Beginnings of Human Reasoning Manifestations of Induction, Deduction and Abduction in Hominid Activities

Dawid Ratajczyk
Uniwersytet im. Adama Mickiewicza w Poznaniu, Instytut Psychologii

Streszczenie. *Reasoning is a significant feature of humans and it might be one of the main reasons for their evolutionary success. Reasoning is a broad concept and can be divided into types (according to a classification system). Logical classifications propose to distinguish inductive, deductive and abductive reasoning. I try to investigate at which point of human evolution particular types of reasoning arose and why. The study presents deliberation on changes in human lifestyle and their impact on reasoning. It also presents possible hominid activities, which evidence usage of different types of reasoning at different stages of human evolution. Early stages (passive scavengers) suggest no need for creative reasoning. It seems induction was sufficient for hominids to perform their activities. However, some strategies of food foraging applied by hunter-gatherers suggest the usage of abductive reasoning. Social interactions need transitive reasoning to occur and this is an indication of deductive reasoning. I put forward a hypothesis that abduction is necessary to create beliefs, so the ability to abduct arose when humans started to consider afterlife at the latest. I also suggest that abductive reasoning is one of the newest achievements in human evolution.*

Słowa kluczowe: *reasoning, evolution, induction, deduction, abduction, hominids, hunter-gatherers, social interactions*

Introduction

It seems that reasoning is a very important ability in people's lives. It is a „device" which allows us to find out what makes sense. Reasoning allows us to get closer to the truth about the surrounding world. And the awareness that panther is going to attack someone in a moment is crucial. Maybe it is not so crucial these days, but 10 million years ago it was extremely important.

Logical approaches give us a conventional classification of reasoning. There are three main types: deduction, induction, and abduction. Deduction is valid reasoning in which true premises lead always to a true conclusion. For example, if I know that all crows are black and I meet a white bird then I can deduce that the bird is not a crow. Inductive reasoning not necessarily leads to a true conclusion. The conclusion is just probable and inferred from particular beliefs. If I saw 1000 crows and all were black, I can induce that the 1001st crow will be also black. Abduction is a form of reasoning which creates an explanation to justify surprising facts. This time the conclusion may also be false. For example, a cookie was on the table, now there is no cookie and my dog is chewing

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something. So the dog ate the cookie.

Descriptions of types of reasoning which I presented above are based on Peirce's syllogistic framework (Urbański, 2009, s. 16–19). However, the conception of Peircean abduction is still not completely clear (Paavola, 2005). In inferential theory, abduction can be considered as a process of forming an explanatory hypothesis. More precisely, this is the schema of the procedure (Belluci and Pietarinen, 2017; Urbański, 2009):

The surprising fact, C, is observed;
But if A were true, C would be a matter of course,
Hence, there is reason to suspect that A is true.

In this paper, I consider reasoning only as an abstract thinking process, not including cognitive processes such as perception. I narrow concept of reasoning to avoid entangling in unsolved problem of abduction (whether it is an instinct or an inference, see: Paavola, 2005). Therefore, to avoid misunderstandings, I regard reasoning as not instinctive.

Subsequently, I investigate at which point of human development particular types of reasoning arose and why. My hypothesis is that inductive and deductive reasoning are more primary than the abductive one. I think that the ability to abduce is one of the newest achievements of human evolution.

The hominid line

Deliberation on development of types of reasoning in hominid lineage, particularly the genus *Homo*, requires short historical overview. The appearance of the hominid line is associated with brain enlargement, bipedalism, and exploitation of high-quality food. In the early Pleistocene environmental conditions and bipedality influenced extractive foraging, hunting and learning at least in one line of the hominid family (Kaplan et al., 2000). During the evolution and development of hominid culture, communities started to bury the dead with grave goods (items buried with the body) around 100.000 years ago. Lieberman (1991) considers this as evidence of religious beliefs that predicates an afterlife, rebirth and perhaps reincarnation. Between those two shifts (extractive foraging and burials) is about 2,5 million years gap (according to the International Commission on Stratigraphy).

The evolution of reason

The evolution creates adaptations by steps, generally as a result of the substitution of many mutations of small effect (Burch and Chao, 1999). For this matter, it is unlikely that the ability to reason did occur suddenly as a fully developed complex entity. It is highly improbable that an efficient computing machine able to reason just popped up. Reasoning was developing piece by piece. Cosmides and Tooby (1994) write about „reasoning instincts" which are components of general reasoning ability. They evolved to solve specified problems present in the lives of our hominid ancestors. Cosmides and Tooby mean specialized modules formed for particular issues such as detection of cheaters or evaluation of social contracts.

Groups of similar „reasoning instincts" which work on the same logical principle can be assigned to different types of reasoning: inductive, deductive and abductive.

Cosmides and Tooby (1994) recall a rule which allows me to assume when induction, deduction and abdution occurred. It says that „the properties of evolved mechanism reflect the structure of the task it evolved to solve". If hominids were performing difficult

activities and a particular type of reasoning was necessary for them, we can infer that the type of reasoning had to evolve at this point at the latest. Firstly, I will introduce activities performed in two different contexts of life: food foraging and social interactions. And then I will refer them to induction, deduction, and abduction, pointing that the first two occurred earlier in the hominid line than the third one.

Hunting and food extraction

We can divide food foraging into hunting mobile resources and food gathering. Both require complicated techniques for successful accomplishment, but some are more demanding than others. Simple food gathering such as fruits or mushrooms picking does not require highly developed reasoning capacity. For example, when a hominid tried blueberry and realized that it was good, he could generalize the knowledge that all blueberries are good. Rule of generalization based on inductive reasoning was sufficient to do it.

Lewis (1997) puts forward the view that during the Pliocene and Pleistocene hominids have been changing their food procurement strategies gradually. From passive scavengers and small prey hunters, they become dominant predators. And the more varied and unpredictable food is, the more creative and complicated techniques are required to forage it.

Kaplan et al. (2000) present possible hunting strategies of hominids based on analyzes of present hunter-gatherer tribes and archaeological knowledge. They suggest that human hunting is unique and so efficient because of the ability to learn the behavior of the prey and analyze remote signs, such as footprints, movement patterns, and vocalizations. When hominid once saw a footprint of a particular animal and associated it with the animal, next time when he saw a similar footprint he was able to infer that the animal had been walking that way. The same applies to the vocalizations of animals. Hominids were able to infer a presence of the specific animal and apply an appropriate strategy to hunt it.

Here is a couple of examples of methods used by humans. Hunting hominid was able to figure out the position of burrowing prey and stab it through the ground with a spear. They were also able to intentionally capture infant animals and use them to lure adult individuals. They were able to shake down animals from trees or emit sounds to frighten them and force them to go into the trap.

Furthermore, extraction of food embedded in a protective context needs adapted techniques, such as cracking nuts and seeds, obtaining growing shoots and roots, removing shells from invertebrates, neutralizing toxins (Kaplan et al., 2000, p. 167 and 171). There are many more methods for food extraction and hunting, each specified for resources available in a particular environment. The number and the variety of them suggest that these are not „thoughtless" instincts, but strategies which result from reasoning.

It is probable that precursors of such reasoning occurred even earlier – at the time before the division of chimpanzees and humans. Similarities between foraging techniques used by these species support this statement. Boesch and Boesch-Achermann (2000) describe that „chimpanzees are capable of predicting escape patterns of their prey and of predicting how prey will respond to the behaviors of other chimpanzees" (Kaplan et al., 2000, p. 176). Also, McGrew (2002) writes that differences in food-getting between chimpanzees and human hunter-gatherer societies are surprisingly small.

Social interactions

A theory of social contracts proposes that social interactions had a fundamental impact on human reasoning (Cosmides, 1989). Reasoning strategies had to evolve in order to allow hominids to form alliances, recognize forbidden activities, evaluate possible benefits from actions, identify rules breaking, briefly: to organize the dominance hierarchies (Cummins, 1996a). I indicate that these strategies are based on inductive or deductive reasoning.

Cummins (1996) distinguishes two informal types of reasoning present in social interactions of hominids – transitive and deontic reasoning. The principle describing the first one is as follows. If A is in relation to B and B is in relation to C then A is in relation to C (Cummins, 1996; Davis, 1992). For example: Steven is more significant than George and George is more significant than Jerry. That implies that Steven is more significant than Jerry. Researchers generally assume deduction somehow underlies transitive reasoning, because the conclusion contains new information entailed by premises, but not directly present (Davis, 1992).

These arguments suggests that deductive reasoning evolved when hominids started to create social groups at the latest. Also in this case precursors of deduction could appear earlier, because (Cummins, 1996a) writes that such reasoning is present in chimpanzees and squirrel monkeys. Also Davis (1992) demonstrates that rats (*Rattus norvegicus*) are capable of transitive reasoning. It is possible that bases for deduction are inherited from last common ancestor or evolved independently.

Deontic reasoning is harder to classify with logical categorization, due to its practical nature. Some voices suggest links to inductive reasoning (Cheng and Holyoak, 1985), however there are objections to this view and it is not generally accepted (see: Cummins, 1996b). For these reasons I will not consider it here.

Abduction

As I stated before, I think abduction is the latest achievement of human reasoning evolution. Abduction requires much more creativity than deduction and induction. The creativity is based on cognitive flexibility, breaks conventional or obvious patterns of thinking and requires conceptual and abstract view (Dietrich, 2004). Abduction possibly started to be useful to humans when they stepped beyond biological imperatives and began the development of culture. Beforehand, it is likely that induction and deduction were adaptively sufficient. Complicated foraging techniques probably correlate with development of abductive reasoning. Scavenging and simple food gathering is less demanding than hunting with techniques introduced above. Some of these techniques astound with their creativity (like luring adult individuals with infants cries or setting traps). It is hard to imagine their invention without abductive reasoning.

The strongest manifestation of the use of abduction in the hominid line is the consideration of afterlife. Burials of the dead give us approximate time when it was present. We can be almost certain that hominids were abducing at that time, because asking questions which exceed everyday problems is necessary to create beliefs. They had to create hypotheses about surrounding reality, and the creation of explanatory hypotheses is the very bases of abductive reasoning. Hence, by this time abductive reasoning had to be developed.

Abductive reasoning apparently occurred earlier but it is difficult to distinguish precise moment. Presumably when hominids were hunting more and more for more and

more different animals abduction was developing gradually. Forming of the language might be associated, but there is lack of solid knowledge on this topic. So possibly there is a gap between evolution of forms of reasoning.

Discussion

In the paper, I tried to link archaeological knowledge about hominid evolution with logical approach to reasoning. I presented possible hominid strategies used to acquire food and I was trying to infer which types of reasoning underlie those strategies with accordance to view that achievements of evolution are adaptive.

The question which can arise is if presented activities actually are the evidence of inductive, deductive and abductive reasoning. It is a plausible hypothesis. If a hominid was searching for the carcass, he did not need abductive reasoning. However, if a hominid was tracking an animal, had knowledge about its behavior and was able to predict possible paths of its escape from observed facts, he was probably reasoning abductively. It is the best possible explanation.

Regarding social interactions, the logic underlying them is not entirely understandable and not every view is consistent. Social interactions are not based only on transitive and deontic reasoning. They are remarkably complex processes. Also, transitive reasoning is not a pure deduction. However, concerning these models brings us closer to uncovering what actually happened and maybe at some point the evidence will be less indirect.

Reasoning is one of the features responsible for the evolutionary success of humans. It allows human mind to be more plastic and exceed beyond specialization. By specialization, I mean adjustment only to very specific conditions. Instincts are formed to solve specific problems. On the contrary, reasoning evolved to solve non-specific problems. For instance spider is a master in catching flies, but such specialization does not allow it to change environment or prey. Reasoning avoids limitations of specialization and allows to diversify food foraging and to choose different environments, such as developing techniques adequate for savanna foraging, and also techniques adequate for subpolar region. To sum up, not the complexity of hunting techniques is evidence of abductive reasoning, but rather the diversity of them.

As I presented, highly developed animals such as chimpanzees, rats, and corvids use reasoning at least partially resembling deduction or induction. As far as I know, abductive reasoning seems to be a unique feature of human beings and may be related to the evolution of culture. Possibly abduction is fundamental to the development of complex culture, but it is not clear yet.

Furthermore, inductive and deductive reasoning are less complex than abductive one, so it is intuitively acceptable that they emerged earlier.

Conlusion

I presented possible human activities, which are evidence of the usage of different types of reasoning in different stages of human evolution. Strategies of food foraging by early hominids suggest no need for usage of abductive reasoning and strategies of hunter-gatherers suggest the need for such reasoning. Social interactions need transitive reasoning to occur and this is an indication of deductive reasoning. Hence, we can assume that there is a gap between the evolution of inductive and deductive reasoning

and abductive one.

Literatura

Bellucci, F., Pietarinen, A-V. (2017) Charles Sanders Peirce: Logic. *Internet Encyclopedia of Philosophy*. URL: http://www.iep.utm.edu/peir-log.

Boesch, C., Boesch-Achermann, H. (2000). *The chimpanzees of the Taï Forest: Behavioural ecology and evolution*. Oxford: Oxford University Press.

Cheng, P. W., Holyoak, K. J. (1985). Pragmatic reasoning schemas. *Cognitive psychology*, 17(4), 391–416.

Cosmides, L. (1989). The logic of social exchange: Has natural selection shaped how humans reason? Studies with the Wason selection task. *Cognition*, 31(3), 187–276.

Cosmides, L., Tooby, J. (1994). Better than rational: Evolutionary psychology and the invisible hand. *The American Economic Review*, 84(2), 327–332.

Cummins, D. D. (1996a). Dominance hierarchies and the evolution of human reasoning. *Minds and Machines*, 6(4), 463–480.

Cummins, D. D. (1996b). Evidence for the innateness of deontic reasoning. *Mind & Language*, 11(2), 160–190.

Davis, H. (1992). Transitive inference in rats (Rattus norvegicus). *Journal of Comparative Psychology*, 106(4), 342.

Dietrich, A. (2004). The cognitive neuroscience of creativity. *Psychonomic bulletin & review*, 11(6), 1011–1026.

Kaplan, H., Hill, K., Lancaster, J., & Hurtado, A. M. (2000). A theory of human life history evolution: diet, intelligence, and longevity. *Evolutionary Anthropology Issues News and Reviews*, 9(4), 156–185.

Lewis, M. E. (1997). Carnivoran paleoguilds of Africa: implications for hominid food procurement strategies. *Journal of human evolution*, 32(2–3), 257–288.

Lieberman, P. (1991). *Uniquely human: The evolution of speech, thought, and selfless behavior*. Cambridge: Harvard University Press.

McGrew, W. C. (1992). *Chimpanzee material culture: implications for human evolution*. Cambridge: Cambridge University Press.

Paavola, S. (2005). Peircean abduction: Instinct or inference? *Semiotica*, 153-1(4), 131–154.

Urbański, M. (2009). *Rozumowania abdukcyjne. Modele i procedury*. Poznań: Wydawnictwo Naukowe UAM.