

Brief article

Age of acquisition predicts rate of lexical evolution

Padraic Monaghan*

*Centre for Research in Human Development and Learning, Department of Psychology, Lancaster University, UK*

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ABSTRACT

The processes taking place during language acquisition are proposed to influence language evolution. However, evidence demonstrating the link between language learning and language evolution is, at best, indirect, constituting studies of laboratory-based artificial language learning studies or computational simulations of diachronic change. In the current study, a direct link between acquisition and evolution is established, showing that for two hundred fundamental vocabulary items, the age at which words are acquired is a predictor of the rate at which they have changed in studies of language evolution. Early-acquired words are more salient and easier to process than late-acquired words, and these early-acquired words are also more stably represented within the community's language. Analysing the properties of these early-acquired words potentially provides insight into the origins of communication, highlighting features of words that have been ultra-conserved in language.

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1. Introduction

There is growing interest in the relation between the way in which language is acquired and the way in which it has evolved (Bickerton, 1990; MacDonald, 2013; MacNeilage & Davis, 2000; Nowak & Krakauer, 1999; Slobin, 2005). Christiansen and Chater (2008) proposed that one of the major pressures driving change of language structure is that it must be acquired, and so ease of acquisition is intimately involved in language evolution. However, evidence for links between acquisition and evolution is thus far indirect, involving computational simulations (Chater, Reali, & Christiansen, 2009; Kirby, 2001; Monaghan, Christiansen, & Fitneva, 2011; Smith, 2004) or laboratory-based behavioural experiments (Kirby, Cornish, & Smith, 2008). At best, these studies can only provide convergent evidence of the link between language

learning and language evolution (see, e.g., Rafferty, Griffiths, & Ettlinger, 2013).

Studies of language acquisition have also been hypothesised to provide insight into the nature of the origins of human communication. For instance, MacNeilage and Davis (2000) suggested that phonotactics of early productive vocabulary reflected the structure of words in proto-language: the phonological properties of words that children first produce are those that are prominent in reconstructed proto-language vocabulary. Spector and Maurer (2009) similarly claimed that the features of language spoken to children very early in their acquisition provide insight into language origins (see also Ramachandran & Hubbard, 2001). They suggested that the preponderance of sound symbolism in child-directed speech promotes language acquisition by highlighting to children that spoken words refer to objects and actions in the environment around them, thus resolving the symbol-grounding problem. Such ideas relate to theories of imitation in speech as a source for first communicative gestures in proto-language (see Cuskey & Kirby, 2013, for review).

* Address: Department of Psychology, Lancaster University, Lancaster LA1 4YF, UK. Tel.: +44 1524 593813; fax: +44 1524 593744.

E-mail address: p.monaghan@lancaster.ac.uk

Table 1

Hierarchical regression analysis of psycholinguistic predictors of rate of lexical evolution, including measure of contemporary frequency of usage in the first stage.

Stage	Predictor	R^2	β	T	p
1	Grammatical categories	.483			
	Log-frequency		-.281	-4.127	<.001
2	Phonological length	.512	.203	3.206	.002
	Phonological similarity		.107	1.743	.083
	Concreteness		-.097	-1.058	.291
3	Log-AoA	.524	.129	2.181	.030

However, these previous accounts lack direct evidence of connections between processes of language acquisition and evolution. Yet, there is potential for establishing this link through historical linguistics studies that investigate evolution of individual words (Pagel, Atkinson, Calude, & Meade, 2013). Pagel, Atkinson, and Meade (2007) estimated the rate of evolutionary change of individual lexical items by determining how many distinct cognate forms there are for the meaning of that item across languages within a phylogenetic tree of Indo-European languages. Meanings with many distinct cognate forms indicate rapid evolutionary change, those with fewer indicate greater stability of the word's form. Pagel et al. (2007) discovered that higher frequency words are more stable than lower frequency words. Frequent occurrence seems to protect the word from replacement by an alternative form.

If language acquisition is directly implicated in language evolution, then there should be a similar relation between the rate of evolutionary change of a word and the point at which that word is acquired by the learner. Words that are acquired early in children's development demonstrate greater salience and stability of representation – early-acquired words are retrieved more quickly and accurately than later-acquired words (Juhasz, 2005). Relatedly, early-acquired words are more enduring when a speaker's language is depleted as a consequence of ageing (Hodgson & Ellis, 1998) or acquired cognitive impairments (Bradley, Davies, Parris, Su, & Weekes, 2006; Holmes, Fitch, & Ellis, 2006). Hence, early-acquired words should be less vulnerable to change than late-acquired words due to the cognitive prioritisation that such early-acquired words are afforded. Similarly to the observed effects of frequency of usage for conservation of a word's form, the individual's early acquisition of a word should result in greater stability in language evolution.

In order to assess whether language acquisition does relate to language evolution, the age at which vocabulary items are acquired was tested as a predictor of the rate of evolutionary change of words.

2. Material and method

The database of words comprised 200 words in English that are fundamental terms in most language vocabularies (Swadesh, 1952), taken from the Indo-European database (Dyen, Kruskal, & Black, 1992). Rate of lexical change was derived from the number of distinct cognate forms across 87 different languages, where words with a greater

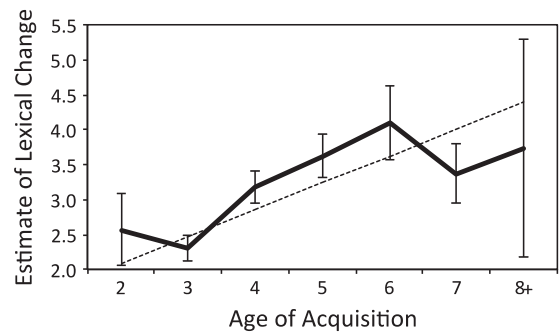


Fig. 1. Relation between AoA and rate of lexical change. Error bars show ± 1 standard error of the mean. Dashed line indicates the regression. Note that only 3 words have AoA ≥ 8 , resulting in a large standard error.

number of distinct forms indicate a higher rate of change for that lexical item (see Pagel et al., 2007, for more details of the model used to derive the rate of change estimates for each lexical item). Word-frequency was taken from the British National Corpus (Leech, Rayson, & Wilson, 2001), calculated from a corpus of 100 million word usages in British English. The database of words, with their rate of lexical change values, was exactly that used by Pagel et al. (2007).

Age-of-acquisition (AoA) values for the words were taken from Kuperman, Stadthagen-Gonzalez, and Brysbaert (2012). These values were constructed from subjective judgments of AoA for more than 30,000 words, and were highly correlated with other measures of AoA on smaller data sets (e.g., Stadthagen-Gonzalez & Davis, 2006). The word *ye* was not included in the database, and so the AoA rating for *you* was used in its place (the inclusion of the *ye* form in the original lists was to record distinctions in number for pronouns across languages).

In order to isolate the effect of AoA from other related properties of the word, it is also important to include in any analysis measures of words' similarity to other words and word length (Kuperman et al., 2012). This is because early-acquired words tend to be shorter and more similar to other words than later-acquired words. In the current analyses, a measure of length in phonemes and phoneme neighbourhood was included, defined as the number of other words that differ by a single phoneme from the current word (Vitevitch, 2002). Similarly, early-acquired words tend to be higher frequency, and so the relative contributions of AoA and frequency must be determined in an analysis that includes all these variables. Early-acquired words also tend to be higher in concreteness, and so concreteness ratings (Brysbaert, Warriner, & Kuperman, 2014) were also included for all but one of the words (*louse* did not appear in the concreteness database, and, as with the AoA values, the concreteness rating for *you* was used for *ye*). Note that in Pagel et al.'s (2007) analysis, only grammatical category and word frequency were included, and other potentially confounded psycholinguistic properties of words were not jointly considered. The current analyses therefore provide a confirmation that the observed frequency effects in terms of rate of evolutionary change of lexical items are not due to other properties of high versus low frequency words.

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