Humans are prolific word learners, learning tens of thousands of words in a short space of time. Do humans have cognitive specializations for word learning, and if so, do these represent cognitive adaptations (the product of natural selection, rewarding better word learners), or something else?

Among the properties that distinguish human language from animal communication, our word-learning ability is particularly remarkable. By adulthood, the average human speaker will have learned between 50,000 and 60,000 words (Bloom, 2000; Pinker & Jackendoff, 2005a). In doing so, children overcome the induction problem famously illustrated by Quine's (1960) "*Gavagai*" thought experiment, namely that, for every new word they encounter, children are required to choose from an infinite array of possible referents in their environment. That they achieve this feat on such a scale and with apparently little effort (Bloom, 2000) suggests that learners are constrained by some cognitive mechanism (or mechanisms) which guide them toward appropriate interpretations. In addition, significant qualitative differences between word-use and its nearest analogues in animal communication, leading some to suggest that cognitive specialisms for word-learning ability evolved as specifically human, specifically linguistic adaptations (eg. Hauser, Chomsky, & Fitch, 2002; Hurford, 1989; Pinker & Jackendoff, 2005). Others (eg. Bloom, 2000; Markman, 1992) claim that word-learning is explicable without recourse to domain-specific constraints, but is instead made possible by mechanisms which are shared across cognitive domains. In this essay, I will argue in broad favour of the latter view but will also attempt to make the case that language-specific selection pressures may still have acted on the cognitive processes that make word-learning possible.

Crucial to investigations of word-learning (eg. Bloom, 2000; Deák & Toney, 2013; Kaminski, 2004) is the idea of *fast mapping*, that is, the apparent ability of word-learners to form an associative connection between a novel word and its referent after very few exposures (Carey & Bartlett, 1978). Recent studies have observed similar behaviour in non-human animals, for example pigeons (Wasserman, Brooks, & McMurray, 2015) and a border collie named Rico (Kaminski, 2004). In particular, the case of Rico, who is able to respond to novel commands by fetching novel objects, excluding familiar objects with familiar names, provides possible insight into a well-attested learning bias known as the *mutual exclusivity* bias, which is claimed to appear in humans across many cognitive domains (Markman, 1992). This bias is claimed to predispose word-learners to avoid mapping a single word onto multiple referents or vice versa (Markman, 1992), thus constraining word-learners' new mappings and thereby partially alleviating Quine's induction problem. Caution should be exercised, however, when drawing conclusions from this finding. For one thing, Rico's admittedly prodigious abilities are dwarfed by the word-learning capabilities of human infants in terms of their scale and robustness (Bloom, 2000; 2004). For example, while children learn words for various kinds of referents in different contexts, including by merely overhearing the word, Rico's receptive vocabulary is limited to referents learned during fetching games (Bloom, 2004). Not least, important qualitative differences exist between words as acquired by humans and by animals, for example their intentional and symbolic use, (Golinkoff & Hirsh-Pasek, 2000; Hauser et al., 2002) and their encoding of grammatical information (Pinker & Jackendoff, 2005a; 2005b) However, findings such as these are suggestive of a possible evolutionary precursor for word-learning. In this respect, it is perhaps significant that these abilities are found in a sheepdog, that is, a product of artificial selection for phenotypic traits that are advantageous within a pastoral context, presumably including reliable responses to verbal commands. Rico's fast mapping ability may therefore be seen as the product of Darwinian selection (albeit artificial) for a communicative function, though it should also give pause to accounts of fast-mapping as domain-specific to human language.

Several similar learning biases are attested to facilitate fast-mapping in human children. For example, in addition to the mutual exclusivity bias, Markman (1992) cites a *whole object bias*, which predisposes learners to favour whole objects as referents for novel words, and the *taxonomic bias*, which predisposes children to extend mappings for count nouns to objects of the same kind as their original referent, rather than a single exemplar. The extent to which these biases are domain specific, or indeed to which they are operative at all (Deák & Toney, 2013) is a matter of debate. For example, while Markson & Bloom (1997) found that children map novel words onto referents just as efficiently as they do arbitrary facts about them, suggesting that fast mapping is not a language-specific process, Waxman & Booth (2000) found a difference between words and facts in the way that children treat them, namely that they will map count nouns onto other objects of the same kind, in accordance with the taxonomic bias, they will not do so for facts about the referents. In Waxman & Booth's view this finding undermines Markson & Bloom's claim that mapping of words and facts are governed by the same mechanism, whereas, according to Bloom (2001), this discrepancy is due to conceptual features of the fact presented in the children's stimuli (*"My uncle gave this to me"*), which unlike the count noun presented *("a koba")* imply applicability to only a single exemplar, rather than any discrepancy between linguistic and non-linguistic mechanisms. Subsequent work by Deák & Toney (2013), found no systematic difference between children's learning of words, facts or pictograms, suggesting that word-learning is governed by domain-general processes. However, they also found no evidence of prevalent fast-mapping, leading them to suggest that the image of children as prodigious fast mappers is in fact a function of experimental design. By contrast, word-learning in realistic contexts is found to be slow and inefficient (Deák et al., 2000). It would therefore seem that claims of constraints on word-learning, whether domain-general or domain specific, should be met with some degree of scepticism.

In any case, fast-mapping is not the only area in which domain-specificity may be pertinent to word-learning. Rather, as Saussure noted (cited in Hurford, 1989) words are bidirectional (Saussurean) signs; that is, their meanings are available to both speaker and hearer. This may be contrasted with non-Saussurean communication, in which an individual produces a certain signal to elicit a desired response in another, but would fail to produce the same response were that same signal produced for them by another (Hurford, 1989). An example of this may be found in interspecies communication: as Bloom (2000) notes, a dog may respond to its owner's command to "come", but it is unlikely to infer that, were it to produce the same vocalisation, its owner might respond in the same way. Supported by computer simulations comparing the evolutionary stability of Saussurean and non-Saussurean communication strategies, Hurford (1989) argues that an innate predisposition toward Saussurean communication evolved in humans as an adaptation for efficient communication. An implication of this is that children tend to assume that novel words are already known by those around them, a finding confirmed by Diesendruck and Markson (2001), cited by Pinker & Jackendoff (2005a) as evidence of the special status of words. However, this hypothesis is cast into doubt by Diesendruck's (2011) findings that this assumption of prior knowledge extends into other domains such as the correct use of objects and is subject to pragmatic cues, as well as children's general tendency to overgeneralise assumptions of knowledge (Birch & Bloom, 2003). A compelling alternative to Hurford's posited Saussurean bias is presented by Bloom (2000), who argues that word learning is driven by children's nascent theory of mind, specifically their abilities to correct distinguish between intentional, or goal-oriented, and unintentional acts. On this view, children learn from experience that words are bidirectional, having inferred from the example of their caregiver that a given utterance fulfils their goal of referring to its corresponding referent (Bloom, 2000).

The examples given above illustrate that accounts of word-learning do not need to invoke additional, language-specific mechanisms. Therefore, parsimony would suggest that these accounts be favoured. In addition, the "moving target" hypothesis of language evolution, which plausibly states that biological evolution is unlikely to have been able to keep pace with a rapidly changing linguistic environment (Christiansen & Chater, 2008), would seem to preclude language-specific adaptations in the gene pool. However, I would argue that adaptations for word-learning may be an exception to this, as it is hard to imagine the associated selection pressures being subject to as much change as other, less fundamental features of language. If cognitive constraints such as those discussed above can be demonstrated via computer modelling to be evolutionarily stable based on their linguistic function, a case may be made for these constraints being, at least in part language-specific. An example of this might be the mutual exclusivity bias, which has been shown to be evolutionarily stable with regard to linguistic function within a gene-culture co-evolutionary environment, provided its sufficiently frequent occurrence in a population (Smith, 2004). If this constitutes a typical example, which of course it may not, a case may be made for the exaptation of already present, non-domain-specific mechanisms by language-specific selection pressures, simply as a consequence of evolutionary dynamics. If this is found to be correct, domain-specificity should not be ruled out as a possible explanation for features of word-learning.

1484 words (excluding essay question and reference list)

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GRADEMARK REPORT

FINAL GRADE

78/100

GENERAL COMMENTS

Instructor

This is a very good essay - you deal with a good amount of literature approaching the problem from two different perspectives, and while you sit on the fence quite a lot (especially in your concluding section!) there's a clear line of logic here. I also like some of your personal touches / insights, which are exactly what we are looking for at this level, rather than merely regurgitating what you have read. I also like the mix of experimental data with evolutionary modelling.

PAGE 1

Comment 1

Great intro

Comment 2

This little section on differences is good.

PAGE 2

Comment 3

I like this idea, but what about e.g. word learning in parrots, language-trained apes?

Comment 4

Would be nice to get a hint of what the difference in method is.

PAGE 3

Comment 5

How does this follow from the Saussurean sign idea?

Comment 6

Nice

Comment 7

I agree, but would be nice to see the logic spelled out.

Comment 8

You do quite a lot of hedging at the end here - it's appropriate, but it would be good to be a little clearer on which side of the argument you are leaning towards.

PAGE 4

PAGE 5