Cognitive Linguistics* 20, 481–508.

Lohmann, Arne. 2017. Phonological properties of word classes and directionality in conversion. *Word Structure* 10, 204–34.

MacWhinney, Brian. 2000. *The CHILDES project: Tools for analysing talk.* 3rd edn. Mahwah, NJ: Lawrence Erlbaum Associates.

Monaghan, Padraic, Nick Chater & Morten H. Christiansen. 2005. The differential role of phonological and distributional cues in grammatical categorisation. *Cognition* 96, 143–82.

Monaghan, Padraic, Morten H. Christiansen & Nick Chater. 2007. The phonological-distributional coherence hypothesis: Cross-linguistic evidence in language acquisition. *Cognitive Psychology* 55, 259–305.

Monaghan, Padraic, Morten H. Christiansen & Stanka A. Fitneva. 2011. The arbitrariness of the sign: Learning advantages from the structure of the vocabulary. *Journal of Experimental Psychology: General* 140, 325–47.

Monaghan, Padraic, Richard C. Shillcock, Morten H. Christiansen & Simon Kirby. 2014. *Philosophical Transactions of the Royal Society B* 369, 20130299.

Palmer, Frank 1971. *Grammar*. Harmondsworth: Penguin.

Quinn, Paul C. & Peter D. Eimas. 2000. The emergence of category representations during infancy: Are separate perceptual and conceptual processes required? *Journal of Cognition and Development* 1, 55–61.

Quirk, Randolph, Sidney Greenbaum, Geoffrey Leech & Jan Svartvik. 1985. *A comprehensive grammar of the English Language*. London: Longman.

Reilly, Jamie, Chris Westbury, Jacob Kean & Jonathan E. Peelle. 2012. Arbitrary symbolism in natural language revisited: When word forms carry meaning. *PLoS ONE* 7, e42286.

Resnick, Michael. 2017. *Lifelong kindergarten: Cultivating creativity through projects, passions, peers, and play*. Cambridge, MA: MIT Press.

Ringe, Don. 2006. *From Proto-Indo-European to Proto-Germanic*. Oxford: Oxford University Press.

Ross, John R. 1972. The category squish: Endstation Hauptwort. *Papers from the regional meeting of the Chicago Linguistic Society* 8, 316–28.

Schuchardt, Hugo. 1885. *Über die Lautgesetze: Gegen die Junggrammatiker*. Berlin: R. Oppenheim.

Sereno, Joan. A. 1994. Phonosyntactics. In Leanne Hinton, Johanna Nichols & John J. Ohala (eds.), *Sound symbolism*, 267–75. Cambridge: Cambridge University Press.

Sereno, Joan A. & Allard Jongman. 1990. Phonological and form class relations in the lexicon. *Journal of Psycholinguistic Research* 19, 387–404.

Sheskin, David J. 2007. *Handbook of parametric and nonparametric statistical procedures*. 4th edn. Boca Raton, FL: CRC Press.

Smith, Mark. 2010. Pragmatic functions and lexical categories. *Linguistics* 48, 717–77.

Spelke, Elizabeth. 2003. Core knowledge. In Nancy Kanwisher & John Duncan (eds.), *Functional neuroimaging of visual cognition*, 29–56. Oxford: Oxford University Press.

Sperber, Dan & Deirdre Wilson. 1986. *Relevance*. Oxford: Blackwell.

Stowell, Timothy. 1981. Origins of phrase structure. Unpublished PhD thesis, MIT, Cambridge, MA.

Taylor, John R. 2002. *Cognitive grammar*. Oxford: Oxford University Press.

Thompson, Sandra A. 1988. A discourse approach to the cross-linguistic category 'adjective'. In John A. Hawkins (ed.), *Explaining language universals*, 167–85. Oxford: Basil Blackwell.

Wierzbicka, Anna. 1986. What's in a noun? (or: How do nouns differ in meaning from adjectives?). *Studies in Language* 10, 353–89.

Winters, James, Simon Kirby & Kenny Smith. 2015. *Language and Cognition* 7, 415–49.

Zipf, George Kingsley. 1935. *The psycho-biology of language*. Boston: Houghton Mifflin.