The "why" of human reasoning and communication:

Cognitive capacities through the lens of evolution

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Todo list

Introduction

{sec:introduction}

1: Don't overuse passive voice. Don't make sentences too long (rule of thumb: not longer than two lines). Don't abuse semicolons. Don't have too long NPs before the VP comes. Watch out for Dutch word order. Explain technical terms always, to fix their meaning. Give examples (and keep them as familiar as possible). Don't undersell your points, be confident! Don't vary terminology for the sake of variation.

Two cognitive skills that are often considered to set humans apart from their evolutionarily closest relatives are on the one hand our outstanding capacity for reasoning, and on the other our profound communicative abilities. Broadly considered to be unmatched in the animal kingdom (Cheney and Seyfarth, 1997) are on the one hand our sophisticated reasoning abilities

2: This paragraph is saying the same thing twice, and word order is funky

3: Explicate this; cite a source

and on the other hand our communication using languages that are infinitely creative in enabling the production of complex sentences.

Our reasoning and communication are intertwined with each other in different ways; it is hard to imagine our communication without reasoning. In our everyday lives, a lot of the content we intend to convey to others, we relay pragmatically: we do not literally spell out these things, but rather hope and expect our interlocutors to infer the intended message from the communicated content. When I ask my dinner partner if they can pass me the salt, they infer that I am not interested in learning about their ability to pass me the salt but rather that I am requesting to be passed the salt. When I give feedback on an interlocutor's behavior, I first reason about how my words will come across to her in order to minimize social conflict.

It is thus easy to see that reasoning and communication are intricately linked. But what exactly is the extent and nature of this link? In 2011, Hugo Mercier and Dan Sperber proposed a revolutionary theory of reasoning that intended to account for a number of long-standing issues in the experimental psychology of reasoning. According to their *argumentative theory of reasoning*, the main function of reasoning in humans is argumentative; that is, reasoning evolved in humans in order to devise arguments and evaluate those of others. Their theory is able to explain a number of purported 'flaws' of human reasoning, such as poor performance on standard reasoning tasks such as the Wason selection task; confirmation bias; and the phenomenon of motivated reasoning leading to attitude polarization.

In the words of Mercier and Sperber,

> Reasoning has evolved and persisted mainly because it makes human communication more effective and advantageous. (Mercier and Sperber, 2011, p. 60)

4: Add a few words about why this thesis is worth scrutinizing: for example, that others also disagree (see the MS11 commentary), or already hint at your own objections

5: Add a few words on that the "why" of communication is an important question, explain why this is needed to ultimately answer the RQ. It's more primitive, or primary; address this

In this thesis, I will scrutinize this position in order to ultimately answer the question of whether advanced reasoning skills in humans evolved because they facilitate more advanced communication.

6: Could do with some more explication: how will I scrutinize this position?

1 | The chicken and the egg: the evolutionary approach

{ch:evolution}

Before we are able to answer any *why*-questions about humans' cognitive capacities, some groundwork needs to be laid out. For what does it mean for some trait to evolve 'for the purpose of' another trait? Are we even justified in using this kind of terminology when it comes to evolution, a process which cannot be said to be intentional or purposeful? And what intermediate questions will we need to ask ourselves in order to ultimately answer the question of why we reason and communicate?

7: Explicate why "why we communicate" is also an important question (maybe elsewhere)

This chapter attempts to answer these questions. It by no means provides an overview of issues in evolutionary theory, a large field of research in its own right with widely diverging opinions on a number of specifics of the process of evolution (see Ariew et al. (2002) and Uller and Laland (2019) for overviews of topics in evolutionary theory). This chapter will serve to get a number of foundational issues 'out of the way' before we can continue our investigation into the cognitive mechanisms of reasoning and communication.

8: Be confident!

9: Define evolution!

1.1 Causation in evolution

{sec:causation-evolution}

First, we will dip our toes into the waters of causation in evolution.

Evolutionary causation is a subfield of philosophy of biology that has continued to see widely diverging opinions (Baedke, 2021; Uller and Laland, 2019). In this section I will restrict focus to three topics in evolutionary causation that are of interest to this thesis: firstly the distinction between proximate and ultimate causation, secondly Tinbergen's methodological questions, and lastly niche construction. The former two will serve to illuminate some basic aspects of the issues evolutionary causation concerns itself with, and the latter is of particular interest in considering the evolution of human cognition.

In evolutionary causation, one may distinguish *proximate* from *ultimate* causes. Proximate causes are the *immediate* influences on a trait: they explain how the trait results from the internal and external factors causing it. Ultimate causes

on the other hand are the higher-level historical and evolutionary explanation of those traits (Mayr, 1961)

10: Add an example to illustrate

. In other words, these two different causes answer two different explanatory questions

11: Apparently a category mistake: causes don't answer questions, *statements* about causes answer questions. I'm not sure if I fully agree though; think about this

: the proximate cause is the answer to the *how*-question, whereas the ultimate cause answers the *why*-question. According to Mayr (1961), who pioneered the distinction[1], one needs to answer both of these questions in order to obtain a complete understanding of the trait.

12: Maybe reformulate this: still reads funky

13: Add here a word on how Tinbergen's questions can be split into proximate and ultimate answers: cite Rymer et al. (2022), and maybe see Wikipedia for extra references

In an influential proposal considered by some to be an extension of this distinction, Tinbergen (1963) outlined four questions or problems central to the study of animal behavior. In order to fully understand a pattern of behavior, one must consider (1) the proximate causation of the behavior, (2) the lifetime development of the behavior, (3) the function[2] of the behavior, and (4) the evolutionary history of the behavior.

14: By whom? I don't remember, maybe it would be elucidating to know why and how they say so

While Mayr's and Tinbergen's frameworks have had considerable explanatory value in the field of evolutionary causation, it has been argued that biologists would be better off rejecting them in favor of a framework of *reciprocal causation* (Laland et al., 2013). In reciprocal causation, there is feedback between the organism and its environment: not only does the environment influence the organism through the process of natural selection, but the organism in turn influences its environment through the process of *niche construction* (Svensson, 2018), where organisms actively partake in modifying their environment and shaping their niche, usually to their own benefit.

15: Define niche and add an example to illustrate: discuss and elaborate way more!

It has been argued that niche construction is at least as important as natural selection in shaping evolution

16: Is niche construction governed by natural selection?

, and moreover that especially in evolutionary processes involving interactions between organisms, reciprocal causation is very frequent (Svensson, 2018).

1.2 Evolutionary psychology and its issues

{sec:evol-psych}

In order to answer the question of whether reasoning evolved for the purpose of communication, we will also need to zoom out to consider the field of evolu-

[1] See (Laland et al., 2013) for a discussion of the origins of the distinction

[2] See Section 1.3 for a discussion of function in biology.

tionary psychology as a whole. What is the merit, and the validity, of adopting an evolutionary approach in our endeavor?

The field of evolutionary psychology concerns itself with trying to understand human behavior using evolutionary theory, by looking into the past and considering how our ancestors must have adapted to their environment in order to survive and reproduce. Researchers in the social sciences and humanities have historically been wary of using evolutionary approaches to study human behavior, because evolutionary theory has been abused for prejudiced ends in the past; see Laland and Brown (2002, pp. 19–20) for an overview. Moreover, evolutionary-psychological research has received the criticism that too much of it is "just-so" storytelling and post-hoc explanation of known phenomena, sometimes accompanied by a sensationalist spin on the story (Laland and Brown, 2002). However, if these pitfalls are avoided, looking at human psychology from the evolutionary perspective can be an illuminating endeavor.

Ask Karolina about feedback here: didn't understand

Let us now consider some of the central concepts and assumptions of evolutionary psychology.

In order to explain humans' psychological mechanisms, evolutionary psychologists look to the concept of an *environment of evolutionary adaptedness* (EEA). The EEA is the environment in which these psychological mechanisms must have come into being; usually the EEA is identified as hunting and gathering groups on the African savannah in the second half of the Pleistocene, between 1.7 million and ten thousand years ago (Laland and Brown, 2002)

17: Are the groups the EEA or the savannah? Elaborate more on this: is it the physical environment or does it include the groups? Aren't the groups a trait that evolved? Think about this

. The assumptions underlying the use of the concept of an EEA are that (1) our modern-day environment is too different from that of our ancestors for us to use it to explain why and how our psychological mechanisms evolved in the past; and (2), for our psychological mechanisms to be as complex as they are, they must have evolved slowly — and thus a considerable amount of time ago, without changing significantly since the Stone Age.

There are a number of issues associated with the use of the concept of the EEA (Laland and Brown, 2002). Firstly, we do not know very much about the environment of our ancestors, so the specifics of the EEA may be filled in as is seen fit for one's purpose. Secondly, we do not know enough about the process of evolution to make assumption (2); while evolution does in general operate on a large timescale, research has shown that it can also be faster, operating on a time scale of thousands of years, or less than 100 generations (Laland and Brown, 2002, pp. 190–191 and references therein). Thirdly, the argument can be made that for our species to have flourished and dominated in the way that it did, we must have remained adaptive to our changing modern environments after the Stone Age. Lastly, the EEA argument does not take into account reciprocal causation or niche construction.

18: Elaborate on this, because it seems to be important for my argument

19: The following section warrants a larger discussion about domain-specificity; define it and give examples (outside of psychology: maybe vision?), maybe with Cosmides/Tooby conception of Wason selection task as cheater detection? Find some literature on domain-specificity, because it turns out to be a bit of a hairy subject. Find definition; because opinions may vary on what features are and aren't domain-specific

Another topic of discussion in evolutionary psychology that is of importance to our investigation, is that of domain-specificity of the psychological mechanisms. The argument has been made that these adaptive mechanisms are necessarily problem- or domain-specific, because the evolutionary process would not favor general solutions to specific problems (Buss, 2015, p. 50). However, as with the EEA, issues with this stance have been raised: the push to domain-specificity can be said to rely on overly strong assumptions about the modularity of the brain; and moreover, there is also a push to domain-generality of cognitive skills because domain-general skills are neurologically more cost-efficient than domain-specific skills (Laland and Brown, 2002).

Lastly, a criticism raised to evolutionary psychology is that not only biological evolution, but also cultural evolution can be said to have played a role in shaping human behavior and human cognitive capacities; it is a joint endeavor facilitated by nature and nurture.

This line in particular needs a citation

20: Add references: where did you read this? Or, if it's your own contribution, make that clear. If it's a summarizing contribution from multiple references, say that, and you don't need to cite them all – use e.g.

1.3 Teleological notions in evolutionary theory

{sec:teleology}

21: This section needs quite some work: see notes from discussion with Karolina

Next, it is useful to scrutinize the terminology that I will be using throughout this thesis. Biological literature frequently makes use of *teleological* terminology, that is, terminology that implies goal-directedness of the processes it describes. Such terminology includes concepts like the *design* of a trait, and *function*, *purpose*, or *utility* of a trait. At first glance, the usage of these terms in discussing evolution would seem to be inappropriate; for evolution is a process of nature, not purposefully performed by an agent, and it is thus without any intentionality or goals. And indeed, this teleological terminology has its roots in pre-Darwinian conceptions of nature: it originates from Aristotle's views on causation, and it was subsequently adopted by creationist Muslim and Christian scholars (Johnson, 2005).

22: Maybe reformulate this sentence again: still too convoluted?

In general, teleological explanations in biology are quite controversial: not only is the usage of the specific terminology itself debated (Ayala, 1999, p. 27 and references therein), the concept has been criticized for its apparent lack of formalization and insufficient argumentative persuasiveness (Baedke, 2021, p. 83).

23: Address the controversy around teleological explanations. Talk about instrumentalism, usefulness of the concepts. Lack of formalization is not such a big problem for the purpose here maybe, but the other thing is more of a problem. Address why they won't be a problem for you. Can mention that MS assume it as well, this teleological explanation is at the heart of their thesis (quote it?), so it's their problem to defend this. I work using the same assumptions as them.

However, explanations in terms of goals and function have considerable instrumental value in describing evolutionary processes. Throughout this thesis, I will be adhering to the conception of teleological explanations of Ayala (1999), which is as follows:

> Teleological explanations account for the existence of a certain feature in a system by demonstrating the feature's contribution to a specific property or state of the system, in such a way that this contribution is *the reason why the feature or behaviour exists at all*. (p. 13)

In this respect, the evolutionary process of adaptation merits a teleological explanation: the function of a trait (its 'contribution to a specific property or state of the system') is the reason that the trait exists, because it exists as a consequence of natural selection.

24: Add example here

25: Is this view compatible with reciprocal causation and niche construction? I think so; they're a complication for the whole picture, not necessarily for using this definition.

26: Is this view compatible with cultural learning? From the quote, it doesn't necessarily follow that it's about biology necessarily. Think about this, and after writing a section on culture, state to what extent and in what way we'll adhere to Ayala (1999)

The distinction between proximate and ultimate causes we saw in Section 1.1 can be applied to teleological explanation as well, yielding the distinction between proximate and ultimate *ends* of features. The proximate end is then the 'immediate' function the feature serves, and the ultimate end is the reproductive success of the organism.

27: Add example

A footnote to this account is that not all features of organisms can be explained teleologically; only if the feature has arisen and persisted as a direct result of natural selection, a teleological explanation is in place.

28: This "direct result of natural selection" is very vague/slippery; acknowledge this, and elaborate more on it if it turns out to be important for my thesis. A way to do this would be to contrast it with an indirect result. Talk about side effects?

1.4 An evolutionary foundation

{sec:evol-method}

Now that we have gathered the puzzle pieces, let us return focus to our field of investigation and lay its groundwork. In particular, before we can continue with our evolutionary approach to human reasoning and communication in the next chapters, we will need to outline and justify the assumptions made.

It has become apparent that for none of the topics in evolutionary theory discussed here consensus has been reached among its practitioners. Since the purpose of this thesis will not be to provide a complete causal framework for the evolution of reasoning and communication, we will be able to cast aside some of the issues plaguing the frameworks discussed in this chapter. We will proceed cautiously, using the concepts outlined without needing to account in detail for their shortcomings.

29: Change structure to drop headings: make sure that the content of the pargraph is still clear without using the headings

Why can we consider these cognitive capacities from an evolutionary perspective? In choosing to explore human reasoning and communication from the evolutionary perspective, I am working on the assumption that it is appropriate to the endeavor: reasoning and communication are two key features of the homo sapiens that must have arisen at some point in our evolutionary history, shaped by natural selection, niche construction, and perhaps (cultural) learning. Moreover, it is justified to assume that the cognitive abilities underlying human reasoning and communication are heritable, either genetically or culturally.

What do we mean when we say 'evolution'?

30: Add a section on culture to this chapter (where?): add things from Heyes (2018, Chapter 2: "Nature, nurture, culture"), and maybe some things from Laland et al. (2013) and Laland and Brown (2002). In there, try to figure out if the parallel between biological and cultural evolution is strong enough that you can assume that the specific driving force behind the evolution is not important. Also, distinguish clearly between (and define) cultural evolution and cultural learning. Taught vs. inherited.

So far, we have mostly considered the concepts and issues surrounding *biological* evolution, and the role of *culture* has remained largely undiscussed. In this thesis, I will use the term 'evolution' and associated terminology to talk about the development of cognitive capacities in humans over time, remaining agnostic about whether this evolution is due to biological processes like natural selection, or cultural processes like cultural learning.

What are our assumptions about the evolutionary process? I accept the concept of the EEA in a general sense despite the flaws discussed in Section 1.2; for our purposes, we need not commit to any strong assumptions about the nature and properties of the EEA. The most important assumption I will make is that homo sapiens throughout history has been dependent on strong social groups for survival.

31: Missing: strong argument for making this assumption; see Laland and Brown (2002, p. 178) for doubts about this assumption

Moreover, I will adopt a reciprocal causal framework along the lines of Laland et al. (2013) and Svensson (2018), maintaining that humans throughout history have not only been the object of natural selection, but that they have also been the subject in shaping their environments through the formation of social groups and development of technology.

What does it entail for one trait to evolve for the purpose of another? In using Ayala's (1999) definition of teleological explanation, we can speak of some feature of an organism having a certain function or purpose, that ultimately contributes to its reproductive success. In the case of our investigation, we are interested in what evolutionary benefits one feature (reasoning) may have to another feature (communication). In order to answer this question, we should first consider what the function of communication is to humans; only then can

we consider whether the function of reasoning could be to advance communication and in doing so improve the reproductive fitness of humans.

32: Elaborate a lot on this: this is a key key point of my research question, so it deserves more attention. Settle on a definition.

What questions will we need to answer?

33: Rewrite this: first reformulate Tinbergen's questions. An enumeration with (i) would be appropriate, or even give each question a code, as you'll maybe refer to them a lot as they're the basis for your methodology. Then say the first one (proximate) – though interesting – is out of scope. Also note that Tinbergen's paper was seminal, so you justify why you use his questions at all as our desiderata: give reasons for obeying his methodological advice. You've seen his method mentioned in many papers, but since you don't say it, your reader won't know that.

In exploring cognitive capacities in more detail from an evolutionary perspective, I will loosely follow Tinbergen's (1963) questions by considering the following aspects of reasoning and communication:

- How does the capacity to reason and the capacity to communicate develop throughout childhood?
- What would advancements in reasoning or communication contribute to the reproductive success of humans? In other words, what is the function of reasoning and the function of communication?
- What is the evolutionary history of reasoning and of communication? To what extent and how do they present in our nearest evolutionary relatives?

One may note that we will skip Tinbergen's first question about what the proximate causation of the behavior in question is. I consider the neurological mechanisms underlying reasoning and communication to be out of the scope of this thesis. The most important reason for this is that we do not know nearly enough about the human brain to provide a satisfactory account of the proximate causation of reasoning and communication.

2 | Why do we communicate?

{ch:communication}

In order to answer the question of how advanced reasoning may have evolved to further communication, we will first need to examine communication in its own right. In doing so, we will first fix our definition of communication, and then we will consider each of the methodological questions raised in Section 1.4 as they pertain to communication.

2.1 Conceptions of communication

{sec:comm:definition}

Before we can take a look at the evolutionary history, developmental origins and functions of communication, we should settle on a definition of communication. This will turn out to not only be trickier than one perhaps might expect, but it is also very important since it determines the frame of our research question.

I should have a look at what Mercier (& Sperber) define as communication

There are many different ways organisms may communicate with each other, and indeed many different ways in which one may define communication. In all cases, communication is an process necessarily involving a signaler (a sender) and at least one receiver (a listener).

In their discussion of communication as it relates to social cognition, Freeberg et al. (2019) define communication as follows:

> Communication involves an action or characteristic of one individual that influences the behaviour, behavioural tendency or physiology of at least one other individual in a fashion typically adaptive to both (p. 281)

This is a very broad conception of communication; on this definition, all organisms communicate. And indeed, this is a definition that is followed by a number of other researchers.

weird sentence

provide some examples of communication here

However, when it comes to human communication, the definition can be refined a bit. Scott-Phillips (2015, 2018) discusses two different models of communication: the classical *code model* of communication, and the *ostensive-inferential* model of communication. On the former model, communication involves processes of coding (on the side of the sender) and decoding (on the side of the receiver) messages. The coding on the side of the sender involves a mapping

reformulate

between the state of the world and a behavior (namely the signal they send), and the decoding on the side of the receiver involves a mapping between two behaviors: the signal received, and a subsequent response. If the mappings are properly calibrated to each other, communication between sender and receiver can be said to have occurred. However, in order to exactly capture human communication, the code model is too simplistic, because it fails to account for the *underdeterminacy of meaning*: in merely looking at the behavior of the sender, at the content of the message, one cannot account for the meaning that the message conveys to the sender (Scott-Phillips, 2018). Therefore, a move away from the code model of communication towards the ostensive-inferential model of communication would be in order. This model takes into account the intentionality inherent in human communication. On the ostensive-inferential model, one may speak of a speaker's *informative intention*, which is when they intend for their listener to believe something. The speaker's *communicative intention* is then their intention for the listener to believe that they have an informative intention. The speaker may then express or convey this communicative intention to their listener with an *ostensive* behavior. If their listener receives their communicative intention, then ostensive-inferential communication has occurred.

this is a really bad explanation

add example

Currently, there is no evidence that any species other than humans communicate ostensively (Scott-Phillips, 2018). Not only may one distinguish between the code model and the ostensive-inferential model, one can also conceptualize these as two different kinds of communication: the former model captures the way that non-human animals communicate, and the latter captures the way that humans communicate with each other. This complicates the view a bit.

add something here

Important to note is that while we most associate human communication with language, humans can easily communicate without language – for example, using glances or gestures[1] – and can use language without communicating – for example, when one is talking to oneself. Therefore, language will come up now and then throughout this chapter, but it is not our object of focus at the present moment.

2.2 Communication in non-human animals

{sec:comm:phylogeny}

In order to illuminate communication in humans, it is necessary to look at the communication of other animals, especially those that we are evolutionarily closely related to. As already mentioned, one fundamental difference between the communication of non-human animals and humans is by which model their communication is best described (the code model and the ostensive-inferential model, respectively) (Scott-Phillips, 2015, 2018).

Communication is used by non-human animals for a wide range of purposes, and it can be elicited by a number of stimuli. One can broadly distinguish between communication in aggressive and cooperative interactions (Seyfarth and Cheney, 2003). In aggressive interactions, primates may for example use

[1] One might even speculate that any human behavior can be used to communicate.

communication in order to intimidate, by using it to signal their size and willingness to fight. This minimizes the chances of a physical altercation or fight actually happening, which minimizes the chance of injury for the animal. In cooperative interactions on the other hand, where the interests of the signaler and the receiver overlap more, communication can be used to alert others of predators, to coordinate foraging activities and to facilitate social interactions:

> [information acquired by listeners] may include, but is not limited to, information about predators or the urgency of a predator's approach, group movements, intergroup interactions, or the identities of individuals involved in social events (Seyfarth and Cheney, 2003, p. 168)

In animals in general, vocalizations are most often elicited by a "complex combination of stimuli" (Seyfarth and Cheney, 2003, p. 150), which may be 'immediate', or dependent on the "history of interactions between the individuals involved" (Seyfarth and Cheney, 2003, p. 151). As for the immediate features, we may distinguish between sensory stimuli on the one hand and mental stimuli on the other. Sensory stimuli then refer to stimuli received through the external senses, such as visual, auditory and olfactory senses. Mental stimuli on the other hand, can be viewed as the mental states an animal attributes to another animal. This type of stimuli elicits the majority of vocalizations in human conversation, but there is no evidence that the attribution of mental states to others causes vocalizations in other animals, except for possibly chimpanzees (Seyfarth and Cheney, 2003).

2.3 Communication in children's development

{sec:comm:ontogeny}

2.4 What is the function of communication?

{sec:comm:function}

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