The "why" of human reasoning and communication:

Cognitive capacities through the lens of evolution

Flip Lijnzaad
Supervisor: Karolina Krzyżanowska

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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)

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.

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: Reformulate

Write more on the purpose of this chapter to ease the nerves

10: Define evolution!

1.1 Evolution: biological vs. cultural

{sec:evo-bio-culture}

This section is about the evolutionary process: what is evolution? Define and explicate the terms, and delve into the issues with biological vs. cultural evolution. 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.

OLD: 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.

1.2 Causation in evolution

Next, we will dip our toes into the waters of causation in evolution. As it turns out, causation in evolution is not a simple notion; let us consider for example a moth's wings which provide the moth with camouflage due to their coloration. The camouflage of the wings is an *effect* of their coloration; yet, it is precisely the camouflage the coloration provides that is the *cause* of the coloration being present (Lipton, 2009).

Generally, evolutionary causation is a subfield of philosophy of biology that has continued to see widely diverging opinions (Baedke, 2021; Scott-Phillips et al., 2013; Uller and Laland, 2019). In this section I will restrict focus to four topics in evolutionary causation that are of interest to this thesis. First, I will discuss the distinction between proximate and ultimate causation. Then, I will mention Tinbergen's (1963) questions for explaining animal behavior, which will be discussed at length in Section 1.5. Thirdly, we will have a look at niche construction and reciprocal causation. Lastly, we circle back to our research question and discuss what it entails for one trait to evolve for the purpose of another.

> ↓ Introduction and discussion of Mayr's proximate-ultimate dichotomy

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). In other words, these two different causes relate to two different explanatory questions: the proximate cause is related to the *how*-question (*how* did a trait come about?), whereas the ultimate cause is related to the *why*-question (*why* did a trait come about?). According to Mayr (1961), who pioneered the distinction[1], one needs to answer both of these explanatory questions about a trait in order to obtain a complete understanding of it.

> Add an example to illustrate

> ↓ Introduction of Tinbergen's four questions; discussion follows in Section 1.5

In a seminal proposal, considered by some to be an extension of Mayr's dichotomy (Laland et al., 2013), Tinbergen (1963) outlined four questions central to the study of animal behavior. In order to fully understand a pattern of behavior, he argued, 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. Since Tinbergen, other authors have grouped these four questions according to Mayr's proximate-ultimate distinction, characterizing the 'causation' and 'development' questions as proximate questions (*how*-questions) and the 'function' and 'evolution' questions as ultimate questions (*why*-questions) (Bateson and Laland, 2013; Laland et al., 2013). Tinbergen's framework has had an extensive and lasting influence on the study of animal behavior, and his questions continue to be used to this

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[1]See (Laland et al., 2013) for a more nuanced discussion of the exact origins of the distinction.
[2]See Section 1.4 for a discussion of function in biology.

day Bateson and Laland (2013). Hence, we will let this framework inform the methodology for this thesis. Therefore, I will discuss Tinbergen's questions in greater detail in Section 1.5.

↓ Beyond unidirectional causation: niche construction, reciprocal causation

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.

11: 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

12: 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).

↓ One trait evolving 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.

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

↓ Settling on assumptions: conclusion

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.

1.3 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-

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

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.

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)

14: 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.

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

6

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.

Settling on assumptions: conclusion

I accept the concept of the EEA in a general sense despite the flaws discussed in Section 1.3; 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.

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.

1.4 Teleological notions in evolutionary theory

{sec:teleology}

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).

20: Maybe re-formulate 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).

21: 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.

Add example here

22: 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.

23: 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 1.2 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.

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.

1.5 Adopting and adapting Tinbergen's four questions

{sec:tinbergen}

As mentioned in Section 1.2, Tinbergen (1963) proposed an influential framework of problems that should be addressed if one intends to give a complete account of a behavior an animal exhibits. Let us dive more deeply into Tinbergen's framework here, as it will prove to form a desirable foundation for the investigations this thesis concerns itself with.

As mentioned before, the four problems that Tinbergen argued to be central to the study of behavior are causation, survival value, ontogeny, and evolution. I will now discuss each of these problems in more detail, such that we can ultimately come to a set of methodological questions to guide us in investigating human communication and reasoning.

Causation

The first Tinbergen problem is that of the mechanistic causation of the behavior, in other words the proximate causation of the behavior. In our case, addressing this problem would entail a detailed investigation of the neurological processes underlying communicative and reasoning behaviors. This problem, however interesting, will not be addressed in this thesis. The reason for this is that more empirical and conceptual research would be necessary in order to give a satisfactory account of the exact neurological processes underlying communicative and reasoning behavior. Although one can only gain a full understanding of a behavior if the four problems are addressed simultaneously (Bateson and Laland, 2013; Tinbergen, 1963), I believe I am justified in considering the proximate-causation problem out of scope for this thesis.

Survival value

The second problem that Tinbergen outlines, relates to the value a behavior provides to an animal's survival: how does the behavior contribute to the

chances of the animal surviving? However, the survival value a trait brings to an organism is not the only reason that it may persist throughout evolution. A trait is also more likely to appear in future generations if it improves an organism's chances of reproducing, i.e. if it enhances its reproductive fitness (Bateson and Laland, 2013) .

This survival value, in teleological terms, is the function of the behavior. However, the use of the term 'function' obscures the fact that a characteristic's function may change over time: the *current* utility that a characteristic has, may not be the same as the *original* utility it had (Bateson and Laland, 2013). For example, feathers originally evolved for temperature regulation in the evolutionary predecessors of birds, and were later adapted for flight (Bateson and Laland, 2013; Benton et al., 2019). We will see in Chapter 2 and **??** what can be construed as the original and current utilities or functions of the cognitive capacities we are dealing with.

25: Convoluted sentence; also, not explained well

26: Change the nature of this comment after Chapter 2 and 3 are more or less finished

Rewrite these questions as soon as the terminology and definitions are fixed

For now, we assume the following questions:

(1)   a. What was the original utility of communication to humans, i.e. what was the survival value of reasoning in the EEA? And what is the current utility of communication to humans?

       b. What was the original utility of reasoning to humans, i.e. what was the survival value of reasoning in the EEA? And what is the current utility of reasoning to humans?

Ontogeny

The third question that is essential for gaining understanding about a behavior is the question of how the behavior emerges and changes throughout the development (ontogeny) of the animal.

Add more on this

So this leads us to the following question:

(2)   a. How does the capacity for reasoning develop throughout childhood?

       b. How does the capacity for communication develop throughout childhood?

Evolution

The fourth and last problem taken up by Tinbergen, is that of the evolutionary history of the behavior: in order to provide a complete explanation of a behavior, one must look at how it evolved throughout history. In order to do so, one must look to whether and how the behavior presents itself in the close evolutionary relatives of the animal.

Bateson and Laland (2013) maintain that for traits related to human cognition, this question about evolutionary history should be split up into two questions. They argue that due to the influence of not only biological evolution but

also culture on the development of the trait, one should distinguish two kinds of evolutionary history, leading to the questions "Which historical processes were responsible for the character?" and "How can its trajectory be explained?" (Bateson and Laland, 2013, p. 714)

> Add a conclusion to this paragraph once done with the section on cultural evolution

This leads us to the following question:

(3)　a. What is the evolutionary history of reasoning? To what extent and in what way does reasoning present itself in our nearest evolutionary relatives?

　　　b. How does the capacity for communication develop throughout childhood?

A fifth Tinbergen problem: observation and description

A problem that is mentioned by Tinbergen in his original paper 1963, but not included as one of the core problems of his framework, and more or less never included by authors discussing his framework (Allen and Bekoff, 1995; Laland and Brown, 2002; Laland et al., 2013), is the problem of *describing* the observed behavior. In the case of describing reasoning and communication, this issue is akin to the problem of defining and delineating what we take to be reasoning and what we take to be communication. This is by no means a trivial issue, which is why it warrants inclusion in the set of questions we will ask ourselves in thesis.

So this leads us to the following question:

(4)　a. What is human reasoning?

　　　b. What is human communication?

1.6　Conclusion

{sec:evo-conclusion}

> Make this section the actual conclusion: recap of the 'recommendations' at the end of each section

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.

- 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?

27: Add in this section 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. Also mentioned by Bateson and Laland (2013)

2 | Why do we communicate?

> **28:** In general: this chapter is very dense, you can go at a bit of a slower pace most of the time. But pace will also be better once elaborations and examples are added.

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: why do we communicate? In order to answer this question, we will discuss each of the methodological questions raised in **??** as they pertain to communication . But before we can take a look at the evolutionary history, the developmental origins and the functions of communication, we must first fix a definition of communication, since this determines the frame of our research question.

> **29:** Terminology: probably drop "advanced" here. Possibly get back to this after writing Chapter 3

> **30:** Refer to the numbers or codes of the Tinbergen questions

> **31:** This whole introduction could be clearer: why do we look at communication now? Can use a bit more words.

2.1 Conceptions of communication

> **32:** Missing from this section: what Mercier (& Sperber) define as, and/or have to say about, communication

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

Some authors regard communication to inherently be a tool of persuasion, which then translates to their very definition of communication: for example, on the manipulative model of communication, communication can be taken to occur "when an animal, the actor, does something which appears to be the result of selection to influence the sense organs of another animal, the reactor, so that the reactor's behavior changes to the advantage of the actor" (Dawkins and Krebs, 1978, p. 283).

> **33:** Rewrite this so that the quote is actually typeset as a quote, for emphasis

> **34:** Say something about this quote in your own words: comment on it, this also justifies you using the quote. Point the reader to why you use it.

One may also notice that this definition has a teleological explanation embedded in it as well (see Section 1.4). I mention this definition only for com-

> **35:** Elaborate on this: make it more explicit

pleteness' sake , because I believe this definition to be insufficiently parsimonious in its assumptions about the function of communication.

> **36: Maybe not necessary to mention this**

> **37: Elaborate on this: what are the assumptions they make, in what sense are they strong, and why are they too strong for my liking (i.e. what's wrong with them)?**

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)

> **38: Explain this in own words; and explain the difference with the definition of Dawkins and Krebs (1978). The difference lies in "to the advantage of"**

This is a very broad conception of communication; on this definition, all organisms, from bacteria to fungi to plants to animals, communicate.

> **Provide examples for each of these kingdoms here, nice illustration**

Scott-Phillips (2015, 2018) contrasts two different models of communication with each other: the classical *code model* of communication, and the *ostensive-inferential* model of communication. In the former model, communication involves processes of coding and decoding messages. The coding, on the side of the sender, involves a mapping between the state of the world and a behavior (namely the signal they send). The decoding, on the side of the receiver, involves a mapping between two behaviors: the signal sent, and a subsequent response of the receiver. If the mappings are properly calibrated to each other, communication between sender and receiver can be said to have occurred.

> **39: This paragraph could do with a lot more philosophical discussion: Quine should definitely be mentioned, even if it's just in a footnote, because it's like this milestone philosophy thing that would be a glaring omission to philosophers reading this. Also, the usage of "meaning" and "content" here is a big philosophical no-no, either explicate what you mean by them or change your terminology. You could also just acknowledge or specify that you use the intuitive, colloquial meaning, not the technical one. Read also the Putnam paper on the ants and Winston Churchill?**

However, in order to capture human communication, the code model is too simplistic, because it fails to account for the *underdeterminacy of meaning*: in merely looking 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.

> **Add example**

> **40: This paragraph also needs a lot more work: (1) mention Sperber & Wilson and relevance theory (credit where credit's due!), and that their theory is neo-Gricean, because most philosophers will be familiar with Grice. (2) Add an example, this needs to be way clearer and elaborated more if this will be my definition of human communication. (3) Define ostensive behavior, also with an example. It's apparent right now that I don't fully understand this model myself. (4) Add a comment on how the underdeterminacy is captured better by the ostensive-inferential model**

In the ostensive-inferential model, one may speak of a sender's *informative intention*, which is their intending for the receiver to believe something. The sender's *communicative intention* is then their intending for the receiver to believe

that they have an informative intention. The sender may then express or convey this communicative intention to their receiver with an *ostensive* behavior. If their receiver receives their communicative intention, then ostensive-inferential communication has occurred.

Currently, there is no evidence that any species other than humans communicate ostensively (Scott-Phillips, 2018). As a result, not only may one distinguish between the code model and the ostensive-inferential model to define what communication entails, one may also conceptualize these two models as two different types of communication. The code model then captures the way that non-human animals communicate, and the ostensive-inferential model then captures the way that humans communicate with each other.

It is this ostensive-inferential model that I will consider to form the definition of *human communication* throughout this thesis. When I speak of communication broadly construed, I will adhere to the definition of communication by Freeberg et al. (2019). This definition is compatible with the code model outlined by Scott-Phillips (2018);

> 41: This is a weird comment, because it implicates maybe that the ostensive-inferential model is not compatible with the Freeberg definition. Make this implicature explicit, say something about how the Freeberg definition compares to the two models we have.

the code model, however, provides a level of detail that will not be necessary for our discussions of non-human animal communication.

> 42: Explicate the relation between the two models/definitions, because now it's very unclear why and how I'm using two different definitions at the same time

> 43: Actually, this section could do with a lot more work on intentional and non-intentional communication: read up on this, and make things explicit here. Could choose to define communication and non-intentional communication, or intentional communication and communication. Need to make a choice in this, explain it, and then be clear and *consistent!* about using this terminology.

> 44: Gricean objection: talking to the self is also communicating, albeit to an imaginary audience, or you yourself are the addressee. The point I make about using language without communicating is a bit slippery, philosophically controversial, and is maybe not relevant. Communicating without language *is* relevant, but maybe this is not the place to point that out; it can also become implicitly or explicitly clear throughout or at the end of the chapter.

As a last side note: while we would often equate human communication with linguistic communication, humans can easily communicate without language – for example, using glances or gestures[1], see also Section 2.3 – and can use language without communicating – for example, when one is talking to oneself. Therefore, although language will come up now and then throughout this chapter, it is not our object of focus at the present moment.

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

2.2 Communication in non-human animals

{sec:comm:phylogeny}

> 45: This section deserves a mention of Chomsky's work on animal communication: something about humans having language, and NHA only having stimulus-dependent responses? Also, this section could do with more references to experimental evidence.

Now we turn to the first methodological question and we 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).

> 46: Are they numbered?

Communication is used by non-human animals for a wide range of purposes, and it can be elicited by a number of stimuli. Moreover, communicative behaviors can manifest themselves in different modalities: not only can animals communicate through vocalizations, they may also communicate through gestures or glances.

> 47: The model that best describes them is a *consequence* of the difference between the two: so the difference is that which makes one model work better for NHA and the other better for humans. Reformulate

> 48: Write more on gestural communication in apes (is mentioned in Tomasello (2008))

One can broadly distinguish between communication in aggressive and cooperative interactions (Seyfarth and Cheney, 2003). In aggressive interactions, primates may for example use 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 both the dominant and the subordinate animal. In cooperative interactions on the other hand, where the interests of the signaler and the receiver overlap, communication can be used to alert others of predators, to coordinate foraging activities and to facilitate social interactions:

> 49: About?

> [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 not by just one stimulus, but rather a complex combination of them. Moreover, the "history of interactions between the individuals involved" (Seyfarth and Cheney, 2003, p. 151) can also play a role in eliciting vocalizations. As for the 'immediate' stimuli eliciting vocalizations, 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. For example, if I stop petting my dog (sensory stimulus), she will direct her gaze at me (communicative behavior) to indicate that she would like me to continue. Mental stimuli on the other hand can be viewed as the mental states an animal attributes to another animal.

> Take a different example: this is too much anecdotal, and with domesticated animals there's issues of evolutionary tractability as well as anthropomorphization. Get a reference on this

For example, . This type of stimulus 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).

Add example from the literature

2.3 Communication in children's development

{sec:comm:ontogeny}

Now that we have seen how communication works in non-human animals, let us turn to how children start communicating throughout their development. Around their first birthdays, children start communicating ostensively by pointing (Tomasello, 2008).

Although at first glance pointing may seem like a simple behavior, it may be used in a number of communicative contexts to convey a fairly wide range of messages and intentions. For example, infants may point at a cup to indicate that they want to drink from it (i.e., pointing to request), but they may also point to a hidden object that their parent is searching for (i.e. pointing to inform).

On the classic account, pointing can serve either of two communicative motives: an imperative motive, in which the pointer requests things from someone, and a declarative motive, in which the pointer shares their experiences and emotions with someone. This account can be extended upon by distinguishing between declaratives as expressives (sharing attitudes and emotions) and declaratives as informatives (providing information), and by furthermore conceiving of imperatives as a continuum, with the underlying motive ranging on a scale from individualistic – e.g. forcing someone to do something – to cooperative, e.g. indirectly making a request to someone by informing them of some desire (Tomasello, 2008).

The fact that pointing is a fairly complex communicative act is underscored

by the fact that non-human animals are not able to understand pointing in the same way humans are. The hypothesis is that in order to communicate intentionally,

> **55: Add reference for this**

> **56:** On the current definition, isn't all communication intentional? Should really settle on this, and then change the wording here as applicable. Read up also on Putnam's Brain in a Vat article, this might be illuminating philosophically. Grice also has some readings on natural and non-natural meaning, distinguishing between different types of communication. Something about intentionality? Make the distinction between intentional and non-intentional stuff very explicit, because it's one of the most important things in this chapter.

like children begin doing around their first birthday, first the skills and motivations for *shared intentionality* need to be present in the infant; that without skills of shared intentionality, infants could only communicate intentionally, but not cooperatively.

> **57:** Elaborate more on intentional vs. cooperative communication: does Tomasello (1999) have something on this? Something to do with joint attention.

Shared intentionality is the "ability to participate with others in interactions involving joint goals, intentions, and attention" (Tomasello, 2008, p. 139). Communicative pointing behaviors in infants emerge around the same time as skills and motivations of shared intentionality do, which according to Tomasello confirms this hypothesis of dependency between them.

> **58:** Disentangle communication and shared intentionality, because up until this point, they seem to be the same thing. Go a bit slower in this section.

> **59:** Reconsider the usage of the terminology "skills and motivation", and make explicit exactly what you mean by them. Would abilities be a better word? Why does Tomasello (2008) use skills? Why are motivations included? What are motivations?

Tomasello further investigates what he calls *pantomiming* or *iconic gestures*, which are symbolic or representational gestures. He presents empirical evidence

> **Give example**

> **60:** Discuss this empirical evidence

that these kinds of gestures rely heavily on convention for their meaning, and that the acquisition and usage of these conventions bears a strong resemblance to the acquisition and usage of language.

> **61:** This trajectory should also be more clear throughout the section

In short, infants first acquire the skills and motivations needed for shared intentionality; then they acquire the skills and motivations for communicative pointing; and then they acquire the ability to use iconic gestures and language around the same time.

2.4   What is the function of communication?

{sec:comm:function}

> **62:** Make a terminological choice between aggressive and competitive, and be consistent in your usage of them (so also back in the phylogeny section). Maybe even define them.

Finally, let us have a look at different conceptions of what the function of communication might be. We have already seen that we can broadly distinguish between competitive and cooperative functions of communication (Seyfarth and Cheney, 2003). For competitive, or aggressive, motives, one might use communication for attempting to intimidate a rival in the competition for food or for a mate. It would be evolutionarily beneficial to the communicator to intimidate verbally rather than physically because of a reduced risk of injury. According to the theory of human self-domestication, a number of human traits can be explained by a process of 'self-domestication', in which females select sexually for less aggressive males. It has been proposed that because of this reduction in physical aggression, interactions between individuals became longer and more frequent throughout evolutionary history, which allowed for our language and communication to become more complex (Benítez-Burraco et al., 2021).

As for the cooperative functions of communication, Tomasello (2008) proposes three different motives underlying communication: sharing (of emotions and attitudes), informing, and requesting (help to achieve goals).

> 64: Explicate and elaborate more on this argument, because now it's not convincing. Cite some literature also on it, maybe Heyes 2018 or Tomasello 2009 talks about it

It is apparent that communication crucially enables individuals to cooperate and collaborate. In addition, more sophisticated communication would make more sophisticated forms of cooperation and collaboration possible, from coordinated hunting activities to the social institutions we depend on nowadays.

> 65: To what extent do animals participate in coordinated hunting activities? I remember reading about it, about monkeys launching a coordinated attack, was that in Tomasello (2009)? Find this reference

But in order for us to complete the causal chain, we need to have a look at what makes cooperation and collaboration something evolution has selected for at all.

In cooperative behaviors, one can distinguish between altruistic behavior (sacrificing something in some way for the benefit of another individual) and collaborative behavior (working together with another individual for mutual benefit) (Tomasello, 2009). In the case of the latter, the evolutionary causation is straight-forward: the mutual benefit of the outcome constitutes the evolutionary pressure that has selected for it. In the case of the former though, it is not immediately obvious that helping another person without benefit to the self would be evolutionarily advantageous. (Tomasello, 2009) hypothesizes that altruism can be best explained in the broader picture of the social group, considering the norms that are enforced and being conformed to within the group and the shared intentionality inherent in the group. Moreover, he emphasizes the role of both human biology and human culture in shaping humans' cooperative tendencies; see also Chapter 1.

> 63: Change around the way you reference it: maybe find multiple references for this theory, and then only the last finding is specifically from the 2021 paper. See notes

> 66: Change the presentation of this last point around: if you want to mention it, then mention his arguments, the evidence he presents, because it's a bit devoid of content as it stands. Why is this relevant?

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