

# From inner cognition to outer speech: An evolutionary perspective

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## ABSTRACT

The origin of speech, in ontogenic terms, is the human brain: there seems to be a system inside the brain which connects an interior modelling of reality with a signalling capacity, allowing individuals to express their models and thus share them. There must therefore be, as the generative tradition maintains, cognitive mechanisms that generate outer speech from inner resources.

However, the generative proposal, that these inner cognitive resources must be dedicated solely to language, encounters problems when a phylogenetic view is adopted. Evolutionary calculus imposes limits on evolved capacities: they must usually have continuity with precursor capacities; and they must serve a function that enhances individual survival. These Ultimate Mechanisms of Behaviour (Tinbergen, 1963) are largely ignored by the generative language engine, which has no precursors and no function other than itself. While the generative proposal simplifies the path from inner cognition to outer speech, it does so largely by ignoring general cognition and evolutionary demands.

If a language engine exists, it must act as a conduit between the internal semantics of the mind and the external semiotics of society; between the syntactic requirements of cognition and the grammatical needs of communication; and between the internal labelling of identity and external cultural gestures of naming and representation. It must use cognitive resources and modes of expression that have their own evolutionary history, and it must itself have a function beyond just language.

This poster reviews some of the features of outer speech and relates them back to inner cognition, attempting to explain the transition from inner to outer in terms of evolution and pre-existing cognitive capacities. Each capacity is considered in terms of its cognitive precursors, its evolutionary fitness, and its function for the individual. From these features a transformational language engine is proposed, which is neither monolithic nor specialised.

## ESTABLISHING THE GROUND RULES

Grammar is a complex phenomenon. This should come as no surprise, the communicative demands it has to accommodate are themselves complex: language needs a wide-ranging expressivity to allow for the sharing of utterances able to describe every aspect of being human in a human culture.

And yet there are regularities in the grammars of different languages which point towards a concept of 'grammar' rather than 'grammars'. Certain word types (e.g. nouns and verbs) and utterance forms (e.g. two-argument constructs) recur in most, if not all, human languages; and the communicative functions (e.g. questioning, manding, describing) are capacities which seem to be needed in all modern languages<sup>1</sup>. This regularity between languages has, however, also led to some of the big myths of linguistics: that all languages are descended from a single

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<sup>1</sup> Bernd Heine & Tania Kuteva (2007). *The Genesis of Grammar: a reconstruction*. Oxford University Press: Oxford, UK. Chs2&4.

linguistic source which determined the forms of all descendant languages; that the regularity of grammar forms indicates an innate capacity for language in humans; and that grammar represents a cognitive capacity that is species-specific to humans. These are myths not because they are untrue but because they remain – currently – unproven speculations; and, therefore, other myths are possible.

Common to all these regularity myths is the hopeful theory that language grammar represents a single system. Although, on one level, the features of grammar are disparate and varied, the way they work together indicates some kind of cohesion at another level<sup>2</sup>. It is this cohesiveness that makes language grammar appear to be a monolithic system; but, as any biologist can attest, the evolution of a complex, cohesive system does not need all its components to evolve simultaneously, or even for the same purpose.

Trying to explain language origins using modern languages as models may therefore be akin to explaining the origins of wheeled transport with reference only to the automobile. So let us, for now, step back from an all-encompassing view of grammar and ask some simpler questions: what are the basic cognitive “bricks and mortar” out of which the simplest grammar could be built? And what socio-cultural conditions would make sharing these simple cognitive models evolutionarily advantageous?

If we consider language in the simplest way possible, then it consists of only three functions: it is segmented, in that it is composed of discrete units which can be used combinatorially; it is differentiated, in that the discrete units are not all of one type – at the very least there seems to be the need to separately identify the roles of object and action; and it is hierarchical, in that the combinations of units form units at higher levels – in its basic form, objects and actions are combined into events. These three functions are often grouped together under the title of combinatoriality, but by identifying them separately we can see that combinatoriality can be viewed as an emergent quality of the other three functions.

Having established the parameters of our search for grammar we can now look at cognition and ask, what features of cognition are likely to require segmentation, differentiation and hierarchy, and are also good candidates for sharing between individuals? The obvious candidate of tool-making certainly requires a segmented, differentiated and hierarchical view of the universe<sup>3 4</sup>, but it lacks two important ingredients: deferred reference and communicative continuity. The easiest way to teach tool-making is by example, so the components of the tool and the processes

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<sup>2</sup> Derek Bickerton (1990). *Language and Species*. University of Chicago Press: Chicago, Ill, USA. Ch1.

<sup>3</sup> Ingar Brinck (1999). Attention and tool-use in the evolution of language. In *Festschrift for Peter Gärdenfors*, <http://www.lu.se/spinning/categories/language/Brinck/index.html>.

<sup>4</sup> Scott H Frey (2008). Tool use, communicative gesture and cerebral asymmetries in the modern human brain. In *Phil. Trans. R. Soc. B* (2008) 363, pp1951-1957.

by which it is made need to be immediate to the teaching; and, when the teaching is done, there is no need for continued dialogue. Tool-making requires segmentation, differentiation and hierarchy, the three basic components of grammar; and, when taught, it does require a communication system able to handle those three components. It does not, though, require a system of grammar able to integrate the components into a system of event descriptions – it does not use them in a linguistic way.

A better candidate as a precursor for language grammar would be social calculus, the sharing of which requires a communication system that is segmented (able to recognise individuals), differentiated (able to recognise relationships between individuals), and hierarchical (able to recognise each relationship between individuals as a discrete event). When communicated, social calculus also shares other features with language: it requires the capacity to exchange relationship events in the absence of the individuals modelled within them, so the labelling system used has to be in some way representative, a precursor of symbolism; and the dynamics of social relationships mean that shared models are subject to frequent change, so need to be shared repeatedly.

Sharing social models does raise important evolutionary issues that need to be explained, such as why the sender should give away valuable information, how the receiver can ensure they are not exploited by the sender's dishonesty, and how the object and action representations are agreed between sender and receiver. Although vital to an understanding of language origins, these pre-communicative problems will be presumed solved for the purposes of this paper and will not be addressed here (see Edwardes 2010<sup>5</sup> for their discussion). However, their absence should not be taken to imply that they are unimportant – they remain vital issues in the origin of language, and deserve a fuller treatment than can be given here.

## **SOCIAL CALCULUS**

The model of language grammar under consideration here is a simple mechanism for exchanging social models between individuals. Behind that mechanism, however, there has to be a cognitive engine available to the sender and receiver which is capable of accumulating, computing and manipulating the social models<sup>6</sup> – some form of social calculus device.

The simplest form of social calculus involves the relationship of the self to others

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<sup>5</sup> Martin Edwardes (2010). *The origins of Grammar: an anthropological perspective*. Continuum: London, UK.

<sup>6</sup> Andrew N Meltzoff (1990). Foundations for developing a concept of self: The role of imitation in relating self to other and the value of social mirroring, social modeling, and self practice in infancy. In D Cicchetti & M Beeghly (eds), *The Self in Transition: infancy to childhood*. University of Chicago Press: Chicago, Ill, USA. pp139-164.

**[BOX A].** In this simple form the self can be an unmodelled entity because it is a constant. When the self is the centre of an individual's universe there is no need – or use – in recognising its existence. There is also no value in separately identifying the modelled other and the emotion felt by the self toward that other: the way I feel about you is intrinsic to my relationship with you, so intrinsic to my modelled you.

However, the ability to separate the modelled other from my feelings toward that other does give me two modelling advantages: first, I can change my feelings toward you without fundamentally reassessing my model of you; and second, I can identify individuals to whom I have the same feelings, so I can identify my friends and enemies as groups, and not just as unlinked individuals. This advanced state of self-centred social calculus is the start of the road towards language.

So, in its advanced state, Relationship-B social modelling requires segmentation and differentiation working together in a one-argument form. The advanced state is also the first stage in building a truly Machiavellian social awareness, in that it involves recognition of the “selfness” of others<sup>7</sup>. It is not, however, a communicable model because it is too centred on the needs of the modeller, it contains no shareable viewpoint to become the basis of communication. This requires a more sophisticated cognitive modelling.

The next step in social modelling extends the one-argument form, and recognises that others interact with each other, not just with me **[BOX B]**. This involves a major change in the social calculus engine, and may require a supplementary system rather than improvements to the Relationship-B modelling capacity. There are clear advantages in being able to use this model, though, as it allows me to anticipate the reactions of unknown others towards me based on their reactions to known allies and enemies. However, the relationship recognised between two others in an A-Relationship-B model may be very different to my relationship toward either of the parties in my Relationship-B models, so the relationship between others has to be recognised without reference to my own feelings – there has to be a level of disinterest in my A-Relationship-B modelling, both of the individuals and of the relationship between them.

There is segmentation and differentiation in A-Relationship-B modelling, as there is in advanced Relationship-B modelling. However, while these components enhance Relationship-B modelling, A-Relationship-B modelling cannot work without them. The two entities in the model must have a separate (segmented) existence in my cognition, so that I can place them in other A-Relationship-B constructs with other entities and know that the entities are continuous between constructs. This means that the relationship part of the construct must also be

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<sup>7</sup> Richard Byrne (1995). *The Thinking Ape: evolutionary origins of intelligence*. Oxford University Press: Oxford, UK. Ch13.

segmented – it has no continuous relationship with the identities of either A or B, a different relationship applies in each construct. This inevitably means that I must have two different segment stores, one for entities and one for relationships – in other words, there must be differentiation between entities and relationships.

There must also be a simple form of hierarchy, in that the A-Relationship-B event is a entity containing entities. A modelling memory must be available to store the events in a way that links them to the stores for entities and relationships. Although the modelling within each event is linear, this form of modelling offers the potential for building complex webs of interrelated events, an effective social calculus for negotiating membership of a large group.

## SHARING THE MODELS

At some point something amazing happened: humans began exchanging their two-argument models [**BOX C**]. How we came to share social models is not an issue that can be addressed here, but it can, at least, be justified in terms of evolutionary fitness selection. Sharing models, from the sender’s point of view, is a fit strategy if it enhances the reproductive success of the sender, and this can come about in three ways: by sharing only with close relatives, thus advantaging individuals with common genes (kin selection); by sharing only with those who share back, thus mutually enhancing the chances of reproduction (reciprocal altruism); or by using the sharing as evidence of “spare capacity”, indicating that the sender is able to resource themselves and still have plenty left for mates and offspring (costly signalling). It is not easy to envisage a circumstance in which sharing cheap information can be viewed as costly, and sharing only with relatives is certainly not how we use information today. However, although reciprocal altruism is likely to have been the main driver of social model sharing, it is probable that all three fitness mechanisms have been involved at different stages in the evolution of modern language<sup>8</sup>.

There are also the issues of ensuring honesty in signalling, and of negotiating to a common code. As stated before, these will not be addressed here; but Scott-Phillips *et al* have shown in an elegant experiment that, where there is co-operation in honest signalling, negotiation to a common code can be remarkably fast and efficient (2009)<sup>9</sup>.

The communication of social models has important implications for both language development and cognition. For language, the existence of a communicative environment means that the existence of the receiver has to be acknowledged.

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<sup>8</sup> Michael Tomasello (2009). *Why We Cooperate*. MIT Press: Cambridge, Mass, USA. Ch1.

<sup>9</sup> Thomas C Scott-Phillips, Simon Kirby & Graham R S Ritchie (2009). Signalling signalhood and the emergence of communication. In *Cognition* 113 (2009), pp226–233.

	INSIDE SELF (1)	COMMUNICATION EVENT	INSIDE SELF (2)	LANGUAGE EVENT	COGNITION EVENT
<b>A</b>	<p><b>RELATIONSHIP-B MODELLING</b> <i>(The relationship of the unmodelled self with another)</i></p> <p>This involves the capacity to differentiate between individuals, and to attach an emotional response to each individual. There does not need to be segmentation of individual and emotional response, they can be collocated; but there are cognitive advantages in segmentation.</p>			<p>One-argument form</p> <p>Segmentation</p> <p>Differentiation</p>	<p>Social awareness</p>
<b>B</b>	<p><b>A-RELATIONSHIP-B MODELLING</b> <i>(The relationship between two others)</i></p> <p>This relationship expresses a modelled emotion between A and B, it is not the emotion from the self towards either A or B. This cognition requires segmentation, differentiation and simple hierarchy. All A and B roles are third person.</p>			<p>Two-argument form</p> <p>Simple Hierarchy</p> <p>3<sup>rd</sup> Person</p>	<p>Linear modelling</p> <p>Modelling memory</p>
<b>C</b>	<p>The sharing of A relationship-B models expands the social knowledge of the Receiver, but it is only possible if:</p> <ol style="list-style-type: none"> <li>1. there can be negotiation to a common meaning between Sender and Receiver;</li> <li>2. only relatives are told, or there is reciprocity in telling, or telling is a recognised costly signal (i.e. telling enhances the fitness of the Sender);</li> <li>3. telling is honest.</li> </ol>			<p>2<sup>nd</sup> Person as object – the Sender can offer models of the Receiver as the recipient of the relationship action</p>	<p>Signalling non-present information</p>
<b>D</b>			<p>Receiving honest A-relationship-B models expands the social knowledge of the Receiver, thus enhancing their fitness.</p>	<p>Telling-about</p>	<p>Merging received models with own models</p>
<b>E</b>			<p><b>EVALUATING THE SIGNAL</b></p> <p>There is the possibility of the 2<sup>nd</sup> person object model being recognised by the Receiver as a model of themselves as recipient.</p>	<p>1<sup>st</sup> Person as Object</p>	<p>Disinterested awareness of self as object</p>

	INSIDE SELF (1)	COMMUNICATION EVENT	INSIDE SELF (2)	LANGUAGE EVENT	COGNITION EVENT	
<b>F</b>			<b>SELF MODELLING</b> The Receiver becomes able to use the model of themselves in the Sender's signal as the basis for their own model of themselves.	1 <sup>st</sup> Person as Subject	Awareness of self as instigator of relationships	
<b>G</b>			<b>EVALUATING THE SENDER</b> To ensure honesty, the Receiver must be able to track the source of information received. They can then check the reliability of the Sender by comparing the information they have given against future information or learning. Every A-relationship-B model must be taggable by Sender, making A-relationship-B-by-C models.	Three-argument form Modality	Theory of Mind	
<b>H</b>			<b>A-RELATIONSHIP-B-BY-C MODELLING</b> <i>(The relationship between two others governed by a third)</i> The special role of the teller can be recognised.	Complex Hierarchy 2 <sup>nd</sup> Person as subject	Two-dimensional modelling Awareness of self as fourth person	
<b>I</b>			Sharing A-relationship-B-by-C models allows the Sender to mitigate the honesty of shared second-hand information – the Sender does not risk their own reputation in telling. By preserving their personal reputation the Sender enhances their fitness.		Adverbials & Adjectivals	Disembodied knowledge
<b>J</b>			Receiving A-relationship-B-by-C models improves the quality of the Receiver's social knowledge, thus enhancing their fitness.		Interpersonal metafunction	Opinion recognition
<b>K</b>	<b>EVALUATING EVALUATIONS</b> The Receiver must be capable of building complex models which can vector in the honesty of the firsthand speaker and the honesty of the secondhand speaker.		Textual metafunction	Modality calculus		
<b>L</b>	<b>A-RELATIONSHIP-B-BY-C-BY-D MODELLING</b>		Recursion Ideational metafunction	Multi-dimensional modelling		

There is now a 2<sup>nd</sup> person, “you”, as a special case of the undifferentiated third person, “they”, which is all that is required for unshared cognitive social models. Unlike the fixed identities of cognition, this 2<sup>nd</sup> person role can be reallocated to whoever is the current receiver – it is a relative symbol representing not the individual but the role of the individual.

For cognition, the sharing of social models requires the foregrounding of individuals who are not currently present. The sender and the receiver have to be able to associate the entities in the signal with their cognitive models of the entities, so the entities in the signal have to stand in place of the actual people as stimuli for the entity models, making the signal entities representational symbols<sup>10</sup>.

With truthful signalling of social models, several important cognitive functions become available to the receiver. First, personal social knowledge is enhanced. This does, though, require the capacity to merge second-hand received signalled models into your first-hand experiential social knowledge net, and the easiest way to achieve this would be to treat the two sources of information as equivalent. Effectively, telling-about has to have the same effect for the receiver as finding-out, which implies that the visual stimulus of seeing social relationships enacted must activate the same semantic mechanisms as hearing the shared social models. This does seem to be the case as, once absorbed into our social model, we do not seem to commonly tag social information with its source – we often cannot remember whether the source of our prejudice is gossip or experience.

Some of the social models shared could pose a particularly interesting problem for the receiver [**BOX E**]. The sender is sharing entity models which are, for them, all 3<sup>rd</sup> person; but one of these 3<sup>rd</sup> person entities in the sender’s cognition is going to be the receiver. So the receiver may be receiving modelled events which include themselves, and somehow they must become able to accommodate this model of themselves within their social calculus. This means that they have to see themselves as the sender sees them: in a disinterested way, as objects in their own social modelling – they have to be able to see themselves represented in signalling as an object within the signal.

This inevitably leads to a modelling of the self by the self, but with recognition that the self in the model co-identifies with the real self [**BOX F**]. This modelled self can be recognised as both an acted-upon object in the signal, and as an instigator of actions in the self’s cognition, allowing the self to recognise the 1<sup>st</sup> person role as the subject in modelled events.

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<sup>10</sup> Michael Tomasello (2008). *Origins of Human Communication*. MIT Press: Cambridge, Mass, USA. Pp282-295.

## NEUTRALISING DISHONESTY

All of this works if the receiver has no problem with the honesty of the sender's signal; if the receiver can rely on the accuracy of messages then there is no need for anything more in this communication system. However, even if the receiver can guarantee the sender's honesty, they cannot guarantee that the social models being offered are reliable. The messages are, by their nature, opinions rather than actualities – they are interpretations of relationships between two individuals by a third. So how can the receiver accommodate dishonesty or unreliability?

It would be useful if the receiver could vector the 3<sup>rd</sup> person into their version of the social model, at least until the truth values in the offered social model can be verified. To do this, the receiver has to tag each received social model with the identity of the sender, giving A-Relationship-B-by-C models [BOXES G & H]. This is not a trivial extension to cognitive social models, however, it alters the whole nature of the modelling. Instead of simple linear models, which are subsumed as events at a higher level, the model itself has to be two-dimensional and hierarchical. The A-Relationship-B model has to be an even taggable with the identity of the sender, and this A-Relationship-B-by-C model has to also be identifiable as an event.

This new form of social modelling opens up a range of new cognitive and linguistic capacities. First is the three-argument form, which is often seen as the default form of language utterances – although it remains, at this stage, a cognitive effect. The second effect relates to the role of the sender in the receiver's model: as an entity being modelled in terms of the information they are telling, the possible intentions of the sender have to be foregrounded in the receiver's social calculus. The 2<sup>nd</sup> person voice, you, has to be recognised as the instigator not just of an utterance but of an intended meaning in the utterance; and this adds a new way to interpret the utterance. The key value of the utterance is no longer the information in the utterance but the intention behind it: even dishonest utterances become information-rich if the dishonesty is detected and the intention of the sender is considered.

This also opens up a further possibility: if other entities can be modelled as having intentions, and the 1<sup>st</sup> person role can be modelled as an "other entity" then the intentions of the self can be modelled by the self<sup>11</sup>. The modelled self becomes a considered engine of self-awareness, and can be approached in a disinterested way. If the self is also modelled as a producer of signals – a sender – then it can be viewed as 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> persons in a signalling event. Most importantly, it can also be modelled as the maker of these models, a "4<sup>th</sup> person" role. A complex iteration

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<sup>11</sup> J Scott Jordan (2003). Emergence of self and other in perception and action: an event-control approach. In *Consciousness and Cognition* 12 (2003), pp633-646.

becomes possible between these different roles, and a detailed awareness of selfhood emerges. This selfhood is not egocentric, the 4<sup>th</sup> person perspective ensures disinterest and creates further possibilities which are not examined here: awareness of the group as an entity, non-reciprocal altruism, and possibly abstracts such as religion. Becoming aware of selfhood as a multi-dimensional system of roles cultivates becoming human in crucial ways<sup>12</sup>.

## SHARING COMPLEXITY

What happens when these two-dimensional social models are shared? [BOXES I & J]. The simple communication system for sharing A-Relationship-B models needs to be augmented, but this can be done by negotiated trial-and-error; the cognitive capacities for three-argument modelling must pre-exist the signalling need, all that is required is a convention on how to express the two-dimensional calculus of A-Relationship-B-by-C in a one-dimensional stream of sound. This sharing of new models will, however, only happen if there are fitness advantages for both sender and receiver in sharing these new models. Fortunately, there are candidates. The advantage for the sender is that these models offer deniability. If I offer you an A-Relationship-B model, you have no way of knowing whether it represents my own first-hand knowledge, or hearsay knowledge I am repeating. By saying “C says A relationship B” I am distancing myself from the reliability of the knowledge, preserving my reputation, and placing the interpretive onus on the receiver. The advantage for the receiver is that the message is richer, containing triangulations of information rather than just strands.

Out of this new type of signal comes the possibility of adjectivals and adverbials. The introduction of explicit reliability into the message has opened it up to mitigation and description, because the model being offered by the sender is not necessarily knowledge they believe. It is offered in a disembodied way, as information existing beyond the sender – true “world” knowledge and not opinion. The sender’s agenda is no longer in the information itself, it is in the way the information is shared.

This A-Relationship-B-by-C model sharing therefore means that the receiver is interested in decoding opinions and not necessarily utterances. The message has to be interpreted as an interpersonal signal, not just as an informational signal: the signal contains explicit information about the social models being exchanged, but it also contains implicit information about the relationship between the sender and the receiver. Just opening our mouths to speak becomes an eloquent expression of relationship; and the content of what we say, mitigated by conditional truth values, becomes a synthesis of message and metamessage.

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<sup>12</sup> Michael V Lombardo, Jennifer L Barnes, Sally J Wheelwright & Simon Baron-Cohen (2007). Self-Referential Cognition and Empathy in Autism. In *PLoS ONE*, 1 September 2007, Issue 9, e883.

The receiver therefore has a complex interpretive job to do, building the intentions of the identities in the message and those of the sender of the message into a useful map of their social environment [BOXES K & L]. The message becomes interpretable in a range of ways: as well as the interpersonal relationship between sender and receiver that it implies, there are the textual implications of what is actually said, and the ideational implications of what the sender intends the message to mean. Understanding the message becomes a matter of interpretation rather than decoding, of placing meanings into a matrix of possibilities. Social model sharing becomes a way to access a shared reality with its own relative truth conditions, rather than a shared actuality with absolute truth conditions – in a word, it becomes language.

A side-effect of this interpretive process comes out of the usefulness of being able to tag a received utterance with the identity of its originator. As the models now being received are A-Relationship-B-by-C, they can be extended to A-Relationship-B-by-C-by-D models by tagging them with the identity of the sender. The repetitive nature of this construct represents something very peculiarly human in our social modelling and in language: recursion. Humans are able to nest models within models, both in cognition and in language, and this is a capacity which remains undemonstrated in any other species. If recursion is a feature emergent from the culmination of processes that gave us language then it is, indeed, something specifically human and language-related<sup>13</sup>; but it is not, in this description, the sole cause (or even *a* cause) of language, it is a co-occurring outcome of the processes that produced language. Recursion, while interesting as a marker of language and a useful test for language-like capacity, is not the eureka-moment that produced language.

## TRACKING THE CHANGES

This paper proposes a very specific model of language origins, involving a defined communicative purpose (sharing social models) and a mechanistic approach to the communication system. It fails to address key questions: how was the first social model shared, what kept the early models honest, how was negotiation to common meaning carried out? It makes assumptions without properly justifying them: information is assumed to be a Good Thing, signalling is viewed as an information transporter, and communication is seen as a central function of socialisation. It subsumes what was probably a complex, multivariate developmental system into a single series of “and then”s. It does not address the elephant in the room: how did a system devised for sharing social models become so versatile and ubiquitous in its use? In the final analysis, the story told here has to be classed as another language

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<sup>13</sup> Marc D Hauser, Noam Chomsky & William Tecumseh Fitch (2002). The Faculty of Language: what is it, who has it, and how did it evolve? In *Science* 298-5598: pp1569-1579.

origins myth, an unproven speculation.

It does, however, track a series of changes from a reliable cognitive start point (social modelling, which seems to be a capacity of chimpanzees and bonobos at least) to a reliable end point (the sort of language we humans use); and hopefully the steps between trace a logical, if not actual, path. This paper set out to produce a transformational grammar which is neither monolithic nor specialised, and it aimed to do this within a neo-Darwinian paradigm of incremental change driven by evolutionary imperatives. Broadly, it has done this, showing that some of the key features of grammar could have evolved separately as elements of cognition, and only later have been integrated into a single system for signalling. It describes a process of increasingly complex social modelling, prompted at different stages by the sharing of those models; and, most importantly, it avoids the need to invoke an evolutionarily improbable event to explain the complexity of language. Complexity can emerge from the consolidation, integration and synthesis of basically simple components and needs; the elegance of a unified system of grammar does not necessarily indicate a single point of origin.

## REFERENCES

- Derek Bickerton (1990). *Language and Species*. University of Chicago Press: Chicago, Ill, USA.
- Ingar Brinck (1999). Attention and tool-use in the evolution of language. In *Festschrift for Peter Gärdenfors*, <http://www.lu.se/spinning/categories/language/Brinck/index.html>.
- Richard Byrne (1995). *The Thinking Ape: evolutionary origins of intelligence*. Oxford University Press: Oxford, UK.
- Martin Edwardes (2010). *The origins of Grammar: an anthropological perspective*. Continuum: London, UK.
- Scott H Frey (2008). Tool use, communicative gesture and cerebral asymmetries in the modern human brain. In *Phil. Trans. R. Soc. B* (2008) 363, pp1951-1957.
- Marc D Hauser, Noam Chomsky & William Tecumseh Fitch (2002). The Faculty of Language: what is it, who has it, and how did it evolve? In *Science* 298-5598: pp1569-1579.
- Bernd Heine & Tania Kuteva (2007). *The Genesis of Grammar: a reconstruction*. Oxford University Press: Oxford, UK.
- J Scott Jordan (2003). Emergence of self and other in perception and action: an event-control approach. In *Consciousness and Cognition* 12 (2003), pp633-646.
- Michael V Lombardo, Jennifer L Barnes, Sally J Wheelwright & Simon Baron-Cohen (2007). Self-Referential Cognition and Empathy in Autism. In *PLoS ONE*, 1 September 2007, Issue 9, e883.
- Andrew N Meltzoff (1990). Foundations for developing a concept of self: The role of imitation in relating self to other and the value of social mirroring, social modeling, and self practice in infancy. In D Cicchetti & M Beeghly (eds), *The Self in Transition: infancy to childhood*. University of Chicago Press: Chicago, Ill, USA. pp139-164.
- Thomas C Scott-Phillips, Simon Kirby & Graham R S Ritchie (2009). Signalling signalhood and the emergence of communication. In *Cognition* 113 (2009), pp226-233.
- Michael Tomasello (2008). *Origins of Human Communication*. MIT Press: Cambridge, Mass, USA.
- Michael Tomasello (2009). *Why We Cooperate*. MIT Press: Cambridge, Mass, USA.