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Lexicalisation and the Origin of the Human Mind

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Abstract
This paper will discuss the origin of the human mind, and the qualitative discontinuity between human and animal cognition. We locate the source of this discontinuity within the language faculty, and thus take the origin of the mind to depend on the origin of the language faculty. We will look at one such proposal put forward by Hauser, Chomsky, and Fitch (2002), which takes the evolution of a Merge trait (recursion) to solely explain the differences between human and animal cognition. We argue that the Merge-only hypothesis fails to account for various aspects of the human mind. Instead we propose that the process of lexicalisation is also unique to humans, and that this process is key to explaining the vast qualitative differences. We will argue that lexicalisation is a process through which concepts are reformatted to be able to take on semantic features and to take part in grammatical relations. These are both necessary conditions for a grammatical mind and the increased ability to express conceptual content. We therefore propose a possible *explanans* for the discontinuity between humans and animals, namely that merge with lexicalisation (and consequently semantic features and grammatical relations) is a *minimal* requirement for the human mind.

Keywords **Discontinuity, Merge-only Hypothesis, Semantic Features, Agreement, Lexicalisation**

Introduction

Accounting for the development and the unique capacities of the human mind remains one of the most fundamental questions within a wide range of academic disciplines. Our approach here will be from an empirically informed philosophical perspective. By this, our aims will not be to propose answers as to what biologically changed to provide for human specific cognition, when this change occurred, or why it did. Instead we will detail the qualitative differences that are exhibited between the minds of humans and other animal species. The hallmarks of this difference include, but are not limited to, propositionality, and cognition that is radically free from immediately present stimuli. Our thesis holds that by detailing the qualitative change we can better grasp the origin of the mind – the origin of these qualitative characteristics *is* the origin of the human mind.

The first section will provide a description of the qualitative difference, as well as narrowing the wide field of possible sources of that difference down to our favoured candidate, which we take to be the language faculty. Isolating the unique characteristics of the human language faculty will simultaneously isolate the distinguishing aspects of the human mind. We are certainly not alone in taking the development of language as key to the development of the human mind[1], and thus taking the origin of language to be the crucial question in this debate.

[1] See Spelke (2003), Chomsky (2005), Carruthers (2006), and Hinzen (2006) for varying views on this relationship.

One influential proposal comes from Hauser, Chomsky, and Fitch (2002). They suggest that the human mind stems from the language faculty, itself manifested through a simple recursive ability unique to the species. Whilst other suggestions for the origin of language exist (for instance Pinker 2003 emphasises the role of adaptive pressures on its development), Hauser, Chomsky, and Fitch's proposal remains one of the most discussed and controversial positions. This proposal will be the evolution of the language faculty will be the focus of section two, but we will argue that it cannot provide satisfactory answers to the qualitative-origins question.

This will lead to our positive proposals for the origin of the human mind in section three, which focuses on the process of lexicalisation and what we term semantic features. We take semantic features to both help build up semantic content within a grammatical expression, and force (at least) some grammatical relations; and lexicalisation to be the creating process whereby a concept is reformatted. A lexicalised concept is then compatible with a grammatical system, through being forced to take on semantic features. Our overall aim therefore will be to argue that the process of lexicalisation is key to creating the qualitative difference observed between humans and animals, and hence the origin of the mind.

1 The Cognitive Discontinuity

We cannot attempt to give an evolutionary account of how the human mind developed until we are clear about what is different about the human mind compared to other animals' minds. It is vital to first have a grasp of the phenomena that we wish to explain. Providing for this will be the main aim of this first section, and will involve outlining the relevant cognitive differences between humans and other animals, and between young infants and adults. Such differences will be drawn from the results of detailed experiments on the cognitive capacities of those three groups of organisms. The focus of this section will be on what the different cognitive abilities are and whether there is a qualitative continuity between human and animal cognition, rather than detailing the nature of the evolutionary changes that occurred. We do this in support of the arguably very similar 'core cognition' and 'core knowledge' hypotheses put forward by Carey (2009) and Spelke (2000; 2003) respectively. This will directly argue against more minimalist accounts of animal cognition. Core cognition systems, though more powerful than previous accounts of animal cognition, still fall well short of the complex symbolic minds adults possess. We will argue that the evidence suggests that there must be a qualitative discontinuity between these forms of cognition, and that the most reasonable hypothesis of the source of this discontinuity stems from an evolutionary change that gave rise to the language faculty. The evidence for this comes from both the timing of the developmental shift between infant and adult cognition, and from the linguistic nature of the human mind. We unfortunately will not be able to discuss the discontinuity/continuity debate, or the location of the source of any discontinuity, in full detail here. We will instead be limited to outlining some considerations for our preferred positions in these debates.

Mental representations are often divided into two broad categories: sensory/perceptual representations, and full symbolic conceptual representations (see Boghossian 1995). The former are created from the processing of the immediate sense data by the brain. Such representations cannot be integrated into a wider set of representations, and therefore cannot be part of any structured form of cognition. The latter contain far more information and are necessary for linguistic cognitive processes. However, if we limit ourselves to only the existence of these two forms of mental representations, it is not surprising that the accounts of animal cognition posited are restrictive. This dichotomy allows us to posit only the limited category of sensory/perceptual representations to animals. This is the sort of account proposed by Dummett (1994), wherein animal cognition is purely 'the superposition of spatial images on spatial perceptions' (1994:123). This severely limits the cognitive abilities that animals are taken to possess, making animals capable of only 'proto-thought' (1994: 121-126), which is strictly context bound.

However, this binary division of mental representations can be questioned. Animals exhibit far more complex cognitive abilities than those available to organisms that only posses sensory/perceptual representations. This can be inferred from the planning behaviours that some animals exhibit. For example, it has been documented that wild chimpanzees create two different forms of dipping wands for ants and termites, creating them both a distance away from and some time before they will be needed. These wands are made in the *expectation* of, or for the *possibility* of them being useful (Byrne 1995; Sanz, Morgan, and Gulick 2004). Such behaviour indicates a minimal level of context free cognition and planning far beyond the capabilities of animals that are limited to immediately present sensory/perceptual representations.

Furthermore, Spelke (2000, 2003) and Carey (2009) have both argued that the evidence suggests that the cognitive abilities that exist in young infants and some animals are similar. For example, in research into the recognition of conspecifics in chicks (Johnson, Bolhuis, and Horn, 1985), chicks will huddle close to an object only if there is an overall bird shape. The innate representation is vague, but key physical features must be in certain configurations for recognition to take place. This is taken to show that very young chicks have an innate perceptual analysing system that specifies what a conspecific looks like and contains an inferential role of 'stay close to that'. Similar results have been shown in human infants by Morton, Johnson, and Maurer (1990). We do not have the space here to detail all the empirical evidence, but this example shows the similarities between the innate cognitive systems in young infants and animals, and that those innate perceptual analysers can create representations that can have an inferential role – something that is beyond the limits of sensory/perceptual representations alone.

Carey concludes from this evidence that we need to posit a third form of mental representation, one that 'differs systematically from both sensory/perceptual representational systems and theoretical conceptual knowledge' (2009:10). Given that such representations have been shown to be shared by humans and animals, an innate (or early developing) 'core cognition' system has been posited. The presence of inferential roles in core cognition also suggests the presence of some conceptual content in the outputs of these cognitive systems[2]. Spelke and Kinzler (2007a, 2007b) argue for four domains founding core knowledge: those of objects, number, actions (or agency), and space (or geometry), each of which produce some (limited) conceptual outputs. Crucially the abilities in each of these core cognitive domains are shared. For example, the object representations possessed by certain species of monkeys (Hauser and Carey 2003; Santos 2004), young human infants, and adult humans share notable similarities as a result of the core cognition systems. However core cognition systems lack the full conceptual representations available to adult humans and thus are comparatively limited in the cognitive abilities they allow for, but can accommodate for relatively complex cognitive abilities such as voluntary action (Carey 2009:67).

The introduction of core cognition representations changes the aims of a theory that attempts to explain the human mind. Under the view that animals (and young infants) possess core cognitive representations and adults possess full conceptual representations, the 'origin of the human mind' question is rewritten as to how *this* change occurs. There are two further questions to be addressed: first, is there a discontinuity in the different cognitive abilities; and second, if there is a discontinuity (as we will argue there is), can we narrow down the area of cognitive change that allows for this discontinuity?

The discussion between authors that support a continuity and those that support a discontinuity concerns a disagreement over whether the later developing cognitive abilities of adults requires positing a qualitative shift or not – whether the representational abilities present in infants can explain those available to adults, or if an entirely new form of representation is needed to explain later cognitive abilities[3]. The continuity theorists will hold that later representational capacities are either present throughout development (though dormant initially) or can be the result of maturation processes (see Fodor 1975, 1980; and Macnamara 1986 in support of this position). For example the propositional nature of complex adult cognition could be the result of improving (more practised) quantificational abilities. The discontinuity thesis however will argue that the abilities manifested by adults cannot be explained through simple maturation processes, and instead that a qualitative shift in representational capacities is needed. The later representational abilities are thus of a new kind that do not rely upon the antecedently available representational capacities. Given our acceptance of a shared core cognitive system discontinuity would need to exist on both a developmental and an evolutionary level. We do not have space here to discuss the debate extensively; instead we will put forward considerations that we find convincing in arguing for the necessary existence of a discontinuity in cognition.

The simplest argument comes from the numerical skills of young infants and adults. Infants are able to discriminate between large numbers of objects and an array of sounds relative to the controlled quantity and set ratios between the numerosities (see Xu and Spelke 2000; Xu, Spelke, and Goddard 2005). Similar abilities to discriminate between large numbers of sounds have been observed in adult monkeys and adult humans (Hauser, Tsao, Garcia, and Spelke 2003; Barth, Kanwisher, and Spelke 2003). These experiments

[2] Some philosophers have taken the presence of inferential abilities to be the mark of possessing concepts (see Crane 1992, and Burge 2010). Though the precise nature of the inferential abilities of animals is debated (see Beck 2012 for a review of the positions in the literature), we take their limited inferential abilities to indicate a limited form of concept possession.

[3] Note that a continuity theorist can accept the existence of a shared core cognition system without contradicting their position. The continuity theorist can posit entirely new forms of representations as the thesis concerns the *source* of their development, not their existence.

would seem to indicate that there is a shared core cognitive system that accounts for these abilities, and that it improves through maturation but still remains limited as adults struggle to differentiate between large numerosities above a certain ratio. Piaget (1980) argued that these sorts of abilities could not equate to, or through a process of maturation explain, the extra mathematical abilities available to adults beyond mere numerical discrimination – such as grasping complex mathematical notions (e.g. rational, real, and complex numbers). Children have the potential to later grasp these concepts, but they appear to be incommensurable with the early existing core cognition concepts. The concepts are not representable through translation into the concepts available within the core cognition domain of number. A similar point comes from the discretely infinite counting ability available to adults. It is unclear how increased abilities in differentiating between large numerosities (even if they were to improve further than the evidence suggests they actually do) could result in the discretely infinite number system. The numerical ability of adults therefore seems to have a representational power that far exceeds that of early developing systems, in part due to the qualitatively different mathematical concepts present within adult cognition. This would indicate a qualitative discontinuity between core cognition and adult cognition. As Carey notes though (2009: 20), such examples of the existence of discontinuities do not answer all the questions that we occur. We must also try to explain what caused the discontinuity. This is the aim of this paper. If we can explain the cause of the discontinuity then we also have an explanation for the origin of the human mind. In order to do this, it will be helpful to identify the area where the discontinuity stems from. Again, we do not have the space here to discuss all the options as to the general source of the discontinuity; instead we will outline considerations in favour of our preferred option, namely that the discontinuity is connected to the language faculty.

In summation, the claim is that the language faculty is responsible for the qualitative differences that we have taken to be the hallmarks of the human mind. The timing of the developmental shift in humans is one significant consideration in favour of this. The acquisition of language occurs at the same period in development as significant advances occur in cognitive abilities. Furthermore, the new kinds of cognition that are available after the developmental shift are the sort standardly taken to be linguistic in nature. For example, continuing from the discussion of discontinuity earlier, the presence of discretely infinite numerical systems in adults bears similarities to the discretely infinite grammatical constructions in natural languages. Connecting these two abilities under one developmental discontinuity would simplify our theory of human-specific cognition. Language under this picture therefore plays a bootstrapping role in cognitive development[4]. This cognitive bootstrapping allows for the fast development of full conceptual representations through the linguistic structures available post-discontinuity, and thus the creation of new representational resources that are not entirely grounded in antecedent representations. This bootstrapping ability is lacking from core cognitive systems and thus in part accounts for the limitations in them. We are not alone in viewing language as providing human-specific cognition. Spelke (2003) and Carruthers (2006, 2011) from independent reasoning also grant language a similar role to the one proposed here. Both view language as allowing for the increased combination of information from a larger number of areas of the mind. For them, language is a developing cognitive system, more powerful than combinatorial systems present before, resulting in the qualitatively different cognitive abilities that adults exhibit.

The positions we take in these debates lead us to redirect the original question of accounting for the human mind in terms of the origins of language. We have not had the space here to go fully into the various debates that surround these claims, and we fully accept that we have made assumptions as to the solutions to some of the issues. To summarise, we have supported a more complex form of animal cognition than has sometimes been supported; have followed Spelke, Carey, and others in linking the abilities of human infants and animals under the notion of a shared core cognition system, and have supported the introduction of a third form of mental representation; have agreed with the discontinuity thesis, arguing that the different forms of cognitive abilities that humans possess must be the result of a qualitative change; and have placed the source of this discontinuity in the language faculty, making the evolutionary development of such a faculty key to explaining the human mind. Each of these positions may be debatable, but all are coherent together, independently motivated, and well supported. The remainder of this paper will take these positions for granted and will focus on the elements of the language faculty responsible for the discontinuity.

[4] Following Carey (2009) we take this bootstrapping to be similar to the way in which Quine (1960, 1969) envisaged for a child acquiring ontological commitments. This is a different form of bootstrapping than is discussed in the language acquisition literature, which concerns a mapping problem of lexical items onto syntactic categories.

2 The Problem of Cognitive Evolution

The problem of language evolution is riddled with difficulties – shifting the question of the origin of the mind onto the origin of language focuses our efforts but does not necessarily make such research easier. Language evolution has itself been touted as one of the hardest problems in science (Christiansen and Kirby 2003b). We are dealing with the origin of language, a complex symbolic system that allows traits previously unseen in the animal world, with epistemological problems unique to investigating such traits. One such problem is how do we define language. Is it simple communication? If so, do the dances of bee's, the pyow-hack noises of Putty-nosed monkeys, and the putative proto-syntax of Campbell's monkeys count[5]? If we take language evolution to be concerned strictly with human language and its open-ended creativity (Berwick and Chomsky 2011), then what aspect should we take to have evolved? Our speech physiology (see Lieberman *et al* 1968, and for a more recent overview Lieberman 2003) that allows such open ended vocalizations; our ability to externalize abstract concepts; or perhaps a simple computational process that puts things together into sets? On top of the issue of *what language is* and *what evolved* to give us it, there are issues concerning *how* this evolution took place. Did language evolution happen over millions of years, perhaps starting at the very beginning of the hominid ancestry some 7myr ago through successive stages of proto-language (Tallerman 2007); or in a much shorter period of time through punctuated equilibrium (in the sense of Gould and Eldredge 1977)? On top of this, is language evolution the result of a particular genetic mutation[6]; an adaptation to newly challenging surroundings (Pinker 2003); or perhaps an exaptation of a pre-existing trait to serve a new function (Gould and Lewontin 1979; Hauser *et al.* 2002; Tattersall 2004)? These issues are all noted and discussed in a landmark paper in the field by Hauser, Chomsky, and Fitch (2002, referred to from now on as HCF). They propose a new formulation of the language faculty that places a recursive set-building operation at the heart of language evolution research. However, to what extent can the myriad of difficulties faced by researchers in this field be reduced to such a simple operation? The following section will illuminate both the achievements of the paper and the further problems it raises.

HCF argue that Merge, a recursive set building operation, is a potential *explanans* for the evolution of the human mind. Merge is a simple set building operation that takes items of a certain type and builds sets out of them. Merge takes two items X and Y and builds a set {X, Y} out of them. This set can then act as an input to a further instance of Merge where a third item is added, Z, yielding the set {Z, {X, Y}}; this operation can then continue *ad infinitum*. HCF cut up the language faculty into a language faculty (FL) in the narrow sense (FLN), which contains just Merge, and the language faculty in the broad sense (FLB), which contains amongst other things a sensory-motor interface and a conceptual-intentional interface. The intuition behind this split of FL is that Merge is a perfect (meaning the most computationally efficient) link of sound and meaning - the so called Strong Minimalist Thesis (Chomsky 2007: 4, 2008: 136). FLB then contain all aspects of cognition that interact directly with the syntactic (recursive) part of FL. In addition, FLB is taken to have homologs or analogs in other species (2002: 1573), and hence the search for the answer to language evolution lies in FLN alone. All non-recursive aspects of language are then derived from this efficient link of sound and meaning. We can draw parallels here between FLB and core cognition systems. Both equate to a level of cognitive ability that exists without human language (FLN). The position advocated in HCF therefore is that "[e]volution in the biological sense of the term would then be restricted to the mutation that yielded the operation Merge" (Berwick and Chomsky 2011: 38). Fully fledged language is then explained through the exaptation route, which takes a pre-adaptive trait to have been reintroduced to a new function. On top of this they claim that this exaptation took place "recently" (2002: 1573), roughly around 50,000 years ago (Chomsky 2005; Berwick and Chomsky 2011: 19), which is established "by traces [...] left in the archaeological record" (2005: 3). Whilst the dates are simply rough estimates the sentiment is clear: human language came about as the hominid lineage awaited the Merge mutation. This is the Merge-only hypothesis.

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[5] The pyow-hack noises made by Putty-nosed monkeys that exist to warn of predators have been taken by some authors to constitute semantic combinatorics (see Arnold and Zuberbühler 2008); whilst the calls of Campbell's monkeys have been taken to exhibit combinatorial organisation akin to a 'proto-syntax' (Ouattara, Lemasson, and Zuberbuhler 2009). The following paper takes such semantic content to be qualitatively different from that of human semantics, this distinction is born out of having a grammatical mind with lexicalisation that affords new ways of using symbolic representations.

[6] For a discussion on FOXP2, a gene involved in speech production, see Lai *et al.* 2001; Enard *et al.* 2002; for other possible genetic mutations see Crow 2008. For a negative perspective on the role of FOXP2 in language evolution see Berwick 2011.

In response to HCF, Pinker and Jackendoff point out that recursion is present in other aspects of cognition, citing the visual system as a key example (Pinker and Jackendoff 2005: 230; Jackendoff and Pinker 2005: 218). The existence of recursion in, for example, visual groupings (Jackendoff and Pinker 2005: 217-218) suggests that other species have recursion if they have visual groupings. On top of this Bloomfield *et al.* (2011) argue that recursion is present in the vocalizations of a certain songbird, and hence is not unique to the human species. Clearly the route taken by HCF is not the only one available to research in language evolution[7]. The questions concerning the accuracy of HCF's thesis have to do with whether Merge is enough to explain all aspects of cognition that feature in adult humans. The advantage of HCF's thesis is that Merge requires one mutation and the rest follows from efficiency considerations. The extensive approaches to language evolution, and consequently the origin of the human mind, illustrate the range of issues still unresolved in the field. With these considerations in mind it is important to see why HCF would defend the Merge-only hypothesis, and the probable reasons are that it appears to fit with the archaeological record. However, it is unclear whether Merge alone can explain all the complex behaviours exhibited in the archaeological record.

As discussed above, the hallmarks of the human mind are clearly linguistic, relying on lexical vocabulary, discretely infinite structures, and the ability to express creative, new, and abstract concepts. Chomsky dates the ‘great leap forward’ to modern cognition to around 50,000 years ago, taking the catalyst for this to be "the origin of modern language with the rich syntax that provides a multitude of modes of expression of thought, a prerequisite for social development and the sharp changes of behaviour that are revealed in the archaeological record" (2005: 3). This position is echoed in work by Tattersall who takes *anatomically* modern man to have existed much before the behaviours we associate with ourselves, such as the production of art and symbols (2004: 25). So at what point did we discover our new anatomy and the illustrious abilities it would afford us? As Tattersall remarks "almost certainly in Africa, like modern human anatomy. For it is in this continent that we find the first glimmerings of “modern” behaviors. From Blombos Cave, near the continent’s southern tip, comes the first indisputably symbolic object, a geometrically engraved ochre plaque almost 80,000 years old." (2004: 25) Both Tattersall and Chomsky take language to be the catalyst for this abrupt leap (Chomsky 2005: 3; Tattersall 2004: 25). These observations tie in with our previous support for the development of language as playing a key role in the discontinuity between animal and human cognition; however HCF’s formulation is extremely restrictive as to what can explain the great leap forward. Language evolution is whatever created Merge, and that is it.

Yet Merge on its own does not give us language, and so one cannot expect nor predict that it is the final stage in the evolution of the human mind as we live and breathe it today. Even within the Minimalist Program Merge fails to explain everything about the link between sound and meaning, it fails to explain endocentricity, or labels, (Boeckx 2009: 47) that are characteristic of grammatical structures; it fails to explain the way linguistic items agree in their features (person, number, etc.), and the times at which they do; it fails to explain the existence of uninterpretable features (the features that force a structural case on arguments); it fails to explain the rigid hierarchies that have been observed in language (see Cinque 1999); it fails to explain movement phenomena; and it fails to explain the linearization of grammatical structures that is required for speech production (see Kayne 1994)[8]. For HCF, all of these issues require explanation from the existence of Merge alone, which is clearly a very difficult research program. Perhaps this drawn-out development of modern man is due not to the discovery of a pre-existing Merge trait, but is instead due to the intricacies of establishing a grammatical system that includes the building of its primitive elements, namely lexicalisation, and the grammatical relations that must hold between such elements. The human mind requires more than just the building of sets together with some ancestral FLB.

It should be noted that nothing so far discredits the position advocated by HCF that Merge was the *catalyst* for the great leap forward that culminated in the human mind. However, it does stress the limitations of a Merge-only approach to the qualitative discontinuity. In defence of HCF it is clear that they provide a neat way to deal with language evolution. They delimit one particular aspect of language and aim to find its origin. By doing this HCF can focus attention on a selected area, and consequently advance the field of language evolution with a specific focus. It is important to point out that this approach lacks the explanatory

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[7] The extent to which these approaches vary can be seen in the edited volumes *Language Evolution* (Christiansen and Kirby 2003a), *The Biolinguistic Enterprise: New Perspectives on the Evolution and Nature of the Human Language Faculty* (Di Sciullo and Boeckx 2011), and *The Oxford Handbook of Language Evolution* (Tallerman and Gibson 2012).

[8] Some authors argue that the imperfections in language can be reduced to conflicting interface conditions, and hence the imperfections become epiphenomenal, see Zeijlstra 2009 for discussion.

force needed to account for the qualitative difference between human cognition, our ancestors, and our closest ancestral relatives. To do this a theory is required to explain the nuances of language that enables such things as propositional thought, which is a wholly new form of symbolic representation. We will argue that three interrelated aspects of language speak to the qualitative difference in cognition directly, namely lexicalisation; grammatical relations (particularly agreement); and semantic features as the primitive elements that are formed by lexicalisation and take part in grammatical relations. These three conditions must be satisfied for the existence of the human mind, and the Merge-only hypothesis falls short of this. What follows in this paper will be an explicit attempt to illustrate what is required *beyond Merge* to reach the hallmarks of human cognition, and, somewhat more speculatively, in what order this evolution will have taken place. The approach will not be an archaeological one, nor will it provide genetic mutations that serve language evolution, instead it will attempt to give a neater grasp on what might explain the qualitative difference between modern man and the rest of the animal kingdom.

3 Semantic Features, Lexicalisation, and Agreement

As we have seen, it is reasonable to suppose that the evolution of the language faculty could be a candidate for what changed within the hominid species to give humans their unique mind. One aspect of this discontinuity between animal cognition and human cognition is the differences between the conceptual repertoires available to such minds. This change will clearly take on board whatever conceptual resources it has from the species that went before; we are not, after all, talking about the existence of a mind that is separate from its biological ancestry. So the next question to consider is what could be taken to be responsible for the qualitative difference observed between human cognition and the rest of the animal world? Specifically, if Merge is not the answer, or at least if it is only part of the answer, then what else is required? What else would help illuminate the coming into being of a new type of cognition that is discontinuous from animals?

The position to be advocated here is that a process of lexicalisation is key to this change; that is a process whereby concepts are *reformatted* for language use. This reformatting creates a lexical item, attached to a concept, that brings together both sound[9] and conceptual content. In addition to conceptual content, a lexical item takes on a feature matrix once Merged into a grammatical structure. It is these features that then provide the route via which semantic content is expressed through grammatical relations, such as agreement relations. This process will be detailed in three stages; first of all we will describe what we take to be a *semantic* feature in human cognition and contrast this to what we term a *proto-semantic* feature in animal cognition; secondly we will describe the process of lexicalisation in relation to these semantic features whereby a core-cognition concept is reformatted[10]; and thirdly we will describe one of the grammatical relations (agreement) that is required for these features to play a role in grammatical configurations.

3.1 Semantic Features

Cedric Boeckx neatly sums up Chomsky's view on the primitives of our linguistic system when he says that "natural language syntax operates on units that are standardly characterized as bundles of features. Such features are lexicalised concepts" (Boeckx 2008: 63).

The primitives of the syntactic system are features that can be roughly separated into three sorts: phonetic features, semantic features, and formal features. According to Chomsky such features appear in lexical entries and lexical items are therefore constituted by the particular bundles of features that are attached to them (1995: 230). Chomsky gives the example of the word *airplane* to illustrate this. Such a word contains features of all three sorts listed above: the phonetic features may include [begins with vowel]; the semantic features may include [artefact]; and the formal features may be [+nominal] (1995: 230). However, this formulation is not uncontroversial. Marantz (2000) and Borer (2005) simplify what lexical items contain by suggesting that categorical information can be derived through grammatical context alone, hence a word is not valued with [+nominal] or [+verbal] in the lexicon, but rather it gains this category depending upon what item it merges with (whether it merges with *v* or T to become a verb or *n* or D to become a noun, see Boeckx

[9] Sound includes all articulatory modes for language expression, including signing or other non-vocal modes.

[10] This is not to claim that all concepts in adult cognition have their source in core-cognition. Once the system outlined in this paper is in place concepts can be formed independently of core-cognition systems.

2008: 76-77 for discussion). Under this view lexical items are roots rather than bundles of features. This debate over [+nominal] or [+verbal] largely concerns formal features of the system, and whilst such features have *some* semantic import through identifying predicates and arguments for example, for the purposes of this paper we will put such features to one side. On top of this we are not interested in phonetic features *so long as* they are features like [begins with vowel].

Our concern here is with semantic features. We take a semantic feature to act as the vehicle through which conceptual content can be expressed within grammar, which demands a certain format for such content. Without such features, grammar could only ever be a formal and phonological device that could not express the aspects of meaning traditionally discussed within philosophical theories of meaning. These features therefore become a conduit through which conceptual content that does not play a role in grammatical relations can be fully expressed in cognition. This new kind of feature provides additional routes for non-grammatical conceptual content to be expressed. We call such features 'semantic' in virtue of their role in building meaning up from conceptual content. These features are key to explaining the discontinuity between the types of cognition present in animals, which may have some basic 'proto-semantic feature', and the human mind where such features are of a new kind.

We must now define exactly what a semantic feature is, in relation to the examples of features mentioned above. We will use the following as a definition of semantic features:

(1) Semantic features are *any* features that help to express conceptual content within a grammatical expression *and* force (at least) some grammatical relations.

We can narrow this set further to a subset of semantic features that we will discuss for the remainder of this paper. We will limit ourselves to discussing the grammatical relation termed agreement, and consequently limit ourselves to the semantic features that play a role in agreement relations; these include person and number features, termed phi features.

Using our definition of a semantic feature it will be useful to consider an example of such features in use within adult human cognition. Consider the word *apple*. It is reasonable to suppose that a high-functioning animal, such as those that share core cognitive abilities with infants, may have a semantically limited concept connected to the perception of an apple. However, the lexical item 'apple' in adults possesses many semantic features whose existence, and potential valuations, would be unavailable to such an animal. Such features include those of [+/-person], such as 'apple' being third person and inanimate, and [+/-number], such as the fact 'apple' can be singular or plural. The rich semantic content of the concept APPLE placed in a particular sentence or thought is therefore partly defined in terms of the semantic features attached to it, which are valued through the grammatical relations it takes on in a derivation. The key point to remember is that a lexical item such as 'apple' is *open* to such valuations; critically it is required to be open to such valuations if it is to be a viable lexical item within a sentence or thought. This allows the term to possess different semantic information when placed in different derivations, each of which reflects the nature of such objects and their uses. Other semantic content may be attached to the item without affecting its grammatical role within a derivation (content such as the object being [edible]); however the expression of such content is dependent upon such items *being able* to take part in derivations. You do not get the extensive semantic content of the concept APPLE within a linguistic expression unless it can be placed there in the first place.

The ability of such concepts to be lexicalised and carry semantic features of the relevant sort is a prerequisite. It is features of this sort therefore that explains the flexibility of the human mind with respect to the semantic content of such lexicalised concepts. To make this concrete it is only necessary to consider linguistic expressions of the following differing sort: *The apple is green, The apples are green, John often eats apples, John is a fan of apple pie, John often goes apple-ing* (potential verbalization of 'apple', which means John picks apples). The myriad of uses for the concept APPLE is the result of the rigorous consistency of semantic features within grammatical patterns; in other words its ability to take part in complex symbolic cognition that is mediated through language.

The semantic features discussed so far are those limited to the human mind. There remains an issue of explaining the cognitive abilities provided for by the core cognitive systems that animals and young infants possess (and are limited to). The question therefore is how the (limited) conceptual content available to such organisms can be expressed in their combinatorial systems given the lack of semantic features. This ability can be explained through 'proto-semantic' features. Proto-semantic features should be considered as primitive versions of the *wholly new kind* of semantic features present in adult cognition. In the same way as semantic features allow conceptual content to be included within cognition, proto-semantic features allow conceptual content to be expressed in core cognition systems. It should be noted that fully fledged semantic features are unique to a grammatical mind and so are not simple advances on proto-semantic features, but instead are qualitatively different features. This difference between semantic features and proto-semantic features, together with the development of a grammatical mind explain the widely differing scope for conceptual content to be expressed in the different forms of cognition. Furthermore, semantic features can be taken to allow for the availability of additional and qualitatively different conceptual content. Organisms limited to core cognition systems do not have such a complex symbolic semantics available to them, precisely because they lack a means through which such meanings could be expressed.

Whilst an adult's lexicalised concept of APPLE contains instructions for various semantic features to be valued, this is not the case for animals and infants. Although animals and infants possess proto-semantic features that are valued within their combinatorial capabilities, these are of a completely different kind. Consider an animal encountering another creature. The animal may have proto-semantic features such as [+/-object] that will allow other semantic information (recognition of prey or predator) to be expressed within their combinatorial systems. This will allow them to respond accordingly. Critically though, these features do not equate to [+3rd person], which require a full grammatical system with lexicalisation and grammatical relations such as agreement. The relative simplicity of the structures demanded by proto-semantic features results in a limited amount of conceptual content that can be expressed in cognition[11].

3.2 Lexicalisation

The process of lexicalisation is key to explaining the discontinuity between animal cognition and adult human cognition. Non-lexicalised concepts are not capable of taking part in grammatical constructions and hence complex symbolic cognition. Instead we need a process that takes such concepts and provides us with a way of using them within a linguistic mind. This process, we argue, is lexicalisation. We will define lexicalisation as:

(2) The creating process whereby a concept is reformatted such that the lexicalised concept is compatible with a grammatical system, which means being able to take on semantic features and values for those features within a derivation.

Through these features, lexicalisation provides a qualitatively different form of concept than those available prior to lexicalisation. The features that a lexicalised concept can take on are drawn from a universal feature set {F} which contains all three types of feature (phonetic, semantic, formal). This universal feature set comes into existence through the creative process of reformatting conceptual information for use in a grammatical system[12]. Semantic features therefore would not exist without lexicalisation. When using a lexicalised concept we draw a subset of features {f} from the universal feature set, which take part in grammatical relations and are subsequently valued. Feature valuation allows the lexicalised concept to take part in grammatical constructions, meaning it is able to combine with other lexicalised concepts in qualitatively different ways than appears in core-cognition systems.

When taking part in a grammatical derivation a lexicalised concept is required to take on features and values that match that concept in a rigorous and consistent way across languages. Due to the universal feature set that is shared by every human this requirement is easily met, for example object type expressions like *apple* will always be able to take on person and number features when placed in nominal positions within a construction. Whilst a lexicalised concept will contain different phonetic features across language (the concept APPLE having the label *ringo* in Japanese for example, which obviously lacks the phonetic feature [begins with vowel]) the semantic features remain the same. This makes lexicalisation a species trait, part of the human phenotype, which is central to the qualitative discontinuity. It is now reasonable to suggest that the primitives of the linguistic system are formed through lexicalisation – as the process through which the range and amount of conceptual content that can be expressed within the newly available (that is, human) combinatorial systems vastly increases.

[11] Note though that although we have endorsed a discontinuity thesis between core cognitive systems and later adult cognition, we do not wish to rule out the idea that the two cognitive systems are commensurable.
[12] For alternative views on lexicalisation see Pietroski (2005).

3.3 Agreement

The semantic features discussed above are necessary but not sufficient conditions for human cognition. In addition to semantic features, structure building operations such as Merge, and some grammatical relations that operate over such features, namely agreement, are required. Agreement is the process by which the features attached to two different lexical items must share the same valuation, one item deriving its valuations from the other. If one item X has the value [3rd Person] and another item Y, that stands in an agreement relation with X, has [+/- Person], in other words Y lacks a distinct valuation, then the 3rd person feature must be carried over from X to Y so that both have the value [3rd Person]. Such valuations have effects on the spell-out, or pronunciation, of elements within a linguistic expression. These effects are key to the consistency of semantic information in linguistic expressions. Consider the following example sentences, which make use of the person and number features of nominal elements:

(3)	a.	The boys are eating biscuits.	The boys = [3rd person, plural]
	b.	He is eating biscuits.	He = [3rd person, singular]
	c.	I am eating biscuits.	I = [1st person, singular]

The tense element of an expression carries unvalued phi features[13] whereas the subject carries valued phi features, as detailed to the right of the expressions. The phi features of tense probe the phi features of the goal (Chomsky 2008: 9), which is the subject, and take those valuations. Following this, the agreement between the two forces the auxiliary to be spelt out in a different way depending on the valuation matrix of the person and number features. Numerous examples can be made which illustrate that phi features are not always important enough to force morphological changes in elements, however once again this does not affect our proposal. Valuations for phi features could, in those silent instances, be considered ‘meaningful silence' (Sigurðsson 2004: 9). What we need to remember is that the claim here is not that the semantic features carry *all* the conceptual content needed to exhaust a concept, but that the lexicalised concept is required to hold semantic features if that very concept is to take part in the grammatical strings that characterise the human mind.

Clearly the types of features exhibited in grammatical relations, in particular agreement relations between elements in a structure, are absent in animal cognition. Whilst an animal may have the proto-feature of [+/- object] such an animal would not have the feature array of [3rd person, singular]. On top of this because animals lack the features that are involved in grammatical relations, they consequently lack the ability to put concepts together in an open ended fashion, critically in a way that maintains semantic regularities. Every human thought or spoken expression requires grammatical relations such as agreement, and it is precisely because humans have the ability to compute such relations that they possess a new, qualitatively different type of cognition.

4 Conclusion

It should be clear by now that the qualitative difference between human and animal cognition is vast. We take lexicalisation to provide this vast qualitative difference through reformatting concepts and forcing two further constraints upon cognition. The first constraint is that every concept that is reformatted as a lexical item must be able to possess semantic features for use within grammatical constructions. The second constraint is that these semantic features force grammatical relations by requiring a value. Taking these two propositions together we now have an *explanans* for the discontinuity thesis outlined at the beginning of this paper, and the qualitative differences that have been observed throughout, namely that merge with lexicalisation (and consequently semantic features and agreement) is a *minimal* requirement for the human mind. This proposal now stands clearly in opposition to that of HCF, which took Merge solely to explain the differences between human and animal cognition. On top of this it also stands opposed to HCF's claim that Merge is the *only* aspect of FLN, hence the only uniquely human trait, as now lexicalisation qualifies as an aspect of FLN.

[13] Phi features are a subset of the universal feature set and are typically understood to be person, number, and gender features.

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