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Human Uniqueness from the Perspective of Evolutionary Anthropology and Cognitive Science

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Abstract

In this paper I explore the question of what is unique and special about modern humans (homo sapiens) from the perspective of evolutionary anthropology and cognitive science. I first give a brief overview of the evolution of the human brain. Then I discuss six candidates for what makes human cognition unique: (1) the ability to adopt a shared perspective (2) symbolic, analogical reasoning (3) a Theory of Mind (4) the creation of a symbolic 'niche' with shared cultural artefacts and norms (5) mental time travel (6) language. Most importantly, a comparison of the sociocognitive capacities and motivations of humans and other primates indicates that humans might possess a unique adaptation for cultural interaction, transmission and learning. This is already evident in infants and young children, who show unique abilities and motivations in the domain of sharing intentions, understanding joint commitments, and sharing attention and other psychological states.

1 Introduction

What makes us human? This question has been asked so many times since the dawn of human thinking - and certainly since the beginning of recorded history and philosophy - that today it has even become a bit of a cliché just to allude to this fact.

Nevertheless, ever since the gradual dismantling of the 'Great Chain of Being' at the turn of the 18th century - which finally culminated in Charles Darwin's 1859 "major blow" to human narcissism (Freud 1966: 353) in his book *On the Origin of Species* - it has been a constant desideratum to re-evaluate "the complex web linking nature, science, man, society, philosophy and theology"(Bynum 1975: 22).

As T. H. Huxley famously stated:

> The question of questions for mankind - the problem which underlies all others, and is more deeply interesting than any other - is the ascertainment of the place which Man occupies in nature and of his relations to the universe of things. Whence our race has come; what are the limits of our power over nature, and of nature's power over us; to what goal we are tending; are the problems which present themselves anew and with undiminished interest to every man born into the world (Huxley 1864: 58).

In light of the "new foundation" (Darwin 1859) of psychological inquiries into what it means to be human we can take an *evolutionary perspective* on this 'question of questions'. From an evolutionary point of view we can ask which of our cognitive capacities are truly novel and unique and to what extent the human mind still "bears the indelible stamp of [its] lowly origin" (Darwin 1871). And after decades of fruitful research we are now more than ever in a position to gain insights into this central question.

This is why in this essay I will present some very exciting recent findings in the areas of cognitive science, developmental psychology and comparative psychology. What makes these findings so exciting is that they have a direct bearing on the questions of what is special or unique about humans and human culture and how we should think about our relationship to other animals and the world around us.

2 The Evolution of the Human Brain

2.1 Human Evolution

We are evolved primates - as are all other primates, of course. So perhaps it may be better to say that we, like all other primates, are evolved beings with a unique set of specializations, adaptations and features.

In our lineage, we share a common ancestor with orangutans (about 15 million years ago (mya)), gorillas (about 10mya), and most recently, chimpanzees and bonobos (5 to 7 mya). We not only share a significant amount of DNA with our primate cousins, but also major anatomical features (Gazzaniga 2008: 51f.; Lewin 2005: 61). These include, for example, our basic skeletal anatomy, our facial muscles, and our fingernails (Lewin 2005: 218ff.).

Among the anatomical features that distinguish us as humans are our bizarre hair distribution, our upright posture and the skeletal modifications necessary for it, including a propensity for endurance running, our opposable thumbs, unusually extensive fat deposits (Preuss 2004: 5), and an intestinal tract only 60% the size expected of primates our size (Gibbons 2007: 1558).

However, there is also a distinguishing feature that stands out much more prominently - a brain three times the size expected of a primate our size. This is all the more interesting as primates are already twice as encephalized as other mammals (Lewin 2005: 217). A direct comparison shows this difference in numbers: Whereas human brains have an average volume of 1251.8 cubic centimetres and weigh about 1300 grams, the brains of the other great apes only have an average volume of 316.7 cc and weigh between 350-500 grams (Rilling 2006: 66; Preuss 2004: 8).

In a human brain, there are approximately a hundred billion neurons, each of which is connected to about one thousand other neurons, comprising about one hundred trillion synaptic connections (Gazzaniga 2008: 291). If you tried to count all the connections in the napkin-sized cortex alone, you'd be finished after 32 million years (Edelman 1992: 17).

2.2 Expensive Tissue

The human brain is also extremely "expensive tissue" (Aiello & Wheeler 1995): Although it only accounts for 2 % of an adult's body weight, it accounts for 20-25 percent of an adult's resting oxygen and energy intake (Attwell & Laughlin 2001: 1143). In early life, the brain even makes up for up 60-70% of the body's total energy requirements. A chimpanzee's brain, in comparison, only consumes about 8-9 % of its resting metabolism (Aiello & Wells 2002: 330). The human brain's energy demands are about 8 to 10 times higher than those of skeletal muscles (Dunbar & Shultz 2007: 1344). In terms of its energy consumption, the brain is equal to the rate of energy consumed by leg muscles of a marathon runner when running (Attwell & Laughlin 2001: 1143). All in all, its consumption rate is only topped by the energy intake of the heart (Dunbar & Shultz 2007: 1344).

Consequently, if we want to understand the evolutionary trajectory that led to human cognition there is the problem that "because the cost of maintaining a large brain is so great, it is intrinsically unlikely that large brains will evolve merely because they can. Large brains will evolve only when the selection factor in their favour is sufficient to overcome the steep cost gradient"(Dunbar 1998: 179).

This is especially important for people who want to come up with an "adaptive story" of how our brain got so big: They have to find a strong enough selection pressure that would have allowed such "expensive tissue" to evolve during the course of human evolution in the first place (Bickerton 2009: 165f.).

2.3 What About the Brain is Uniquely Human?

A lot of work in comparative neuroscience suggests that in the course of human evolution the human brain didn't simply grow bigger, but that some of the areas of the brain expanded disproportionally. This holds especially for "higher-order cortical areas, including the prefrontal cortex" (Preuss 2004: 9). These specialized expansions indicate that there could have been a qualitative shift in how the brain worked, leading to a wholly different, 'front-heavy' style of cognition (Deacon 1998: 435-438; Rilling 2006: 75).

This scenario squares well with what we know about the way evolution works: it always has to work with the raw materials that are available, and constantly co-opts and tinkers with existing structures, at times producing haphazard, cobbled-together, but functional results (Gould & Lewontin 1979; Gould & Vrba 1982). Given the relatively short time span for the evolution of the 'most complex structure in the known universe,' as the human brain is sometimes referred to, we have to acknowledge how preciously little time the evolutionary process had for 'debugging.' It could well be that the human mind is so unique because it is an imperfect 'Kluge:' "a clumsy or inelegant - yet surprisingly effective - solution to a problem," like the Apollo 13 CO2 filter or an on-the-spot invention by MacGyver (Marcus 2008: 3f.). Thus, it may well turn out that what we think makes us so special is simply a mental "oddity of our species' way of understanding" the world around us (Povinelli & Vonk 2003: 160).

In all, it is reasonable, then, to assume that human cognition did not just simply get better across the board, but that instead we owe our unique style of thinking to quite specific specializations of the human mind.

With this in mind, we can now ask the question how these neurological differences translate into psychological differences. But this is where the problem starts: Which features really distinguish us as humans and which are more derivative than others? A true candidate for what got uniquely human cognition off the ground has to pass this test and also solve the problem of how such "expensive tissue" could evolve in the first place.

3 Six Candidates for What Makes Human Cognition Uniquely Human

The never-ending debate about what makes humans unique has sparked a long list of proposals and counter-arguments. To quote from a recent article on this topic,

> a similar fate most likely awaits some of the claims presented here. However such demarcations simply have to be drawn once and again. They focus our attention, make us wonder, and direct and stimulate research, exactly because they provoke and challenge other researchers to take up the glove and prove us wrong. (H¯gh-Olesen 2010: 60)

It goes without saying, then, that the list of candidates presented here is far from exhaustive and that there are countless others (see e.g. Gazzaniga 2008; H¯gh-Olesen 2010; and Rosati et al. 2010).

Two of the key candidates for what makes human cognition unique are of course **language** and **symbolic thought**. We are "the articulate mammal" (Aitchison 1998) and an "animal symbolicum" (Cassirer 2006: 31). And if one defining feature truly fits our nature, it is that we are the "symbolic species" (Deacon 1998). But as psychologist Michael Tomasello and his colleagues at the Max-Planck-Institute for Evolutionary Anthropology in Leipzig, Germany, argue, "saying that only humans have language is like saying that only humans build skyscrapers, when the fact is that only humans (among primates) build freestanding shelters at all" (Tomasello et al. 2005: 690).

3.1 Language and Social Cognition

According to this position, held by Tomasello and many other researchers, language and symbolic behaviour, although they certainly are crucial features of human cognition, are derived from human beings' unique capacities in the social domain. As Willard van Orman Quine pointed out, language is essential a "social art" (Quine 1960: ix). Specifically, it builds on the foundations of infants' capacities for **joint attention**, **intention-reading**, and **cultural learning** (Tomasello 2003: 58). Linguistic communication, on this view, is essentially a form of joint action rooted in common ground between speaker and hearer (Clark 1996: 3-12) in which they make "mutually manifest" relevant changes in their cognitive environment (Sperber & Wilson 1986). This is the precondition for the establishment and (co-)construction of symbolic spaces of meaning and **shared perspectives** (Graumann 2002; Verhagen 2007: 53f.). These abilities, then, had to evolve prior to language, however great language's effect on cognition may be in general (Boroditsky 2003; Wolff & Holmes 2011). So when we look for the origins and defining features of human uniqueness we should probably look into the social domain first.

Corroborating evidence for this view comes from comparisons of brain size among primates, as there are significant positive correlations between group size and primate neocortex size (Dunbar & Shultz 2007). Our brain, it seems, is essential a "**social brain**" that evolved to cope with the affordances of a primate social world that frequently got more complex (Dunbar & Shultz 2007; Lewin 2005: 220f.). Although there is also a positive correlation between technological innovation and tool use on the one hand and brain size on the other (Reader and Laland 2002), these abilities are both facilitated by social learning. This and other evidence suggest that although these abilities "played a crucial role in the evolution of ape and human brains, these skills were probably built upon mental computations that had their origins and foundations in social interactions" (Cheney & Seyfarth 2007: 283).

3.2 Language, Mental Representations, and Symbolic Thought

But this of course does not mean that we expect all other unique aspects of human cognition to be derivative of social cognition. The development of higher social cognition may only have presented the enabling context and cognitive starting point for other human mental capacities to evolve. Language, for instance, does not only have an **interactive** function but also a **symbolic** one: It creates 'symbolic assemblies' that function as form-meaning pairings (Evans & Green 2006: 6f.). But the ability to acquire arbitrary symbolic units itself does not appear to be uniquely human, as it has been demonstrated in great apes, parrots, dolphins and dogs (see Tomasello 2008: 254ff.).

There are, however, two essential differences between the symbolic abilities of humans and other animals: Firstly, even with lexigram- or sign language-trained apes there appears to be nothing that even comes close to the **production** and **joint engagement** skills possessed by human children (production) or even pre-verbal infants (joint engagement) (Tomasello 2008: 109ff.; but see GÛmez 2010 for a critique). Secondly, human symbols and concepts function as '**decoupled representations**' which are not directly bound to a reaction pattern as in most other animal species, including symbol-trained animals, and enable significant "response breadth" and planning (Sterelny 2003: 29f.). In addition, symbolic thought and linguistic usage does not only rely on the comprehension and production of arbitrary signs, but essentially depends on our capacity for **abstract**, **relational**, **analogical**, **higher-order**,

hierarchical and **role-governed compositional thought** (Deacon 1998; Gentner 2003; Jackendoff 2007; Penn et al. 2008).

We now have two tentative candidates for what makes us special:

1. The capacity to develop a **shared point of view** or "we-perspective" (Tuomela 2007: 46f.) and jointly engage in and attend to **shared goals**, **plans** and **intentions** in a cooperative collaborative activity within a **joint attentional frame** and a **shared frame of reference** (Tomasello et al. 2005).
2. A conceptual system that is able to reinterpret and re-describe sensory as well as cognitive data and store them in an abstract, decoupled format that can be used for **symbolic**, **relational** and **analogical reasoning** (Penn et al. 2008).

We can now imagine a step in evolution where these two capacities were further integrated, yielding the analogical realization that others are "like me" (Meltzoff 2007).

This then enabled us to

3. actively attribute mental states to others in the same sense as one experiences mental events and states oneself, that is to, have a "**theory of mind**" (Premack & Woodruff 1978).

The first species in the hominin line that developed this capacity would not only have shared a *perceptual* world with his or her conspecifics, but they would inhabit

4. a shared *mental* world: A shared frame of reference and "we-perspective" mediated by joint engagement and shared linguistic symbols would enable them to create a shared "**symbolic niche**" in which meaningful cultural practices, artefacts and shared symbolic constructs, such as institutions, could be co-created and which would 'come alive' and have actual real-world significance (Harder 2011; Tuomela 2007).

Examples for this process are all the things that only exist by virtue of everybody agreeing that something material (a **brute fact**, like a red light, or a piece of paper) stands for something else (a **social**, or **institutional fact**, like a traffic sign, or money) (Searle 1995).

Additionally, when we were able to project ourselves and others into the same mental frame of reference, and could also insert more abstract symbolic units into this coordinate system (Bühler 1934/2011), it follows that along with these other changes a capacity evolved for

5. **projecting** ourselves and others backwards or forwards into past and future situations, that is, a capacity for **mental time travel**, including the ability to retrieve and re-live

episodic memories of past autobiographical events (Tulving 2005) as well as prospective foresight enabling the planning of future actions and events (Suddendorf & Corballis 2007).

Given the amazing experimental results on the abilities of food-caching birds and great apes in this domain, however, it is still quite a contentious topic to what extent the capacities for episodic memory and prospective foresight are uniquely human (Haun et al. 2010). What seems clear is that the human mental time travel system in its adult form exceeds that of other animals in terms of flexibility and depth (Suddendorf & Corballis 2007; Colombo & Hayne 2010).

Finally, these changes were certainly accompanied co-evolutionary by a means of externalising shared proto-concepts and communicatively coordinating cooperative activities in a flexible manner via the vocal and gestural level (Hurford 2007; Tomasello 2008). At some time, concepts became **public**; that is "they became the sorts of things that lots of people can, and do, share" (Fodor 1998: 28).

It is conceivable that "building upon pre-existing representational schemes in animals" (Hurford 2007: 140), and a general perceptual and cognitive machinery that scaffolded them (Jackendoff 2007: 388), ever increasing linguistic abilities and concepts evolved step by step. They probably did evolve from the **proto-concepts** we can see in the higher mammals of today into the **pre-linguistic concepts** that are argued to exist in some of the other great apes (especially those individuals who are enculturated and symbol-trained) and then into some form of **proto-language** (Bickerton 2009). At some time, this proto-language with already quite sophisticated conceptual representations then evolved into

6. the fully human language we know today.

It is still an open question whether the final steps to a fully human language were based on a language-specific biological change (Jackendoff 2002; Hauser et al. 2002) or rather a process of cultural evolution (Smith & Kirby 2008). But disregarding the question whether language is based solely on general cognitive mechanisms — as proposed e.g. by Cognitive Linguistics (Evans & Green 2006) — or whether there are computational features and capacities unique to humans and language (Jackendoff 2007; Hauser et al. 2002), it seems clear that language as a whole is a multi-component system made up of many incremental parts (Fitch 2010).

In this regard the cognitive capacities of a) analogical pattern-finding and b) social cognition, which featured prominently in this section, seem to be especially vital for language acquisition and use (Tomasello 2003, 2011). With this in mind I will focus on social cognition as a key element in what makes humans special for the remainder of this essay.

4 Social Cognition and Culture

As mentioned earlier, one important aspect that should be borne in mind is that our cognitive style may more be something of an idiosyncrasy due to a highly specific cognitive specialization instead of a definitive quantitative and qualitative advance over other styles of animal cognition. Chimpanzees, for example, beat humans at certain memory tasks (Inoue & Matsuzawa 2007) and behave more rationally in reward situations (Jensen et al. 2007).

In addition, it has been shown that in tasks in the social domain, which are generally assumed to be cognitively complex, domesticated animals such as dogs and goats (Kaminski et al. 2005) fare similarly well or even outperform chimpanzees. It is entirely possible that the first signs of human uniqueness were first simply side-effects of our self-domesticating lifestyle — the same way the evolution of social intelligence in dogs and goats is hypothesised to have come about —, acting on a complex primate brain (Hare & Tomasello 2005).

This line of reasoning is also supported by domesticated silver foxes which have been bred for tameness over a time period of 50 years but developed other interesting characteristics as a by-product: "They started having splotched and piebald coloration of their coats, floppy ears, white tips of their tails and paws. Their body proportions changed. They started barking. They improved on their performance in cognitive experiments." (Zivkovic 2012). What seems most interesting in this context, though, is another by-product of their experimental domestication: they also improved in the domain of **social cognition**. For example, like dogs, they are able to understand human communicative gestures like pointing. This is all the more striking because, as mentioned above, chimpanzees do not understand human communicative gestures like helpful pointing. Neither do wolves or non-domesticated silver foxes (Hare et al. 2005).

It is certainly a fact "that Homo sapiens has become 'localized' by having to depend upon learned, culture-specific modes of interacting." (Bruner 2005: 693). Humans are constantly immersed in culture and social interactions and at the same time extremely dependent on it, and human ontogeny fundamentally differs from that of any other primate species. Human infants are even more helpless and completely dependent on others, and remain unable to feed and care for themselves for a uniquely long time span. Furthermore, childhood and adolescence are two additional and prolonged states of mental development and cultural learning absent in any other species that seem to be vitally important for the development of culturally adept and cognitively highly sophisticated human beings (Locke & Bogin 2006).

5 Comparing Social Cognition in Great Apes, including Humans

The fact that **social interaction**, **learning**, and **cultural transmission** play such a vital and important role for children's ongoing cognitive development suggests that they may have a biologically-based "adaptation for culture" which has to be operative from early on. Comparing young children's and infants' cognitive abilities with that of the other great apes may be a useful indicator of the biological foundations of what makes us uniquely human. In addition, by using great apes as comparative model organisms for the capacities of our last common ancestor with them, we can gain crucial insights into the phylogenetic platform the evolution of human cognition could have started from (Bjˆrklund et al. 2010; Haun et al. 2010).

Herrmann et al. (2007) compared the performance of 2.5-year-old children and other great apes (in this case chimpanzees and orangutans) across a wide range of domains and indeed found that in some domains the differences are much more marked than in others. In the **physical domain**, which includes the understanding of **space**, **quantity** and **causality**, the subjects were tested by rewards that were out of reach and could only be retrieved with a stick (causality), or they had to find a reward that was not directly accessible but had to be located (space). In the **social domain**, subjects had to follow "an actor's gaze direction to a target," solve "a simple but not obvious problem by observing a demonstrated solution" (**social learning**), or understand what an actor intended to do, but in the end failed to (**intention attribution** or **Theory of Mind**).

Generally, orangutans fared worst in most of the tests, whereas chimpanzees and humans were quite similar in the physical domain. In some of the physical tasks, especially the one which required active tool use, chimpanzees even outperformed human children. But in the causality tasks in which "a judgment must be made before manipulation or choice" (Hermann et al. 2007:1362) children were better.

They were also better in **inhibitory** and **cognitive control** in general, something that is expected given what we know about the disproportionate dominance and prominence of higher-order prefrontal circuitry, which better enables a child's brain "to coordinate processing among its millions of neurons in order to direct them toward future goals" (Miller et al. 2002: 1131).

Overall, according to Herrmann and her colleagues, the results provided strong support

> for the **cultural intelligence hypothesis** that human beings have evolved some specialized social-cognitive skills (beyond those of primates in general) for living and exchanging knowledge in cultural groups: communicating with others, learn-

> ing from others, and "reading the mind" of others in especially complex ways (Hermann et al. 2007: 1365).

But as indicated by children's performances in the causality task, and in congruence with the models of human cognition I have outlined above, the social domain is not the only catch-all distinctive property of human minds. Instead, the ability to re-interpret cognitive data in terms of more abstract properties such as "unobserved causal forces" and "mental states" seems to be the distinctive foundation for excelling performances in both the physical and social domains. The authors of the study find it plausible, however, that "understanding hidden causal forces evolved first to enable humans to understand the mental states of other persons, and this generalized only later to the physical domain" (Herrmann et al. 2007: 1365).

If we follow this line of reasoning we are once again justified in further looking for uniquely human attributes in the socio-cognitive development of children. One of the most interesting proposals in this domain is that of shared intentionality.

6 Shared Intentionality — The Foundation of Human Uniqueness?

Shared or collective intentionality is defined as the ability and motivation to engage with others in collaborative, co-operative activities with joint goals and intentions (Tomasello et al. 2005). The term also implies that the collaborators' psychological processes are jointly directed at something and take place within a joint attentional frame (Hurford 2007: 320; Tomasello et al. 2005).

Michael Tomasello and his colleagues have proposed that shared intentionality and the cognitive infrastructure supporting it may be the crucial feature that makes humans unique.

6.1 Understanding Pointing

The infrastructure of this capacity requires abilities that are present in humans at a surprisingly young age. Although human children only know what others can and cannot see at 24 months of age (Moll & Tomasello 2006), other social cognitive skills appear at a much earlier date (Chimpanzees, interestingly, appear to know what another one sees only in competitive situations, i.e. when there are two rewards and one of them is in plain sight of a dominant chimpanzee, the sub-dominant chimpanzee takes the one that is hidden from view (Hare & Tomasello 2004)).

At 14 months of age, for example, human children are able to successfully pass an object-choice task. In this task, children are presented with two upside-down buckets, one of which contains a toy, and the experimenter points toward the bucket where the toy is hidden. The child then turns to the right bucket and retrieves the toy. Although this task may appear simple, it is remarkable that chimpanzees fail it. It seems that they fail to see the pointing gesture as a relevant cooperative signal within a shared attentional frame. Instead chimpanzees seem to think something along the lines of: "'A bucket. So what? Now where's the food?' They do not understand that the pointing is intended to be 'relevant' to the searching as a shared activity (see Sperber & Wilson, 1986)" (Tomasello & Carpenter 2007: 122).

But this result is reversed in chimpanzees when instead of pointing cooperatively towards the bucket, the experimenter makes a prohibiting gesture by holding her arm out towards the correct container with her palm out, says something like "Don't take this one" in a firm manner, and then leaves the room. In this competitive context chimpanzees can successfully infer the location of the hidden reward. What is equally interesting is that 24-month-old children do not retrieve the hidden toy, possibly because they are better at cognitive control than 18-month-old children and chimpanzees and are aware of the social and communicative conventions of the prohibiting action (Hermann & Tomasello 2006; see e.g. Miller et al. 2002; Tomasello 2008: 208ff.).

6.2 Understanding Shared Experience

At the age they are able to solve a simple informative object-choice tasks, infants can also keep track of who is familiar with some toy and who is not through shared experience (Moll & Tomasello 2007; Moll et al. 2007). But their understanding of joint engagement seems to go even deeper than that: In an experiment involving three toys and two experimenters, the first experimenter and the infant played together with two of three toys, then the first experimenter left the room. After that, the second experimenter and the infant played with all three of the toys, but with two of them in a normal fashion and with one of them in a very excited manner. When the first experimenter then came back in ambiguously asked for "it" infants reliably gave them the toy they had an excited shared experience with. Control conditions clearly showed that the infants knew "which of these objects "we" — and not just me or you alone — had experienced in a special way in the immediate past" (Moll et al. 2008: 98).

A linguistic experiment in which a mother played with three toys together with her child and then left the room, and the child then played with a fourth novel toy together with an experimenter, had similar results. When the mother came back and looked at the four toys and excitedly exclaimed "Oh, a modi, a modi!" the child successfully learned this as the word for the fourth novel object, drawing on their experience of sharing common ground with the mother in respect to the first three toys, but not with the new toy (Akhtar et al. 1996).

6.3 Understanding Joint Commitments

In general, human children and infants seem to be much more interested in cooperation, sharing, and committing themselves to a shared goal and a shared experiential perspectives than other primates. It is true that in specific contexts chimpanzees exhibit joint, co-operative, coordinated hunting for small monkeys (Boesch & Boesch 1989). In addition, human-raised enculturated chimpanzees successfully solve co-operative problem-solving tasks in which food could be retrieved only together with a non-competitive, familiar human adult both when it required parallel and complementary roles. When it comes to social games, however, such as one person rolling a ball down a tube and another one catching it with a can (complementary), or making a wooden block jump on a trampoline (parallel), the chimpanzees showed no interest and played with single parts of the game set-up for themselves. 18- to 24-month-old human children on the other hand successfully took part in both the co-operative problem-solving tasks as well as the social games. What is more, in contrast to the chimpanzees the children actively tried to reengage the adult when he ceased doing his part of the co-operative activity in both problem-solving and social contexts.

Children thus explicitly displayed skills of shared intentionality by being jointly committed to a shared goal with shared intentions (Warneken et al. 2006). These skills can also be seen in the manifesting conversational and linguistic skills of children around that time (Tomasello 2003).

6.4 Pointing in Human Children and Chimpanzees

The shared intentionality infrastructure is also already present in the communicative power of pantomiming and informative pointing just for the sake of sharing attention and sharing information, which infants acquire around their first birthdays (Tomasello 2008: 111). These behaviours even include references to absent object or events such as something that is going on outside, something that happened in the past or will happen again in the future, a cup that is empty and should be filled, or something that is hidden or not present at the moment (Tomasello 2008: 116f.).

Chimpanzees, on the other hand, very rarely point in natural contexts, and captive chimpanzees only do so when requesting something, using the human as a "social tool" (Tomasello 2006). A similar imperative behaviour has recently been observed in the wild: During grooming, chimpanzees sometimes point to a specific part of their body where they want to be scratched (Pika & Mitani 2009). These "directed scratches," however, are also imperative in nature and not declarative.

In contrast, 12- to 18-month-olds also point co-operatively to inform others of the location of an object they are looking for (Liszkowski et al. 2006: 173).

7 Conclusion

Generally human infants and children have a natural tendency to be extremely cooperative in a variety of tasks and help others solve their problems

> even when the other is a stranger and they receive no benefit at all. However, our nearest primate relatives show some skills and motivations in this direction as well, and this suggests that the common ancestor to chimpanzees and humans already possessed some tendency to help before humans began down their unique path of hyper cooperativeness (Warneken & Tomasello 2006: 1302).

The evidence presented here strongly suggests that social intelligence was a driving factor and maybe the crucial foundation for what makes us unique.

But in addition, it seems that in the human lineage the "Machiavellian Intelligence Hypothesis," which sees social competition as the main causal factor for primate, including human brain evolution (Byrne & Whiten 1988; Humphrey 1976), does not apply across the board. Instead, humans also show unique social motivations for sharing psychological states and collaborating in joint activities with others. From very early on, they are motivated to align themselves with others and in a sense to be like them (Carpenter 2011). This suggests that the unique aspects of human cognition were driven, and are perhaps even constituted by, collaboration, cooperation and the natural motivation to share experiences, intentions and perspectives, which then led to the advances in culture, technology, and higher-order cognition we see today (Moll & Tomasello 2007b).

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