The origins of narrative

In search of the transactional format of narratives in humans and other social animals*

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This article presents work in progress towards a better understanding of the origins of narrative. Assuming an evolutionary and developmental continuity of mental experiences, we propose a grounding of human narrative capacities in non-verbal narrative transactions in non-human animals, and in pre-verbal narrative transactions of human children. We discuss narrative intelligence in the context of the evolution of primate (social) intelligence, and with respect to the particular cognitive limits that constrain the development of human social networks and societies. We explain the *Narrative Intelligence Hypothesis* which suggests that the evolutionary origin of communicating in a narrative format co-evolved with increasingly complex social dynamics among our human ancestors. This article gives examples of social interactions in non-human primates and how these can be interpreted in terms of narrative formats. Due to the central role of narrative in human communication and social interaction, we discuss how research into the origins of narrative can impact the development of humane technology which is designed to meet the biological, cognitive and social needs of human story-tellers.

Keywords: Social intelligence, Narrative intelligence, Autism

1. Introduction: The Social Animals

Humans share fundamental cognitive and behavioral characteristics with other primates, in particular apes (orangutan, gorilla, chimpanzee, bonobo). Although it is widely accepted that humans and other apes have a common ancestor and that human behavior and cognition are grounded in evolutionary

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'older' characteristics, many people still insist that human intelligence and human culture are 'unique' and qualitatively different from most (if not all) other non-human animals. Traditionally human language has often served as an example of a 'unique' characteristic. However, due to Donald Griffin, the founder of the field of cognitive ethology, it is recognized as a valid endeavor to study the evolutionary continuity of mental experiences (Griffin, 1976). Humans are not discontinuous from the rest of nature.

The particular topic of this paper is narrative. With a few exceptions (Read & Miller, 1995), most discussions on the 'narrative mind' have neglected the evolutionary origins of narrative. Research on narrative focuses almost exclusively on language in humans (see, e.g., Turner, 1996). Similarly, narrative is often conceived of as a (sophisticated) art form, rather than serving a primarily *communicative* function. The work presented in this paper[1] argues that human narrative capacities are not unique and that an evolutionary continuity exists that links human narratives to transactional narrative formats in social interactions among non-human animals. Also, from a developmental point of view, we argue that narrative capacities develop from pre-verbal, narrative, transactional formats that children get engaged in with their parents and peers. Instead of focusing on differences between humans and other animals, we point out similarities and evolutionary, shared histories of primates with specific regard to the origins and the transactional format of narratives.

The article sets off by reviewing the main arguments of a debate that is currently discussed intensively in primatology and anthropology, namely, that the primary function of human language might have been its capacity to afford coping with increasingly complex social dynamics. Based on this framework of the social origin of human intelligence, we discuss the *Narrative Intelligence Hypothesis* (NIH), first suggested in (Dautenhahn, 1999), that points out the intertwined relationship between the evolution of narrative and the evolution of social complexity in primate societies. The underlying assumptions and arguments are discussed in greater detail. The NIH as referred to in this paper consists of the following line of arguments:

a. *Individualized societies* are a necessary (but possibly not sufficient) 'substrate' for the evolution of narratives. In such societies members know each other individually.
b. The specific *narrative format* of such transactions serves an *important communicative function* among primates and has possibly evolved independently in other groups of species that live in individualized societies. Narrative capacities co-evolved in order to cope with increasingly complex dynamics.

c. The evolution of communication in terms of narrative language (story-telling) was an important factor in human evolution that has shaped the evolution of human cognition, societies and human culture. The use of language in a narrative format provided an efficient means of 'social grooming' that maintains group coherence.
d. Pre-verbal transactions in narrative format bootstrap a child's development of social competence and social understanding.
e. Human cultures which are fundamentally 'narrative' in nature provide an environment that young human primates are immersed in and facilitate not only the development of a child into a skilled story-teller and communicator, but also the development of an autobiographical self.

The NIH is speculative and part of ongoing research. The particular contribution of this article is that it discusses in more detail the *transactional* and *canonical format* of narrative that can be found in different verbal and non-verbal social interactions among primates, and in preverbal communication of human infants.[2] While this paper discusses work in progress, it is hoped that future research in this area can lead to a theory of the (social) origins of narrative. Essential for the development of such a theory is empirical evidence. The current paper only provides supporting material that helps in a) the process of synthesizing ideas from various research fields, and b) in formulating the NIH. In Section 5 we discuss experiments that are needed in order to test/falsify a theory on the social origins of narrative.

The NIH implies a better understanding of the origins of narrative intelligence in humans and other animals. Such an understanding can point out issues relevant to the design of *narrative technology.* Therefore, Section 6 concludes this paper by discussing implications of the NIH for technology that meets the social and cognitive needs of human story-tellers.

2. The Social Brain Hypothesis

Primate societies belong to individualized societies with complex types of social interactions, social relationships and networks. In individualized societies group members individually recognize each other and interact with each other based on a history of interactions as part of a social network. Many mammal species (such as primates, elephants, and cetaceans) live in highly individualized societies, so do bird species such as corvids and parrots. Preserving social

coherence and managing cooperation and competition with group members are important aspects of living in individualized societies. Dealing with such a complex social field often requires sophisticated means of interaction and communication which are important for the Narrative Intelligence Hypothesis discussed in this article.

2.1 Primate group sizes and the neocortex

Why do humans have, relatively speaking, large brains? No other organ of the human body consumes as much of the body's energy (20%), even at rest, while making up only 2% of an adult's body weight. How can human primates afford such an expensive organ? What were the particular selective pressures in human evolution that led to such costly brains, or to put it differently, what are brains good for?

In the context of human (or generally primate) intelligence the *Social Intelligence Hypothesis* (SIH), sometimes also called *Machiavellian Intelligence Hypothesis* or *Social Brain Hypothesis*, suggests that the primate brain and primate intelligence evolved in adaptation to the need to operate in large groups where the structure and cohesion of the group required a detailed understanding of group members (cf. Byrne & Whiten, 1988; Whiten & Byrne, 1997; Byrne, 1997). Given that maintaining a large brain is very costly, it is assumed that the necessity to evolve social skills (which allow interpreting, predicting and manipulating conspecifics) has been a prominent selective factor accelerating primate brain evolution. Identifying friends and allies, predicting behavior of others, knowing how to form alliances, manipulating group members, making war, love and peace, are important ingredients of primate politics (de Waal, 1982). Thus, there are two interesting aspects of primate sociality: it served as an evolutionary constraint which led to an increase of brain size in primates, which, in return, led to an increased capacity to further develop social complexity.

Research in primatology that studies and compares cognitive and behavioral complexity in and among primate species, can shed light on the origins of primate cultures and societies. Particularly relevant for the theme of this article are the potential relationships between social complexity and brain evolution. A detailed analysis by Dunbar and his collaborators (Dunbar, 1992, 1993, 1998) suggests that the mean group size N is a function of relative neocortical volume C_R (volume of neocortex divided by volume of the rest of the brain (see formula (1) and Figure 1)).

$$\log_{10}(N) = 0.093 + 3.389 \log_{10}(C_R) \quad (1)$$

This correlation does not provide 'hard' evidence, which is fundamentally difficult to obtain for many aspects of the evolution of animal (and human) minds, but it supports the argument that social complexity might have played a crucial role in primate brain evolution. In order to manage larger groups bigger brains might provide the required 'processing capacity'. No such correlates have been found when comparing the increase of neocortex size with the complexity of the environment, such as the size of the home range of a species.[3] The causality and complexity of the argument 'complex social dynamics led to larger neocortices' are still not completely understood, but in primatology it is currently widely acknowledged that social complexity provided an important, and possibly causal, factor in the evolution of primate (social) intelligence.

How can primate societies cope with an increase in the number of group members and relationships among them? How are social networks and relations established and maintained? How is cohesion and stability preserved? What are the mechanisms that serve as 'social glue'?

2.2 Preserving cohesion in primate societies: Grooming and language

Judging from our own experience as a member of human society, communicating via *language* seems to be the dominant mechanism for the purpose of preserving social cohesion. However, non-human primates in the wild do not seem to use a human-like language. Here, social cohesion is maintained through time by *social grooming*. Social grooming patterns generally reflect social relationships; they are used as a means to establish coalition bonds, for reconciliation and consolation and other important aspects of *primate politics*. Social grooming is a one-to-one behavior extended over time, that poses particular constraints on the amount of time an animal can spend on it, given other needs such as feeding, sleeping, etc. Also, cognitive constraints limit the complexity of social dynamics that primates can cope with, as discussed in the following paragraph.

Given the neocortical size of modern humans, Dunbar (1993) extrapolated from the non-human primate regression (relative neocortical volume vs. group size) and predicted a group size of 150 for human societies. This number limits the number of relationships that an individual human can remember and monitor. It is the upper group size limit which still allows social contacts that

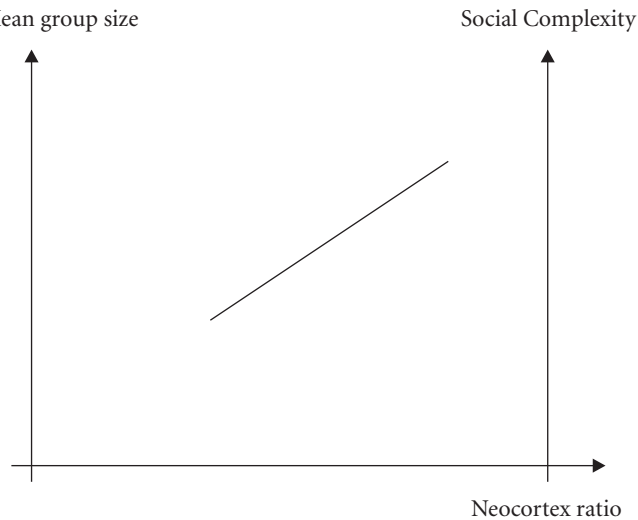

Figure 1. Group size plotted against neocortex ratio (logarithmic scales). Correlations were found, e.g., in 36 primate genera (Dunbar, 1993). Similar relationships (not necessarily on the same grade as the primate regression) have been found in carnivors, some insectivors (Dunbar & Bever, 1998), cetaceans (Marino, 1996), and some bats (Barton & Dunbar, 1997). Thus, it seems that a common relationship between social complexity and encephalization (relationship between brain size and body size) can be found in animal species that live in stable social groups, although each species might live in very distinctive environments, with very distinctive 'brains' and very different evolutionary histories.

can be maintained and interaction-histories that can be remembered, thus supporting effective coordination of tasks and information-flow via direct person-to-person contacts. The number 150 is supported by analysis of contemporary and historical human societies. But how do humans preserve cohesion in groups of 150 individuals, a function that (physical) social grooming serves in non-human primate societies? In terms of survival needs (resting, feeding, etc.) primates can only afford to spend around 20 % of their time on social interactions and social grooming, much less than a group size of 150 requires. It was therefore suggested by Dunbar (1993) that, in order to preserve stability and coherence in human societies, *human language has evolved as an efficient mechanism of social bonding*, replacing social grooming mechanisms in non-human primate societies where direct physical contact affords only much smaller groups. Following this argument, language allowed an increase in group size while still preserving stability and cohesion within the group. The next

section will elaborate this argument further by analyzing what the particular features of communication via language are that make it an efficient 'social glue' in human societies.

3. The Narrative Intelligence Hypothesis

According to the primatologist Richard Byrne (Byrne, 1997), in the context of the evolution of human intelligence, the Social Intelligence Hypothesis offers little explanation for the evolution of specific ape and human kinds of intelligence (e.g., involving mental representations): clear evidence for a systematic monkey-ape difference in the neocortex ratio is lacking. Great apes do not form systematically larger groups than monkeys do, which draws attention to physical rather than social factors (e.g., tool use, processing plant food, etc.). Why have in particular human apes evolved sophisticated representational and mental skills? Are there any candidate factors that could have accelerated the evolution of human intelligence? If the evolution of language played an important role, as suggested by others (e.g., Dunbar, 1993; Donald, 1993), *what are the particular characteristics of language that matter?*

3.1 What is special about language?

A closer look at the ontogeny of language and narrative, i.e., the role of language in the development of children, can give important hints about the special characteristics of language: Studies in developmental psychology of how children develop narrative skills, show that narratives play a crucial role in how young human primates become socially skilled individuals (cf. Nelson, 1993; Engel, 1995).

Narrative psychology considers stories *the most efficient and natural human way to communicate, in particular, to communicate about others* (Bruner, 1987, 1990, 1991). According to Read and Miller "stories are universally basic to conversation and meaning making", and as developmental and cross-cultural studies suggest, "humans appear to have a readiness, from the beginning of life, to hear and understand stories" (Read & Miller, 1995, p. 143). The *Narrative Intelligence Hypothesis* (Dautenhahn, 1999) interprets such observations from the ontogeny of human language in the context of primate evolution. It proposes that the evolutionary origin of communicating in stories co-evolved with increasing social dynamics among our human ancestors, in particular the

necessity to communicate about third-party relationships (which in humans seems to reach the highest degree of sophistication among all apes (cf. gossip and manipulation (Sinderman, 1982)). According to the NIH, human narrative intelligence might have evolved because the *format of narrative* is particularly suited to communicate about the social world.

Thus, in human evolution, we can observe an evolutionary trend from physical contact (non-human primates) to vocal communication and language (hominids), to communicating in stories (highly 'enculturated' humans living in complex societies), correlated with an increase in complexity and sophistication of social interaction and communication. This trend demonstrates the evolution of increasingly efficient mechanisms for time-sharing the processes of social bonding. While physical grooming is generally a dyadic activity, language can be used in a variety of ways, extending the dyadic use in dialogues to, e.g., one-to-many communication as it is used extensively in the mass media (television, books, email, etc.) today. It can be estimated (Dunbar, 1993) that the human bonding mechanism of language is about 2.8 times as efficient as social grooming (the non-human primate bonding mechanism). Indeed, Dunbar's studies indicate that conversational groups usually consist of one speaker plus two or three listeners. Of course larger groups can be formed easily but, in terms of actively participating and following different arguments within the group, 1+2(3) seems to be the upper limit for avoiding 'information processing overload' in the primate social brain. Also, because of its representational nature, language affords documentation, preservation in storage media and transmission of (social) knowledge to the next generation, as well as communication between geographically separated locations (Donald, 1993).

3.2 Narrative, the social context and meaning

Discussions in the social domain (e.g., on social relationships and feelings of group members) are fundamentally about *personal meaning*, different from, e.g., discussions in the technical domain (such as how to operate a tool or where to find food). *Narrative might be the 'natural' format for encoding and transmitting meaningful, socially relevant information (e. g., emotions and intentions of group members).* Humans use language to learn about other people and third-party relationships, to manipulate people, to bond with people, to break up or reinforce relationships. Studies suggest that people spend about 60 % of conversations on gossiping about relationships and personal experiences (Dunbar, 1993). Thus, a primary role of language might have been to commu-

nicate about social issues, to get to know other group members, to synchronize group behavior, to preserve group cohesion.

To summarize, the following strategies of coping with a complex social field in primate societies were outlined in the preceding sections:

stage 1: non-verbal, physical, social grooming as a means of preserving group cohesion, limited to one-to-one interaction
stage 2: communicating about social matters and relating to others in the narrative format of transactions with non-verbal 'enacted' stories (see Section 4)
stage 3: using language and verbal narratives in order to cope with social life

The Narrative Intelligence Hypothesis suggests that the evolution and development of human narrative capacities might have gone through these different stages, not replacing preceding stages, but adding additional strategies that extend an individual's repertoire of social interaction. These range from physical contact (e.g., in families and very close relationships) to preverbal 'narrative' communication in transactions with others (let alone the subtleties of body language and nonverbal social cues, not necessarily conscious (cf. Hall, 1968; Farnell, 1999)), to developing into a skilled story-teller within the first years of life and refining these skills throughout one's life. The next section gives a few examples of where we might find narratives in the behavior of humans, other animals, and possibly even artifacts. To begin with, we need to have a closer look at the specific canonical format of narrative.

4. In search for narratives

4.1 What are narratives?

Many definitions and theories of narrative exist in the literature. In the following we select and discuss a few definitions. With respect to adult literature and conversation, what we usually mean by narrative is a story with the following structure: First, a certain introduction of the characters is given (making contact between individuals, actors, listener and speaker). Then, the story develops a plot, namely a sequence of actions over time that convey meaning (value, pleasurable, not pleasurable), usually with a high point and a resolution (reinforcement or break-up of relationships), and focuses on unusual events rather than stereotypical events.

Note that such a structure is typical for 'adult' narratives. Children's narratives can have rudiments of this structure but still count as narratives that describe personal experience of the story-teller. Children are not born as perfectly competent story-tellers. The format of narrative story-telling is rapidly learnt by typically developing children during their first years of life. Here, the social environment is crucially important in developing and shaping children's narrative skills (Engel, 1995; Nelson, 1989, 1993); narrative skills are socially constructed. The narrative styles and abilities of children develop during their daily interactions and conversations that they participate in and listen to. The environment, e.g., parental input, shapes and influences this development. Children's narrative styles and abilities reflect particular styles, values and conventions used in families, cultures, etc. Story-telling development is a highly social and interactive process, 'tutoring ' is usually informal and playful (Engel, 1995). The typical 'adult' story format of beginning, middle and end is usually mastered by 3-year olds. The following two examples show the differences between a typical story of a 2-year old girl and a 5-year old boy, both telling the story to their mother:

> "We went trick and treating. I got candy. A big red lolly-pop and I lost my hat." (Engel, 1995, p. 16).

> "Once there was a monster that lived where other monsters lived just like him. He was very nice. He made bad people good. He lived always happy. He loved to play with kids. One day he gets caught in a hurricane. The lights went off except there was flashlights there. He jumped into the ocean. He meeted all the fish. And he lived in water" (Engel, 1995, p. 71).

Thus, children's stories can occur in rudimentary forms (see first example), or can be elaborated (second example), from which the step towards fully-fledged adult story-telling seems relatively small. Note that even the rudimentary story told by a 2-year old is 'successful' in terms of its 'meaning' and its communicative function: a significant experience in the child's life is recalled and reconstructed.

While many discussions of the format of narrative focus on narratives in oral format, in this article we refer to narrative in a wider sense, including written and spoken narratives. Note that structural aspects relating to the syntax of a story are not our primary concern. Story grammars (Mandler, 1984), i.e., notational, rule-based systems for describing regularities and formal structures in stories (e.g., in traditional folk-tale or problem-solving stories), are not the kind of narrative formats that are the focus of this article. Instead, we stress the *transactional nature* of narratives and the way that narratives convey *meaning,*

can create *intersubjectivity* and are embedded in a *social context*. According to this perspective, we tentatively propose the following definition of narrative:

A narrative consists of verbal (spoken or written) or non-verbally 'enacted' social transactions with the following necessary properties:

a. Narratives have an important communicative function. "We use stories to guide and shape the way we experience our daily lives, to communicate with other people, and to develop relationships with them. We tell stories to become part of the social world and to know and reaffirm who we are" (Engel, 1995, p. 25). Thus, the major topic of narratives is the social field, involving transactions of intentional, social agents acting in a social context. Narratives are means to create intersubjectivity between people who communicate with each other, or between ourselves and our former or future 'self', which leads us to the second important property of narrative:

b. Remembered experience, when put in the format of a narrative, allows us to think about the past (Engel, 1995, p. 26) and to 'go back in time'. More generally, narrative extends the temporal horizon from the present (the 'here and now'), to the past ('how things used to be') and to the future ('how things might be') (cf. Nehaniv et al., 1999). Narratives allow us to travel back and forth in time, to create imaginary or alternative realities, to re-interpret the past, and in this way are fundamentally different from communicative non-narrative events that are limited to the immediate present. One might speculate that, because narratives extend the 'temporal horizon', they are crucial to the development of a 'self' (Nelson, 1989, 1993), an *autobiographic* self. But what is the format of narrative that provides all this, namely, creating intersubjectivity and extending the temporal horizon? We suggest that:

c. The narrative follows a particular transactional format which in its simplest form, found in preverbal children, and possibly other non-verbal non-human animals, consists of the following sequence: canonical steady state, precipitating event, restoration, and a coda marking the end. This transactional format was suggested by Bruner and Feldman (1993), see Section 4.2. Other transactional formats of narrative might exist, but, for the purpose of this paper, we focus on this simple format suggested by Bruner and Feldman.

In the fields of narrative psychology and narrative intelligence Jerome Bruner's theories and work have been very influential (Bruner, 1987, 1990, 1991). Particularly relevant to this paper is Bruner's notion that stories are primarily dealing with people and their intentions; they are about the social and cultural domain rather than the domain of the physical world. Narratives are often

centered towards subjective and personal experience. According to Bruner (1991), narrative is a conventional form that is culturally transmitted and constrained. Narrative is not just a way of representing or communicating about reality, it is constituting and understanding (social) reality. Unlike scripts (Schank & Abelson, 1977) that describe regular events, narratives are about 'unusual events', 'things worth telling' (Bruner, 1991). Narratives describe people or other intentional and mental agents, acting in a setting in a way that is relevant to their beliefs, desires, theories, values, etc., and they describe how these agents relate to each other.

Although narrative capacities (understanding and producing stories) are capacities shaped by society, they clearly develop in an *individual* (cf. Nehaniv, 1997; Dautenhahn & Coles, 2001) with an important meaning for the individual agent. For example, stories that children tell to *themselves* play an important part in a child's abilities to make meaning of events (cf. Nelson, 1989; Engel, 1995). Nevertheless, stories, at least for fundamentally social animals such as humans, are most effective in communication in a social context:

> "We converse in order to understand the world, exchange information, persuade, cooperate, deal with problems, and plan for the future. Other human beings are a central focus on each of these domains: We wish to understand other people and their social interactions; we need to deal with problems involving others; and other people are at the heart of many of our plans for the future." (Read & Miller, 1995, p. 147).

Human culture has developed various means of artistic expression (sequential visual arts, dance, pantomime, comics, literature, etc.) which are fundamentally 'narrative' in nature, conveying meaning about people and how people relate to the world. Children who are immersed in human culture, exposed to those narratives, develop as skilled story-tellers, as is shown in the following story called "Jig Jags Day", written by a 9-year old girl when asked to write a story about a robot. This story and the one mentioned in Section 4.2 were part of a project with typically developing children, summarized in (Bumby & Dautenhahn, 1999). The story fits Bruner's criteria very well:

> "Once there was a robot called Jig Jag and Jig Jag lived in the countryside. One day Jig Jag's lights started to flash, that meant that the robot had an idea. "I think I will go for a walk", so Jig Jag went into a field with some sheep in it and the silly robot tried to talk to the sheep, "Silly, silly, Jig Jag". Next Jig Jag saw some cows in the next field, so silly Jig Jag tried to talk to the cows! After that Jig Jag went to the shops, he wanted to buy some bolts and oil. So Jig Jag went into the hardware shop, but poor Jig Jag set the alarm off. So Jig Jag went into

another hardware store across the road. So the robot tried to get into the shop but again Jig Jag set the alarm off. So poor Jig Jag had to go home empty handed."

4.2 Narratives and autism

Traditionally psychologists interested in the nature and development of narratives have a particular viewpoint of narratives in terms of human *verbal* story-telling. Interestingly, Bruner and Feldman (1993) proposed the *narrative deficit hypothesis of autism*, a theory of autism that is based on a failure of infants to participate in narrative construction through *preverbal* transactional formats. Children with autism generally have difficulty in communication and social interaction with other people. A variety of competing theories attempt to explain the specific communication and social deficits of people with autism (Jordan, 1999). Among them is the well known *Theory of Mind (TOM)* (cf. Leslie, 1987; Baron-Cohen, 1995). TOM models of mindreading have a clear modular, computational and metarepresentational nature. However, the TOM explanation of autistic deficits is controversial and other researchers suggest that primary deficits in emotional, interactive, or other factors central to the *embodied* and *intersubjective* nature of social understanding, might be causing autism (e.g., Rogers & Pennington, 1991; Hobson, 1993). Deficits in narrative skills have been observed in children with autism (e.g., Loveland et al., 1990; Charman & Shmueli-Goetz, 1998). Bruner and Feldman's theory suggests that autistic deficits in communication and social interaction can be explained in terms of a *deficit in narrative communication skills*. This theory, which differs from TOM, assumes that transactional capacities, and the lack thereof, are at the heart of autistic deficits. As we discuss later in this article, this work gives important hints about the transactional structure of narratives, a structure that we believe is of wider importance, not limited to the specific context of autism.

What exactly is a narrative transactional format? Bruner and Feldman distinguish different stages. They suggest that the first transactional process is about reciprocal attribution of intentionality and agency. The characteristic format of preverbal transactions is, according to Bruner and Feldman, a narrative one, consisting of four stages:

1. canonical steady state
2. precipitating event
3. a restoration
4. a coda marking the end.

An example is the peek-a-boo game where (1) mutual eye gaze is established between infant and caretaker, (2) the caretaker hides her face behind an object, (3) the object is removed revealing the face again, and (4) "Boo", marking the end of the game.

Let us consider the following story called "Weebo", told by an 11-year old girl:

> "In America there was a professor called Peter Brainared and in 1978 he created a robot called Weebo. Weebo could do all sorts of things: she could create holograms, have a data bank of what the professor was going to do, show cartoon strips of what she was feeling like by having a television screen on top of her head which could open and close when she wanted to tell Peter how she felt. And she could record what she saw on television or what people said to her. Weebo looked like a flying saucer about as big as an eleven year old's head also she could fly. Peter Brainared had a girlfriend called Sarah and they were going to get married but he didn't turn up for the wedding because he was too busy with his experiments so she arranged for another one and another one but he still didn't turn up, so she broke off the engagement and when he heard this he told Weebo how much he loved her and she recorded it, went round to Sarah's house and showed her the clip on her television screen to show Sarah how much he loved her and it brought Sarah and Peter back together."

Bruner and Feldman's four stages of the transactional narrative format are clearly identifiable in this written narrative:

1. introduction of setting and actors
2. Peter misses the wedding and is sad
3. Weebo comes to the rescue: he shows Sarah how much Peter loves her
4. happy ending: Sarah and Peter are back together

Interestingly, although a central protagonist in the above story is a robot, it is depicted as an intentional agent (Dennett, 1987), embedded in a social context and behaving socially.

Bruner and Feldman suggest that problems of people with autism in the social domain are due to an inability early in their lives to get engaged in 'appropriate' transactions with other people. These transactions normally enable a child to develop a narrative encoding of experiences that allows it to represent *culturally canonical forms of human action and interaction.* Normally, this leads a child, at 2–3 years of age, to rework experiences in terms of stories until she ultimately develops into a skilled story-teller (Engel, 1995).

As research by Meltzoff, Gopnik, Moore and others suggests, transactional formats play a crucial role very early in a child's life when she takes the first

steps of becoming a 'mindreader' and socially skilled individual: reciprocal imitation games are a format of interaction that contributes to the mutual attribution of agency (Meltzoff & Gopnik, 1993; Meltzoff & Moore, 1999), immediate imitation creates intersubjective experience (Nadel et al., 1999). By mastering interpersonal timing and sharing of topics in such dyadic interactions, children's transition from primary to pragmatic communication is supported. It seems that imitation games with caretakers play an important part in a child's development of the concept of 'person' (Meltzoff & Gopnik, 1993; Meltzoff & Moore, 1999), and are a major milestone in the development of social cognition in humans.

As we mentioned above, studies by Bruner and Feldman (1993) and others (e.g., Loveland et al., 1990) indicate that children with autism seem to have difficulty in organizing their experiences in a narrative format, as well as a difficulty in understanding the narrative format that people usually use to regulate their interactions. People with autism show a tendency to *describe* rather than to *narrate*, lacking the specific causal, temporal and intentional pragmatic markers needed for story-making. A preliminary study with high-functioning children with autism, reported by Bruner and Feldman (1993), indicates that, although they understood stories (gave appropriate answers when asked questions during the reading of the story), they showed great difficulty in retelling the story, i.e., *composing* a story, based on what they knew. The stories they told preserved many events and the correct sequence, but lacked the proper emphasis on *important and meaningful events*, events that motivated the plot and the actors. The stories lacked the narrative bent and did not conform to the canonical cultural expectations that people expect in ordinary social interaction. Such a lack of *meaning-making* makes conversations in ordinary life extremely difficult, although, as Bruner and Feldman note, people with autism can show a strong desire to engage in conversations (Bruner & Feldman, 1993).

4.3 Narratives in animal behavior?

Stories have an extended temporal horizon, they relate to past and future, they are created depending on the (social) context. Do animals use (non-verbal) narrative formats in transactions? Studies, e.g., with bonobos, Grey parrots and dolphins, on animal language capacities usually focus on teaching the animals a language (using gestures, icons or imitating human sounds), and test the animal's language capacities primarily in interactions with humans (Savage-Rumbaugh

et al., 1986; Pepperberg, 1999; Herman, 2002). In the wild, the extent to which animals use a communication system as complex as human language is still controversial. For example, dolphins and whales are good candidates for sophisticated communicators.

However, we argue that looking for verbal and acoustic channels of communication might disguise the *nonverbal*, transactional nature of narratives, as shown in *preverbal* precursors of narratives in the developing child, and possibly evolutionary precursors of (*non-verbal*) narrative that can be found in non-human animals. Michael Arbib (2002) proposes an evolutionary origin of human language in non-verbal communication and body language that can be found in many social species (e.g., mammals, birds). He suggests that imitation (and the primate mirror neuron system (Gallese et al., 1996)) provided the major mechanisms that facilitated the transition from body language and non-verbal imitation to verbal communication. Arbib's work supports the arguments as presented in this paper, namely, proposing a) the existence of a strong link between non-verbal, preverbal and verbal communication, and b) stressing the important role of *dynamic formats of interactions*, such as imitative games, in the development of social communication.

With this focus on interactional structure and non-verbal narratives, what can stories in non-human primate species look like, and how can we recognize them? To date we are not aware of any 'hard' empirical evidence for story-telling capacities in non-human animals. However, it is known that primates are excellent 'politicians' in primate societies, involving extensive knowledge about direct (one-to-one) and third-party relationships. Primate behavior is not confined to fulfilling their immediate biological needs. Actions taken by an individual need to consider the social context, the primate social field. Primatologists know numerous examples of interactions that cannot be understood without assuming that the animals are aware of the social context. Note that any description of animal behavior can be biased by the narrative mind of the human observer, the story-teller. When watching a paramecium under a microscope, we can use our imagination to 'make-up' a story about an intentional agent that is 'hungry', 'chases prey', 'searches for a mate', etc. However, in the case of single-cell organisms, it is safe to assume that their 'social field' is far less developed (if at all) than in primate or other social species. Because of this danger of using imagination and anthropomorphism to attribute a narrative structure to animal behavior, below we give examples of stories of animal behavior told by primatologists who have been working for many years with their subjects, and who are more likely than untrained observers to report on

observable sequences of events and their own well informed interpretations of the animal's intentions and motivations.

Let us consider Frans de Waal's description of an event of reconciliation in chimpanzees.

> "On this occasion Nikkie, the leader of the group, has slapped Hennie during a passing charge. Hennie, a young adult female of nine years, sits apart for a while feeling with her hand on the spot on her back where Nikkie hit her. Then she seems to forget the incident; she lies down in the grass, staring in the distance. More than fifteen minutes later Hennie slowly gets up and walks straight to a group that includes Nikkie and the oldest female, Mama. Hennie approaches Nikkie, greeting him with soft pant grunts. Then she stretches out her arm to offer Nikkie the back of her hand for a kiss. Nikkie's hand kiss consists of taking Hennie's whole hand rather unceremoniously into his mouth. This contact is followed by a mouth-to-mouth kiss. Then Hennie walks over to Mama with a nervous grin. Mama places a hand on Hennie's back and gently pats her until the grin disappears" (de Waal, 1989, pp 39, 42).

This example shows that the agent (Hennie) is interacting with an eye to future relationships, considering past and very recent experiences. Hennie, Nikkie and Mama have histories, autobiographic histories as individual agents (Dautenhahn, 1996), as well as a history of relationships among each other and as members of a larger group. Although the event might be interpreted purely on the basis of behavioristic stimulus-response rules, for many primatologists the interpretation of the event in terms of intentional agents and social relationships is the most plausible explanation.

Interestingly, Hennie's interaction with Nikkie can be interpreted in terms of the canonical format of narrative transactions among intentional agents described in Section 4.2:

1. canonical state: greeting: soft pant grunts
2. precipitating event: Hennie reaches out to Nikkie (attempt at reconciling relationship)
3. restoration: kissing (relationship is restored)
4. end: Hennie is comforted by Mama

The second example we discuss is a different type of primate social interaction, namely, tactical deception whereby the animal shifts the target's attention to part of its own body. In this particular case the animal (a female Olive baboon) distracts the target (a male Olive baboon) with intimate behavior.

> "One of the female baboons at Gilgil grew particularly fond of meat, although the males do most of the hunting. A male, one who does not willingly share, caught an antelope. The female edged up to him and groomed him until he lolled back under her attentions. She then snatched the antelope carcass and ran", cited in (Whiten & Byrne, 1988, p 217).

Here, the analysis in terms of transactional narrative formats looks as follows:

1. canonical state: male brings antelope, female waits
2. precipitating event: distraction by grooming
3. restoration: female snatches food and runs away (resolution, female achieves goal)
4. end: female eats meat (not described)

Episodes of animal behavior as described above are very different from other instances of structured and sequential animal behavior, such as the chase-trip-bite hunting behavior of cheetahs. Also, the alarm calls of vervet monkeys (Cheney & Seyfarth, 1990), although serving an important communicative function in a social group and having a component of social learning, are not likely to be narrative in nature. It is not the short length of such calls that makes it difficult to interpret them in terms of narrative, it is the fact that their primary function is to change the *behavior* of others as a response to a non-social stimulus, i.e., the sight of a predator, causing an appropriate behavior such as running to the trees after hearing a leopard alarm. The narrative format in animal behavior, on the other hand, refers to *communicative* and *transactional* contexts where communication is *about* the social field, i.e., group members, their experiences and relationships among them. Narratives are *constructed* based on the current context and the social context (communicator/speaker plus recipients/audience). The primate protagonists described above apparently interacted with respect to the social context, i.e., considering the social network and relationships among group members, with the purpose of influencing and manipulating others mental states. Thus, such kinds of non-verbal narratives are fundamentally social in nature.

Table 1 summarizes the role of narratives in human ontogeny and phylogeny as discussed above.

A lot more work is necessary for a more detailed analysis of narrative formats in animal behavior. For example, the characteristics of the transactional format that Bruner and Feldman (1993) suggested need to be elaborated, possibly revised or replaced, and might need to be adapted to specific constraints of the primate social field. So our interpretation can only give a first

Table 1.

Human Ontogeny	Primate Phylogeny	Primary mechanism for social bonding
Transactions with a narrative format in infant-caretaker interactions (Dyadic interactions, direct relationships, preverbal children)	Non-verbal transactions in narrative format: narratives 'enacted' in primate social interactions (Direct and third party relationships, primates)	Grooming
Language in a narrative format: narratives spoken, written (Direct and third party relationships, verbal humans)	Language in a narrative format: narratives spoken, written (Direct and third party relationships, humans)	Language

hint of what aspects one might be looking for when searching for narrative formats in animal behavior.

5. How could the narrative intelligence hypothesis be tested?

If human language and narrative intelligence, rooted in *nonverbal* narrative skills in non-human primates, have evolved to deal with an increasing need to communicate in more and more complex societies, what predictions can be made based on this hypothesis? How could the Narrative Intelligence Hypothesis be tested? What are important research directions based on the importance of narrative in animals and artifacts?

Let us first consider how the NIH might be tested or falsified. As with other hypotheses on the origin of primate/human intelligence and language, animal behavior and communicative abilities are not directly documented in the fossil record. They can only be inferred indirectly from anatomical features (e.g., the vocal system that is necessary to produce a human-like language) and remains that indicate social structures (e.g., remains of nests or resting places, or groups of animals that died together). However, recent primate species that could serve as models of ancestors of the human species might give clues of what groups of primate species one might analyze if one wants to trace the origins of human narrative intelligence. Possible narrative structures confirmed in primate behavior might then be correlated with the complexity of

the social field in these species.

Today's primates show a great variety of social organizations and group living. The Narrative Intelligence Hypothesis would predict that *comparative studies* of communicative and, in particular, narrative formats of interactions across primates species with different social organizations can identify a correlation between the complexity of the narrative format and an increasing complexity of the primate social field. Such an increase of social complexity need not be limited to group size. It could also cover all other aspects of social complexity, such as an increasing number of different types of interactions and roles of group members, and the dynamics of how the social network can change and adapt to changes. Such stages of social organization can be related to behavioral as well as cognitive and mental capacities of primates. The NIH suggests a search for the narrative format in interactions, a format that is so efficiently suited to communicate and deal with the complexity of social life.

What kind of research directions and research methods could the NIH inspire?

Testing with robotic and computational models

Robots have been increasingly used as models for understanding behavior, and sensori-motor control, in humans and other animals. Similarly, robots might have their place in the study of the origins of narrative intelligence.

In an initial study (Dautenhahn & Coles, 2001) we investigated precursors of narrative based on episodic memory in autonomous robots. Following a bottom-up, Artificial Life approach towards narrative (Dautenhahn & Nehaniv, 1998; Nehaniv & Dautenhahn, 1998), we studied a single robot that could remember sequences of events ('pre-narratives'). A particular goal in this project was to study *minimal experimental conditions* of how story-telling might emerge from episodic memory. An initial experiment (Dautenhahn & Coles, 2001) showed that 'story-telling' could be beneficial even to a single agent (cf. Nehaniv, 1997), since it increased the behavioral variability of the robot.

Such research with an experimental, computational and robotic test-bed demonstrates a bottom-up approach towards studying narrative and how it can arise and evolve from pre-narrative formats (e.g., episodic memory abilities and formats that are necessary, but not sufficient, for narratives, as discussed in previous sections) in agents and agent societies. Also, it can provide a means to design and study narrative robots with 'meaningful' narratives that are grounded in the robot's own experiences, and means of interacting, with the world and other agents (including robots), so as to contribute to the robot's agenda to survive.

The work described above indicates how artifacts might be used as scientific instruments to explore and experimentally test the design space of narrative intelligence. Narratives in this sense need to have a 'meaning' for an (intentional) agent. The approach of using artifacts as experimental test beds has been used successfully for many years in the areas of Adaptive Behavior and Artificial Life, yielding many interesting results that a) help understand animal behavior and b) help design life-like artifacts, in this case artifacts with narrative skills.

Study and analysis of animal narrative capacities

Since the Narrative Intelligence Hypothesis does not assume any fundamentally 'novel' development in the transition from nonverbal (through evolution) or preverbal (development) to verbal narrative intelligence, a detailed study and analysis of the structure and format of animal narrative communication is required in order to develop a proper theory. Many vertebrate species are highly social and use non-verbal means of body language in interaction and communication. Narrative intelligence has a communicative function (as a means of discourse and dialogue). However, it also has an individual dimension (understanding and thinking in terms of narrative, recreating a 'self'). Revealing narrative structure in animal communication might, therefore, further our understanding of meaningful events in the lives of these animals.

Interesting open research questions (this is not an exhaustive list)

- Relationship between preverbal and verbal narrative intelligence in humans (ontogeny)
- Relationship between nonverbal narrative intelligence in non-human animals and narrative intelligence in humans (phylogeny)
- The format of nonverbal narrative intelligence in animals (Species specific? Specific to social organization of animal societies?)
- Can we identify narrative 'modes of thought' in different animal species (Bruner, 1990)?

The work presented in this paper is a small first step towards developing a theory of narrative that shows the evolutionary and developmental continuum of narrative capacities in humans and other animals. However, if, as we argued above, narrative and the narrative formats of transaction are deeply rooted in our ontogeny and phylogeny, then these provide important constraints and requirements for the design of artifacts that can meet the cognitive and social needs of 'Homo narratus'.

6. 'Homo narratus': Implications for Human Society and Technology

There are many implications of the Social Brain Hypothesis and the Narrative Intelligence Hypothesis for technology development. Human cognitive and narrative capacities are constrained by evolution and development. Even technological extensions and enhancements (new media, new means of communication, new interfaces and implants) need to operate within the boundaries set out by biology.

Firstly, 'imagined relationships' might stand in for human beings, in particular when the 'real' social network is smaller than 150. With the help of book, television or email we can easily *know* (by name or sight) more than 150 people, e.g., have more than 150 phone numbers stored in our mobile's database. However, these are not the types of *individually known* kin, friends, allies, or even enemies who are mutually known over an extended period of time so that the term 'relationship' applies. In particular, mass media such as television can give us the illusion that we 'know' news presenters, talk show hosts, movie stars, comic or video game characters, etc. The roles of friends and social partners might be filled by such imagined 'partners', and might serve a role similar to real human networks (Dunbar, 1996). However, any such 'relationships' are uni-directional; feelings such as love and admiration can only be expressed from a distance and will (realistically) not be returned. Recently emerging interactive agent technology adds another dimension to such 'imagined friends': virtual or robotic agents that give the illusion of life, namely, show appearance and behavior of real humans, such as embodied conversational agents (Cassell et al., 2000).

However, no matter how many virtual and robotic friends will become members of our social network, these extensions are not without limits. There are biological limits, constrained by the cognitive group size limit of 150 that characterizes the size of social networks of human primates. As Dunbar argues (1996), modern information technology might change a number of characteristics of *how* and with whom and with what *speed* we communicate, but will not influence the size of social networks, nor the necessity of direct personal contact that is needed to provide trust and credibility to social relationships. "Yet underlying it all are minds that are not infinitely flexible, whose cognitive predispositions are designed to handle the kinds of small-scale societies that have characterized all but the last minutes of our evolutionary history." (Dunbar, 1996, p 207).

We cannot escape our biology, as Dunbar (1992, p. 469) put it: "species will

only be able to invade habitats that require larger troops than their current limit if they evolve larger neocortices." Consequently, for us to exceed the magic number 150, our environmental 'niche' would have to change so that larger group sizes have a selective advantage and biological evolution (if it still applies to the human species today) can select for larger neocortices.

Expanding this argument to a hypothetical super-human species that might evolve, we might speculate that this 'Homo narratus' would have enhanced narrative intelligence that enables the species to deal with an increasing group size. It is impossible to predict what the stories of the future might look and sound like: Will they be beautifully complex and experience rich? Will language itself have changed, adapting to an enhanced need to deal with a complex social field?

Generally, we can expect that empowering human skills of forming and maintaining social networks might be advanced by supporting the development of narrative skills in children and adults. As we have shown in this article, narratives are not only entertaining and fun; they serve an important cognitive function in the development of social cognition and a sense of self (Dennett, 1989). Humane technology needs to respect human narrative grounding (Nehaniv 1999).

The narratives of the future might reflect our ability to preserve coherence and structure in human societies that consist of increasingly fragmented, temporally and geographically distributed, social networks. In shaping this development it is important to investigate the evolutionary heritage of our narrative capacities and the natural boundaries it provides. Also, appreciating the stories other non-human animals tell will allow us to put our familiar stories-as-we-know-them into the broader perspective of stories-as-they-could-be.

Notes

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1. This article is a modified version of K. Dautenhahn (2001). See also related work in (Dautenhahn, 1999) and (Dautenhahn, to appear).

2. The relationships between narrative, on the one hand, and culture and autobiography, on the other hand, are only touched upon in this paper but are discussed in more detail elsewhere: (Dautenhahn, 1999; Dautenhahn, to appear).

3. Note that group size as such is not the only indicator of social complexity: other researchers have found, e.g., that primate species with relatively larger neocortices exhibit more *complex social strategies* than species with smaller neocortices (Pawlowski et al., 1998).

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