Protolanguage reconstructed

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One important difference between existing accounts of protolanguage lies in their assumptions on the semantic complexity of protolinguistic utterances. I bring evidence about the nature of linguistic communication to bear on the plausibility of these assumptions, and show that communication is fundamentally inferential and characterised by semantic uncertainty. This not only allows individuals to maintain variation in linguistic representation, but also imposes a selection pressure that meanings be reconstructible from context. I argue that protolanguage utterances had varying degrees of semantic complexity, and developed into complex language gradually, through the same processes of re-analysis and analogy which still underpin continual change in modern languages.

1. Introduction

The controversy over the structure of early human language, and its subsequent transformation into modern language, is essentially a disagreement over the semantic complexity of the proposed units of protolanguage. In this paper, I propose a unified explanation, where the repeated inferential reconstruction of meaning enables the complexification of protolanguage into modern language, providing both a mechanism for the development of linguistic variation and complexity, and a constraint for the level of complexity which can be maintained.

The paper is divided into four main parts: In Section 2, I briefly discuss the two competing accounts of protolanguage, exploring their differences and similarities. In Section 3, I focus on the nature of (proto)- linguistic communication, and argue that any account of complexification must acknowledge the important role played by the inference of meaning. In Section 4, I highlight two important characteristics of inferential communication systems, that they must tolerate variation, and that there is a pressure on utterances that their meanings be reconstructible. In Section 5, I briefly set out how these characteristics can combine to form a unified explanation of the complexification of protolanguage, based on the same mechanisms which still form the basis of modern linguistic change.

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2. The nature of protolanguage

Most scholars agree that there must once have been a predecessor of human language, or protolanguage, which did not contain the complex syntactic structures prevalent in modern languages (Bickerton, 1990; Carstairs-McCarthy, 1999; Hurford, 2003), but they disagree vehemently over the nature of protolanguage, and over how it developed into modern human language. One account characterises protolanguage as containing a limited set of word-like units with simple, atomic meanings (Bickerton, 1990, 1995; Tallerman, 2007), associated with basic pre-exisiting cognitive concepts, effectively the ancestors of modern nouns and verbs. The other account (Wray, 2000; Arbib, 2005), believes that protolanguage units represented complex propositions, more like whole modern sentences. Both accounts assume that individual units in the protolanguage lexicon are mutually distinguishable, but their disagreement over the level of semantic complexity represented by the protolinguistic forms, leads to different visions of how protolanguage could have developed into modern language. These are explored below: briefly, the synthetic account emphasises composing word-like units into sentences, while the analytic account stresses breaking sentence-like units apart into words.

2.1 Synthetic complexification

Bickerton (1990) first proposed protolanguage as an intermediate stage between a non-linguistic state and a fully-fledged modern language. He suggests, moreover, that protolanguage still exists in the human brain, only resurfacing when normal linguistic development fails, as in the emergence of pidgin languages. Each word in his protolanguage refers to a single, simple concept, and although these could have been concatenated together in a "slow, clumsy, ad hoc stringing together of symbols" (Bickerton, 1995, p.65), Bickertonian protolanguage is always characterised as "a lexicon without syntax" (Bickerton, 1995, p.51).

Evolutionary linguists have appealed to attested linguistic processes like grammaticalisation to account for the increase in complexity necessary to produce modern language (Jackendoff, 2002; Hurford, 2003; Tomasello, 2003; Tallerman, 2007). In grammaticalisation, content words like nouns and verbs develop into function words which explicitly mark relationships between words. For example, a particularly common grammaticalisation pattern is the transformation of verbs meaning 'go' into future tense markers, attested in numerous unrelated languages, including Basque, Ecuadorian Quechua, Igbo, Tamil and Zulu (Heine & Kuteva, 2002). Example 1 shows the hypothesised steps for the grammaticalisation of modern English *gonna* from constructions with non-finite complements. Initially (1a), the sentence has two clauses, and a meaning of purposeful directed movement. In

(1b), it has a single clause, where the event occurs in the immediate future. Grammaticalisation processes are often characterised by subsequent formal simplifications, such as phonetic reduction (1c).

(1) a. I am going [to see Bill]. MOTION
b. I am [going to] see Bill. FUTURE, *not* MOTION
c. I am [gonna] see Bill.

The different analyses of the utterance in (1a) and (1b) exemplify the process of *re-analysis*, which is widely recognised as a crucially important mechanism in grammaticalisation, and in language change more generally (Trask, 1996; Hopper & Traugott, 2003). Such re-analyses by speaker and hearer, driven by inferential semantic reconstruction, form the principal mechanism of my account of linguistic complexification, described in more detail in Section 5. Two conditions are required for re-analysis to occur: there must be an appropriate, accessible, pragmatic inference linking the two different analyses; and the communicative episode must be successful. In (1), these conditions apply because events happening after directed movement necessarily happen in the future, and yet this slight difference in interpretation is unlikely to cause communicative failure.

2.2 Analytic complexification

The opposing view, that protolanguage units represent full, complex propositions, and that protolanguage developed into modern language through segmentation, is now most frequently associated with Wray (2000) and Arbib (2005), though its provenance goes back at least as far as nineteenth-century utilitarian Jeremy Bentham, whose unfinished manuscripts display his belief that "single primitive utterances were equivalent to whole sentences" and "linguistic progress … came with analysis, the breaking down of primitive one-word sentences into their component parts" (Stam, 1976, p.42).

(2) a. tebima
'give-that-to-her'
b. kumapi
'share-this-with-her'

Example 2 shows part of a hypothetical holistic protolanguage from Wray (2000), with arbitrary unstructured forms coupled with arbitrary complex meanings. When a coincidental correspondence across more than one form-meaning association is found, then the learner can generalise, segmenting both form and meaning into sub-units, using analogy to create additional rules to allow their recombination. In (2), for instance, the morphological component *ma* and the meaning

component 'her' occur in both holophrases, so a learner can extract these, creating the representation in (3). Segmentation leads not only to the creation of individual words, such as *ma* meaning 'her', but also to more complex, schematic syntactic constructions containing slots with variables.

(3) a. tebi x
'give-that-to' α
b. ku x pi
'share-this-with' α
c. x = ma
α = her

Many computational models (see Kirby, K. Smith, & Brighton, 2004) have demonstrated how the segmentation process can transform holistic languages into structured compositional languages. Holistic protolanguage itself, however, has been subject to much recent criticism, particularly because the segmentation it depends on can only work if both signals and meanings contain sub-units, yet holistic signals are defined by their proponents as unitary, *unstructured* utterances (Tallerman, 2007).

2.3 Semantic complexity

The crucial distinction between the competing accounts, therefore, lies in their initial conditions, specifically in the complexity of the meanings associated with the proto-forms. This defines both the nature of protolanguage, and the putative route of its development into complex language (see Figure 1), whether through

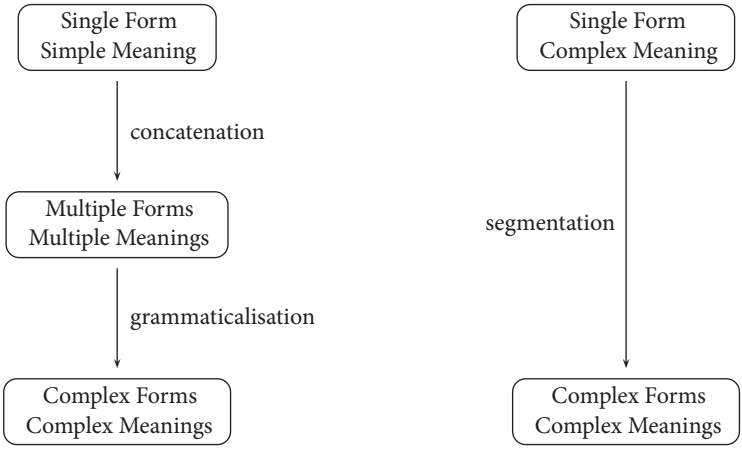

Figure 1. Competing routes for the transformation of protolanguage into modern language.

concatenation and grammaticalisation or through segmentation and generalisation. Reliable information about exactly how semantically complex the stored proto-meanings were would clearly be extremely useful in allowing an informed choice between the two theories. Unfortunately, it is notoriously difficult even for speakers of modern languages to precisely define the meanings of words, and of course we cannot ask any protolanguage speakers, so discussion of the complexity of the meanings associated with hypothetical proto-forms must remain mostly conjecture. At least two characteristics, however, are uncontentious and shared by both accounts: protolanguage consisted of form-meaning associations, and was used communicatively. An investigation into the nature of linguistic communication in general will inform the debate over the likely semantic complexity in protolanguage.

3. Protolinguistic communication

Communication can broadly be regarded as the transfer of meaning from one individual to another, but if meaning transfer was direct and explicit, utterances themselves would be redundant, because they would be devoid of information; communication must clearly involve *indirect* mappings, from meanings into signals and vice versa (A. Smith, 2005). I will describe two important methods used to model communication in evolutionary linguistics: the code model and the inferential model, and will argue that only the latter is a realistic and complete communicative model.

3.1 Coded communication

In the code model of communication, meanings and forms are mutually associated in a code, and can be converted into each other automatically: speakers have algorithms which translate internal meanings into expressible signals, and hearers have equivalent reverse algorithms to decode signals and recover the meanings. For coded communication to be maximally useful, the code must be *unambiguous*, and *shared* by the interlocutors. Ambiguity in a code model undermines its viability, because if two different meanings are encoded with one signal, the recovery of the correct meaning cannot be guaranteed. Likewise, communication fails if the interlocutors' algorithms are not equivalent, and a signal means different things to different individuals.

Could protolanguage have been code-based? Many natural animal communication systems do indeed appear to function like codes: the famous vervet monkeys, for example (Cheney & Seyfarth, 1990), have three different alarm calls, each

corresponding to a different predator's presence. Such codes are both unambiguous and shared, but these very characteristics mean that the systems are also extremely stable, and contain very few form-meaning mappings ó in stark contrast to the enormous expressive capacity and dynamic nature of human language. This discrepancy is perfectly understandable, however, if we consider how difficult it is for code users to extend their code organically, for instance by adding a new concept.

Modern language speakers use several productive mechanisms to add new concepts, like metaphor and metonymy (Kövecses, 2002; Deutscher, 2005). In metaphor, a new concept is understood in terms of an existing concept, through the systematic mapping of the structure of one cognitive domain to another cognitive domain. For instance, we might refer to a leader as the *head* of a group of people, linking the *body* domain to the *group* domain, and mapping the existing head-body relationship to the new leader- group relationship. In metonymy, a distinct or salient part of a cognitive domain is used to represent to a less salient or more abstract concept to which it is tightly linked within the same domain, such as using *the crown* to refer to the concept of monarchy. The dynamic productiveness of such mechanisms, however, mean that they are incompatible with a code model of language; if an innovative user added a new meaning "leader" to the word "head" in their lexicon, and expressed it, communicative failure would inevitably result, unless the hearer simultaneously, without any obvious motivation, added an equivalent lexical entry to their own lexicon before decoding. More fundamentally, both metaphor and metonymy lead inevitably to polysemy, when the existing meaning of a signal is augmented by the innovation, and thence to ambiguity and the breakdown of the code.

The mappings of a code cannot easily be changed, however, without undermining the viability of the code. Even if we allow protolanguage users to have the appropriate creation and linking mechanisms to add to and modify their own code, it is difficult to explain how particular modifications made by one user can spread, with all other users making equivalent modifications. Origgi and Sperber (2000, 2004) claim convincingly that code extensions must be extremely rare (hence the very small size of codes like the vervet alarm system), and can only plausibly occur under very strong functional pressure for the meaning to be unambiguously evident: perhaps the appearance of a new predator. In reality, word meanings are far from unambiguously evident, and the code-based algorithmic model itself is an inadequate, incomplete model of dynamic, expressive communication.

3.2 Inferential communication

The code model ignores one fundamental characteristic of all linguistic communication: the meaning of a sentence is more than the logical meaning suggested by

the words, and additionally contains components drawn from the conversational context (Grice, 1957, 1975). Although the exact semantic nature of protolanguage remains unknown, we can confidently assert that protolinguistic communication, like all linguistic communication, involved the *inference of meaning from context*: the meaning of a proto-utterance was derived from the hearer's discourse world knowledge (Kuteva, 2001), including their perception of the external environment, their pragmatic insights, and their models of cultural and social knowledge.

Coded communication is an exact, algorithmic process of conversion, but inferential communication is inherently approximate (Hurford, 2007). In inferential communication, the meaning is not simply decoded from the speaker's signal, but the decoded signal is instead used as evidence from which the hearer *reconstructs* the meaning in context, inferring the meaning they *think* the speaker intended. Polysemy and ambiguity are not fatal problems in an inferential model, because the precise meaning of an utterance is inferred from context, using general pragmatic principles (Grice, 1975; Sperber & Wilson, 1995). Communicative success is evaluated not in terms of an identity between speaker's and hearer's meaning, but by their perlocutionary effects. Moreover, a system based on inference can be extended relatively straightforwardly, and without communicative breakdown, through metonymy and through metaphors grounded in human experience and motivated by analogy and iconicity (Kövecses, 2002). The inferential nature of linguistic communication has been hitherto neglected by most protolanguage researchers,[1] yet has important consequences, explored in the following section.

4. The consequences of meaning inference

Quine (1960) demonstrated that inferential meaning reconstruction is characterised by semantic *uncertainty*, because the hearer cannot know the exact meaning intended by the speaker.[2] Such uncertainty has two important consequences for the account of protolanguage complexification in Section 5:

1. the hearer's reconstructed meaning can *differ* from that intended by the speaker, as long as there is no communicative failure;
2. there is a selective pressure on utterances, that their meanings be *reconstructible* by hearers.

4.1 Variation

There are many sources of information for the hearer to use in their reconstruction of meaning, including their representation of the world, existing linguistic

knowledge, and the context of the situation in which the signal was uttered. These form a rich collection of highly idiosyncratic knowledge, making it extremely unlikely that the speaker's relevant collected knowledge will be identical to the hearer's. In most communicative episodes, therefore, the speaker's original meaning and the hearer's reconstruction of the meaning will differ, at least to some extent: linguistically, this is equivalent to the hearer having *re-analysed* the utterance.

I show, in computational models of inferential communication (A. Smith, 2005, 2007), how simulated language users develop their own conceptual representations based on their experience in an external world; speakers communicate about events in the world, and hearers infer the meanings of utterances from context. The individual creation of meaning produces significant variation in the resultant conceptual representations, while the uncertainty inherent in inferential communication also yields significant variation in the lexical associations made. Despite these conceptual and lexical differences, which render the language susceptible to rapid change, however, it remains communicatively viable.

4.2 Reconstructibility

Semantic reconstruction provides a mechanism for the development and maintenance of linguistic variation, long recognised as the driving force behind the continual regeneration of language (Trask, 1996). Moreover, it imposes a vital *constraint* on the level of linguistic complexity which can be maintained between interlocutors, and thus provides a possible criterion against which to judge the plausibility of proposed proto-utterance meanings.

The hearer's reconstruction of the speaker's intended meaning, and its association in a form-meaning mapping, is, following Croft's (2000) evolutionary model, a replication of the speaker's original mapping. This replication is the mechanism by which form-meaning mappings survive: those whose meanings cannot be successfully replicated die out, and those whose meanings *are* reconstructible from context are preferentially replicated. Over many episodes of linguistic usage, therefore, the language adapts to its means of transmission. Much discussion of usage-based models of language change centres on the locus of change, and a distinction can be made between theories focussed on speaker-driven innovation (e.g. Traugott & Dasher, 2005) and those based on hearer-driven innovation (e.g. Kuteva, 2001). My emphasis here, however, is not on where language change starts, but on its propagation. The *locus of replication* resides with the hearer: all linguistic innovation is replicated only through hearer reconstruction.

So what kind of meanings are more easily reconstructed from context? There is much evidence that humans conceptualise objects and actions most readily at a basic level of categorisation (Rosch, Mervis, Gray, Johnson, & Boyes-Braem,

1976), by using idealised cognitive models of the world (Lakoff, 1987). Basic level categories, exemplified by categories like 'dog' or 'chair', contrast both with more general categories like 'animal' and 'furniture', and more specific categories like 'spaniel' and 'deckchair'. They are cognitively more salient, maximally informative in distinguishing objects and actions, and more easily and quickly learnt by children (Taylor, 1995). Many disparate suggestions for the meanings of early protolanguage utterances have been proposed, from simple representations of tangible things and actions in the synthetic account, like 'spear' or 'eat' or 'antelope', through the more complex 'give that to her' (Wray, 2000), to exceedingly elaborate suggestions like 'go and hunt the hare I saw five minutes ago behind the stone at the top of the hill' (Mithen, 2005, p. 172) and 'take your spear and go round the other side of that animal and we will have a better chance of being able to kill it' (Arbib, 2005, p.118–119). There is an obvious mismatch between the latter meanings and the very simple meanings most happily learnt by humans, based on basic-level categories.

In modern language, all the above meanings are clearly expressible, but elaborate meanings like 'go and hunt the hare I saw five minutes ago behind the stone at the top of the hill' are reconstructible only *because of* the cues provided in the utterance's detailed linguistic structure. A unitary holophrase contains no structure by definition: context and general pragmatics provide the only evidence for semantic reconstruction, and it is implausible in such circumstances that any meaning could be reconstructed to such a degree of specificity, complexity and intricacy. On the contrary, it seems reasonable that, without linguistic cues, the more complex and elaborate the semantic representation, the *less* likely the meaning can be faithfully reconstructed. The appropriate level of complexity for meanings reconstructed on the principles described by Grice (1975) and Sperber and Wilson (1995) is one sufficient for successful communication, allowing relevant distinctions to be made, yet not unnecessarily elaborate. Very complex meanings *may* be recoverable from context occasionally, but the pressure of semantic reconstructibility on a language still applies: even if an individual did manage to infer a highly complex meaning from an unstructured form, this meaning would have almost no chance of being *repeatedly replicated* across communicative episodes and by different individuals, and would very quickly disappear from the language used in the population. Unitary, unstructured utterances can only reliably be associated with highly salient, *relatively simple* meanings, as they must be reconstructible without any linguistic cues.

Looking through the prism of reconstructibility has given a rather negative view of holistic protolanguage thus far, with the elaborate nature and extreme semantic complexity of many proposed holophrases contributing greatly to undermining their own case. Defining semantic complexity is not straightforward,

however, not least because there are many ways of representing the same situation, and indeed no obvious limit to the possible levels of specificity and elaboration; simple, basic meanings like 'eat' can be reconfigured highly precisely and specifically if desired, as in dictionary definitions: 'to take into the mouth piecemeal, and masticate and swallow as food' (Simpson & Weiner, 1989). These semantic representations clearly fall along a continuum of elaboration, and the position of a meaning along this continuum is important in gauging the likelihood of its being reconstructed. This means that if a unitary utterance's meaning has a single semantic component, for example something we might represent as 'eat', then the meaning is relatively likely to be reconstructed, but is unsegmentable; conversely if it has many semantic components, like the dictionary definition above, then it is segmentable, but it is relatively unlikely for all of its components to be reconstructed. The processes of metaphor and metonymy described above are themselves constrained by reconstructibility: any new coinage must be understood in order to be replicated, and so must be relatively predictable, and built on the interlocutors' assumed shared knowledge.

We can consider the number of semantic components in a meaning as a rough guide to the meaning's complexity (as is done in the examples in the remainder of this paper), always recognising that the level of semantic complexity is *constrained* by the need for each component to be reliably re-constructed. Reconstructibility, however, also makes it possible for meanings with several different levels of complexity to co-exist in a linguistic population; each meaning can persist as long as all its semantic components are reconstructible, and the meaning as a whole is communicatively successful.

5. Complexification

The development of protolanguage into language requires the introduction of complexity in both form and meaning. I now discuss how these can enter a structureless linguistic system, and how abstraction and generalisation can create linguistic constructions, allowing additional structure to develop.

5.1 Semantic complexification

In a holophrastic protolanguage of unitary utterances, linguistic forms have no structure, and their meanings must be reconstructed *solely* from context. Semantic complexity can enter such a system only if new meaning components are sufficiently salient and important to be reliably and repeatedly inferred from context. For example, a speaker might use an unstructured utterance to mean [ANTELOPE],

while the context shows clearly that the antelope in question has just been killed by a group of his colleagues for food. In such circumstances, it is reasonable to assume that [DEAD] is also a sufficiently salient semantic component, that the hearer might reconstruct the meaning as [DEAD ANTELOPE] or [ANTELOPE LET'S-EAT], with multiple semantic components, and that the episode may succeed communicatively despite the discrepancy between the internally stored meanings.[3]

A comparison of these internal meanings stored by speaker and hearer would show an increase in semantic complexity. Such complexity could only remain in the protolinguistic system if each semantic component continued to be reliably and repeatedly reconstructed; if the utterance were regularly used in the context of dead antelopes killed for food, the more complex meaning might become entrenched in the language. Even if it persisted for a while, however, it might still disappear if used in a context where it is no longer sufficiently salient, and semantic reconstruction yields the *simpler* [ANTELOPE] or [FOOD].

The inferential model of communication therefore allows bidirectional change in the semantic complexity of proto-utterances; in each communicative episode the meaning can become simpler or more complex (or indeed remain the same). But if unitary utterances can readily move throughout the space of semantic complexity, the difference between the accounts of protolanguage is no longer so fundamental. It is perhaps better to regard protolinguistic meanings as mapping onto a continuous scale of semantic complexity and elaboration, and reconstructibility as a pressure which constrains them towards the simpler end of this scale. Protolanguage was probably not semantically monolithic, but could have contained words with many different levels of semantic complexity.

5.2 Syntactic complexification

For protolanguage to grow beyond a simple set of unitary utterances, however, structure must also be recognised in the signal. In the holistic account, individuals recognise chance similarities between segments in forms, although the very existence of segments in *unstructured* utterances is problematic (Tallerman, 2007).[4] A more promising account stems from a strictly Bickertonian protolanguage, where a speaker's lexicon contains only simple words associated with atomic concepts. Figure 2 shows a communicative episode with two words uttered consecutively within a short timescale. Barring an implausibly strict convention of turn-taking between interlocutors, indeed, natural discourse process will ensure that the utterances are effectively concatenated, and may therefore be interpreted, or re-analysed, by the hearer as a single utterance. For the hearer, therefore, the utterance is no longer unitary, but (minimally) *structured*, being composed of the two original forms as sub-units of a more complex structure.

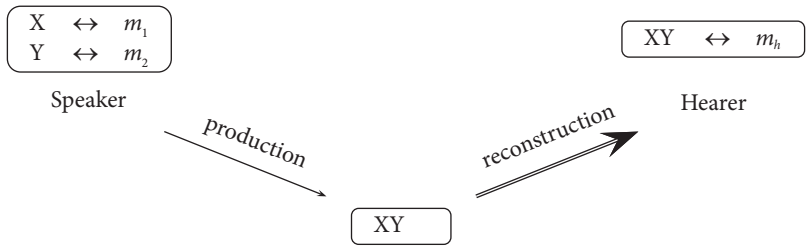

Figure 2. Two unstructured Bickertonian protolanguage items (X and Y) are uttered consecutively, and re-analysed as a single structured form, whose meaning m_h is reconstructed from context.

Concatenation thus leads to the emergence of structured utterances, as noted by Jackendoff (2002). The emergent structures have an inherent linear ordering, and once signal and meaning are *both* structured, then the system meets the conditions necessary for Wray's (2000) analogical segmentation to take place; the learner can take advantage of coincidental correspondences to abstract across instances of use to create basic schematic, construction-like, mappings.

5.3 To language

Schematic mappings have an advantage over unstructured signals, as they too form part of the linguistic context against which meanings are reconstructed. Frequently used mappings become entrenched, enhancing the reconstructibility of more complex meanings. Figure 3 shows the same signal being presented to two hearers: for hearer A, the signal has two distinct segments X and Y, where X forms part of a mapping already in their lexicon; for hearer B, the signal remains an unanalysed whole. Hearer A can extract part of the meaning from its existing lexical mapping, and part from the non-linguistic context; for hearer B only the latter is available. Both reconstructions from context will, other things being equal, be similar in complexity, but hearer A can always reconstruct a meaning with an additional meaning component than can hearer B.

As the lexicon develops more schematic mappings, the system itself develops more linguistic complexity. This complexification is consistent with cognitive approaches to linguistics (Goldberg, 1995; Croft, 2001), and is very similar to how children use pivot schemas like 'all gone X' or 'X off' in the initial stages of building their language (Tomasello, 2003), before developing increasingly complex constructions as their linguistic repertoire and their inferential, intention-reading capacities improve. Although it is unlikely, therefore, that a very complex meaning like 'take your spear and go round the other side of that animal and we will have a better chance of being able to kill it' can be reliably and consistently reconstructed

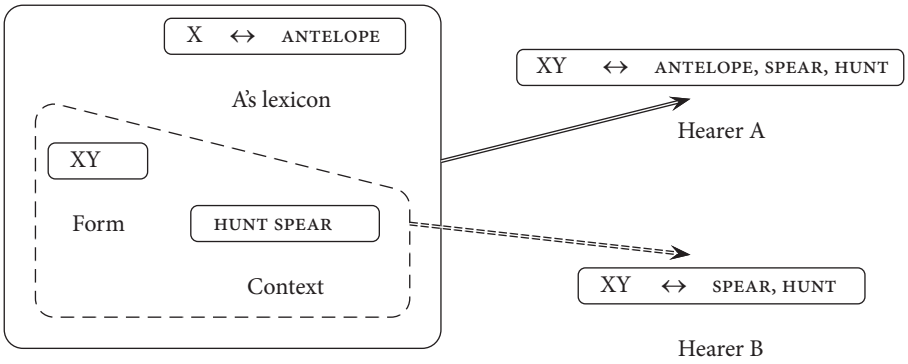

Figure 3. A single form (XY) is presented to two hearers. Hearer A can derive part of the meaning from a mapping in their lexicon, and can therefore reconstruct a more complex meaning than hearer B, who can use only the context.

for an utterance with *no* morphological structure, it is much more plausible that such a meaning can be reconstructed if the hearer's inferences are supported by existing linguistic knowledge including schematic fragments like 'take X', 'behind X' and 'X can do Y'. The problem with existing holistic accounts of protolanguage, therefore, is not in the analytic process itself, which is indeed a powerful and proven mechanism for abstraction and analogical generalisation, but in the implausibly elaborate semantic structures proposed for unstructured utterances.

In order to be successfully replicated and spread through a community, linguistic structure cannot appear from nowhere. Re-analysis, namely the differential

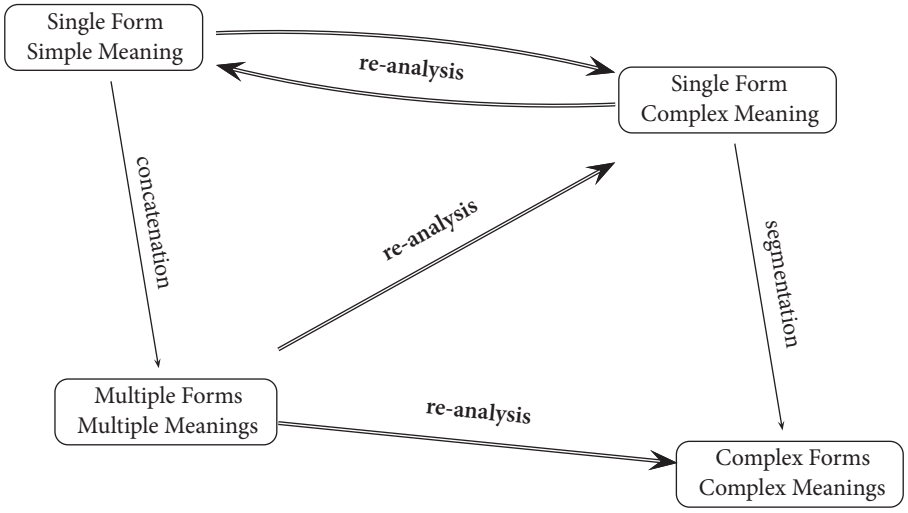

Figure 4. A unified account for the complexification of protolanguage based on re-analysis.

reconstruction of meaning by speaker and hearer, is the inevitable result of the inferential reconstruction of meaning from context. Hopper and Traugott (2003, p.39) have described re-analysis as the "most important mechanism for grammaticalization, as for all language change", but more than this; it is the mechanism which can also account for the transformation of protolanguage into language. Re-analysis can enable both bidirectional change in the semantic complexity of utterances, and the emergence of syntactic structure and linguistic constructions from unstructured utterances. Figure 4 shows re-analysis in this role, as the unifying factor combining the competing synthetic and analytic accounts into a single explanation of the complexification of protolanguage.

Under this unified account, there is no clear dividing line between protolanguage and modern language, rather the latter emerges slowly, both driven by, and constrained by, the reconstruction of meaning.[5]

6. Conclusion

Linguistic communication is fundamentally inferential; the meaning of an utterance is reconstructed from the context in which it is used. This inferential nature has two important consequences: variation in semantic representations, or re-analyses, can be supported without communicative failure; and there is a selection pressure for meanings to be reconstructible, so that they can be replicated over repeated episodes of use. Semantic complexity can emerge in the (proto-)linguistic system if additional meaning components are sufficiently salient to be reliably reconstructed; syntactic complexity can emerge initially through the interpretation of multiple unitary utterances as a single structured utterance.

Reconstructibility can combine the competing theories of protolanguage complexification into a united explanatory mechanism, which emphasises stable linguistic variation and uniformity of process. Protolanguage probably contained units with varying degrees of semantic complexity, and its complexification into modern language was a gradual process of increasing complexity arising from discourse, through the same processes of re-analysis and analogy which underpin contemporary language change.

Acknowledgments

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Notes

1. Bickerton does refer to "functional considerations" in the absence of syntax (Bickerton, 1990, p.123), and Jackendoff acknowledges an inferential ingredient in the meanings of two-word utterances being "dictated purely by context" (Jackendoff, 2002, p.246), yet neither acknowledges that *all* (proto-)linguistic communication is inferential, nor that this may hold the key to a unified explanation of protolanguage's development into modern language.

2. An anonymous reviewer points out that Quine's uncertainty is not unlimited in practice, as no language has a word for 'undisconnected rabbit parts'; in Section 4.2 I claim that it is the repeated reconstruction of meaning from context which constrains this uncertainty, effectively ruling out irrelevant meanings, and allowing the negotiation of linguistic convention.

3. For ease of exposition, I have chosen in this paper to represent semantic complexity simply by the number of semantic components, so that, for example, a meaning with three different components is more complex than one with just two components. This is of course a very simplified semantic model, but the arguments are equally valid for any model which can represent different levels of semantic complexity (however this might be defined).

4. This may not be insurmountable, as both young children (Saffran, Aslin, & Newport, 1996) and tamarins (Hauser, Newport, & Aslin, 2001) can recognise potential words, so the required cognitive capacities are not necessarily language- or even human-specific.

5. It is beyond the scope of this paper to discuss why other primates lack the requisite inferential abilities which lead to language, although Tomasello, Carpenter, Call, Behne, and Moll (2005) argue persuasively that the crucial difference stems from great apes' lack of motivation to collaborate in activities involving shared intentionality.

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