THE DARK SIDE OF ANALOGY-MAKING

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Abstract: Analogy-making is the most beautiful manifestation of the fundamental property of human's thought. It shows how the incoming information maps to the already memorized old one, and they both change until fit consistently. What we see depends on what we already know and vice versa, what we know depends on what we have already seen. It is broadly accepted that ability to make deep analogies is one of the strongest predictors of the intelligence, the creativity, the ability to understand causal relationships. However, analogy-making, being one of the strongest instrument of human though, may have a dark side too. There are examples in the literature how wrong analogies may produce various fallacies of human thought. Widespread beliefs in world conspiracy, superstitions, etc. could be a product of wrong analogies. Different effects of the known phenomena of confirmation bias are also modeled by the sub-processes of analogy-making. This paper systematizes different types of fallacies and possibilities how those effects could be modeled within a cognitive architecture are discussed.

KEYWORDS: COGNITIVE SCIENCE, ANALOGY-MAKING, FALLACIES, COGNITIVE MODELING

1. Introduction

Analogy-making is the most beautiful manifestation of the fundamental property of human's thought how the incoming information maps to the already memorized old one, and they both change until fit consistently [1, 2]. What we see depends on what we already know and vice versa, what we know depends on what we have already seen. Indeed, many researchers assume the sub-processes of analogy-making as being at the core of human cognition [2, 3]. These sub-processes are used by various cognitive models of thinking, but also by models of understanding social interactions, judgment and decision making, even vision and emotions [4, 5, 6].

It is broadly accepted that ability to make deep analogies is one of the strongest predictors of the intelligence [7], the creativity [8, 9, 1], the ability to understand causal relationships [10], learning of logical inferences [11]. The scientists make a lot of analogies during their work. Beautiful analogies had inspired some of the greatest scientific discoveries, as well some of the most famous artworks [12].

However, analogy-making, being one of the strongest instrument of human though, may have a dark side too. There are examples in the literature how wrong analogies may produce various fallacies of human thought [13]. Widespread beliefs in world conspiracy, superstitions could be a product of wrong analogies. Different effects of the known phenomena of confirmation bias are also modeled by the sub-processes of analogy-making [14].

The DUAL cognitive architecture [15, 16, 17] is a perfect instrument for modeling various phenomena based on analogy-making. DUAL combines associative organization of the memory with powerful mechanisms for discovering and transferring complex relational structures. DUAL combines the advantages of the classical neural networks – high context sensitivity and fluid representation of the concepts and situations, with the potential of the symbolic modeling to manipulate structures. Within the DUAL cognitive architecture already had been modeled various cognitive phenomena: classical analogy-making [17], constructive vision [5], judgment on a scale, choice, and decision-making [18], constructive memory [19], concept formation [20], etc.

In the sections bellow, different known from the literature fallacies of human thought are discusses and classifies. The possibility how they may emerge from the sub-processes of analogy-making is analyzed, as well how they could be modeled within the DUAL cognitive architecture. More specifically, the assumption is that some fallacies are a product of the associative, network-based organization of the memory, whereas some others are result of a transfer of complex relational structures.

2. Taxonomy of the common simple fallacies of the human thinking

The fallacies usually are grouped into informal and formal (or logical) ones [21].

The informal fallacies could be caused by a wrong deductive conclusion, applied to a particular case in an inappropriate context. For example, if from the statement that humans are capable of seeing is inferred that the blind men are capable of seeing. Such type of fallacies deserves a special attention because of the prototypical hierarchical organization of human memory [see for example 22, 23]. The taxonomic of the human conceptual system includes a huge number of exceptions – for example, the birds can fly as a general rule, but many birds do not. Many of the cognitive models of the human memory assume a kind of hierarchical organization (at least for some concepts), in which the properties of the concepts are encoded at the highest possible level. For example, the penguins are birds, the birds are animals. The properties like *lives*, *breathes*, etc. usually are associated with the concept at the highest level (animal in the example); the property of *flying* is attached to the concept of bird. This organization allows economy of encoding, as well ability for deductive transfer of knowledge. Now, in order to encode the information about any exception, it should be attached to the more concrete concept. In the example, the information that the penguins *do not fly* should be associated directly to the concept of penguin. This organization of the human memory is very suitable for most of the task people perform – transfer of knowledge beyond the perceptions, deduction, etc. However, in some specific circumstances it may produce informal fallacies as well. The exceptional knowledge could be forgot, weekly activated or its manipulation could be obstructed for one or another reason. The DUAL cognitive architecture uses a classical taxonomical organization of the memory. In addition, the spreading activation mechanism is suitable for modeling all these effects of temporal or permanent inability to deal with a concrete piece of memory.

A lot of the informal fallacies are related to a kind of shift of the main point. The well-known ad hominem fallacy (speaking against the man rather than to the issue) is in this group. The usage of various emotional arguments (inducing sympathy or unsympathy to the speaker) also is similar kind of fallacy. We argue analogy-making is probably the main mechanism for producing these type of fallacies. People can transfer the relational structure of that wrong argumentation from one domain to another very easy. Here, the second of the main characteristics of the DUAL architecture plays a

role. DUAL is equipped with powerful mechanisms for transfer of complex relational structures from one domain to another.

Very interesting structure can be observed in the so-called circular fallacies. Example of that is: "Wellington is in New Zealand. Therefore, Wellington is in New Zealand" [24]. These type of reasoning is broadly used from people, even from the scientists. [25] point that "using the scientific method to judge the scientific method is circular reasoning". Actually, often it is very hard to distinguish the circular thought from the non-circular one. The common structure of this fallacy is that a sequence of statements p_1, p_2, …, p_n is used as a sequence of premises and conclusions (p_1 is used for inferring p_2, p_2 is used for inferring p_3,…) but finally p_n is used as a premise for inferring p_1. This is just a relational structure of arguments. Once learned, it could be applied in various domains and contexts. The result is a set of seeming superficially different fallacies but their deep relational structure is the same and probably the main mechanism of their producing is analogy-making and more specifically, the mechanisms for transfer of relational structures. In addition, the definitions of the words are most of the time circular too. As most of the thinking is performed with words, probably the circular thought is even much more widespread then we may expect.

One of the characteristics of the human cognitive system is the ambiguity between concepts and words. We often use one and the same word for pointing different entities and vice versa, the languages are full of synonyms depicting one and the same things with different words. This may produce various verbal informal fallacies. One well-known example is the pseudo syllogism: "Nothing is better than the eternal happiness. Ham sandwich is better than nothing. Thus follows that ham sandwich is better than the eternal happiness" [26]. Actually, the vagueness of the human concepts and the misalignments between words and concepts are good things. They lay at the basis of our flexible usage of language. They allow metaphor creation, conceptual combination [27]. Probably they are basic elements of creative thinking and various aspects of the intelligence. However, at the same time, the mechanisms for analogy-making may work independently of the data and may detect similarities on the basis of common words even where there are not such similarities at the conceptual level. The problem with the example above, about the eternal happiness, is obvious – the word *nothing* is used with two completely different meanings.

Finally, the formal fallacies violate the formal logic of the inferences, most often of the syllogistic inferences. For example, "If George is a man of good faith, he can be entrusted with this office; but George is not a man of good faith; therefore, George cannot be entrusted with this office" or "If Amos was a prophet, then he had a social conscience; he had a social conscience; hence, Amos was a prophet" [21]. This type of fallacies again depends on the structure of the inference, not on its meaning. As usual when we face a relational structure, the mechanisms of analogy-making offer an excellent explanation of the cause and process of the fallacy creation. Once formed, the wrong logical structure could be easily transferred in various domains.

3. More complex human fallacies

In the previous section, the most popular simple fallacies of human thinking were systematized. A brief possible explanation of how the sub-processes of analogy-making may produce them, was proposed. Summarizing, some of the fallacies emerge from the mechanism of transfer of relational structures. Some other – from the associative organization of human conceptual system, with a lot of exceptional conceptual properties, as well with a lot of misalignment between concepts and words. All these mechanisms

are modeled in the cognitive architecture DUAL [15, 16, 17] for simulating various positive aspects of analogy-making. However, some aspects of the "dark side" of analogy-making were also simulated by DUAL. [14] simulated successfully various aspects of the so-called confirmation bias. More precisely, human tend to retrieve, to search, and to interpret information in a biased way, trying to verify but not to falsify their current hypotheses. In a series of four simulations, it was shown how the mechanisms of spreading activation and transfer of relational structures may underlie the effects of confirmation bias, known from the literature [28, 29, 30].

The effects of confirmation bias are more dangerous than the fallacies from the previous section. Confirmation bias may lay in wrong decisions in various domains. [31] explores the so-called filter bubbles in social media. The editors often use such filter bubbles showing to the auditory news and points of view that people are more likely to agree with, censuring opposite views. [32], as well [33] proved experimentally than judgers become more extreme in their verdicts when more people support those extreme views.

In the medicine and psychology, the therapists often evaluate the improvement of their patients in a biased way, misguided by the confirmation bias [34]. Dangerous practices from the alternative medicine emerge also from the confirmation bias [35, 36].

Finally, confirmation bias is one of the factors implying paranormal beliefs [37]. The same author argues that the phenomena of the so-called numerological pyramidology probably is based on the same mechanisms.

4. Conclusion

One of the general direction in cognitive science is to search for the basic mental differences between humans and the other animals. Many researchers test different hypotheses of what the fundamental difference could be – the language, or the ability to use and produce tools, the socialization…

[38] assumes that the interaction between the processes of language acquisition and relational thinking is the fundamental, innate difference between humans and apes, and all other differences are later consequences. Nowadays the hypotheses that analogy-making, and particular, relational reasoning is the most important mental capability of humans, is shared many researchers. Analogy-making is related with creativity, intelligence, understanding of causality, etc.

However, few researchers only try to connect this capability, typical for the humans only, to some less pleasant mental differences between the humans and the animals. If analogy-making is so basic and fundamental for humans, it probably is the building block for fallacies in thinking, beliefs in world conspiracy, superstitions, etc.

This paper summarizes some of the well-known fallacies in thinking, and groups them accordingly to the cognitive mechanisms that may produce them. It is hypothesized that there are two mechanisms, basic for the process of analogy-making, that may produce all of these fallacies, either severally or combined. The first mechanism is the associative organization of the memory; the second one is the ability to compare relational structures. Both mechanisms are evolutionary developed and are very useful. However, in a certain context, they may produce also a lot of mistakes and problems.

Both mechanism are modeled in the cognitive architecture DUAL, which makes this model very convenient for modeling various fallacies of human thought.

This line of research may have a lot of applications in education, but also in politics, journalism, even in law.

5. *References:*

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