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Everybody lies: deception levels in various domains of life

Kristina Šekrst

University of Zagreb, ksekrst@ffzg.hr[1]

Abstract

The goal of this paper is to establish a hierarchical level of deception which does not apply only to humans and non-human animals, but also to the rest of the living world, including plants. We will follow the hierarchical categorization of deception, set forth by Mitchell (1986), in which the first level of deception starts with mimicry, while the last level of deception includes learning and intentionality, usually attributed to primates. We will show how such a hierarchy can be attributed to bacteria, plants, and fungi, see that self-deception is not inherent only to humans, and then connect the evolutionary roots of deception with the philosophical notion of intentionality.

Levels of deception and intentionality

According to de Waal (1992), *deception* can be defined as the projection of inaccurate or false image of knowledge, intentions, or motivations. Animal deception has been thoroughly studied, but it was mostly focusing on mimicry and primate intentionality. Mitchell (1986, p. 21) states that *deception* occurs when:
1) an organism *R* registers something *Y* from another organism *S*, where *S* can be described as benefiting when:
2a) *R* acts appropriately toward *Y*, because
2b) *Y* means *X*; and
3) it is untrue that X is the case.
If *S* and *R* are the same organism, we are talking about *self-deception* (see Figure 1).

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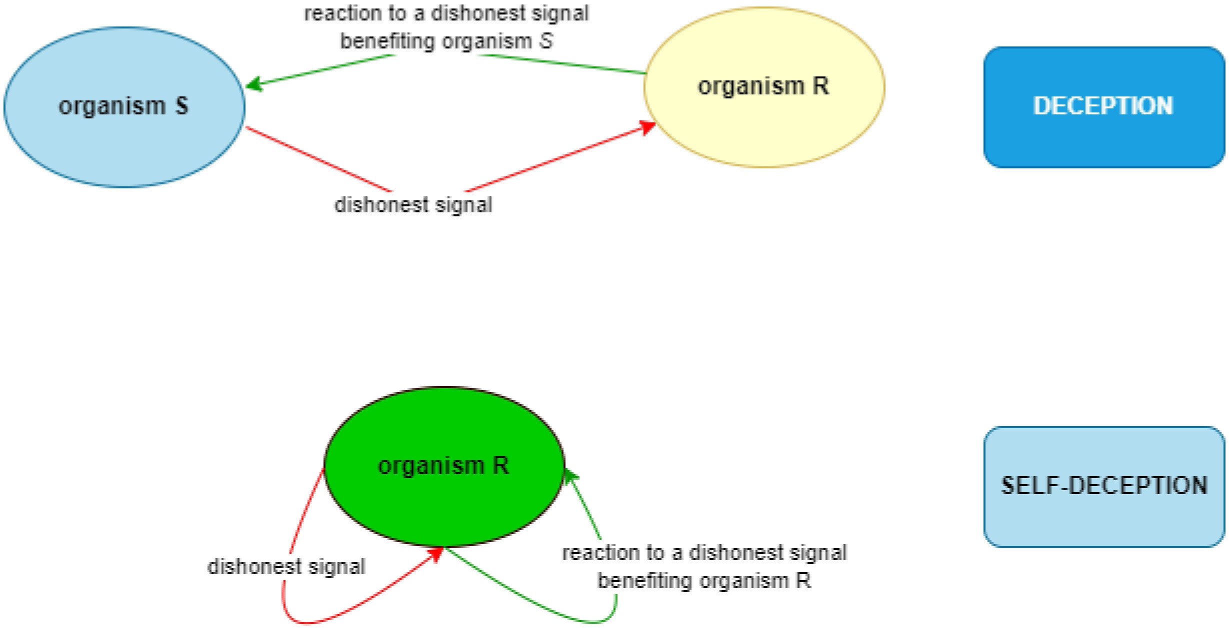

Figure 1. Deception and self-deception according to Mitchell (1986).

In philosophical research, self-deception usually involves a *person* who seems to acquire and maintain false belief in the teeth of evidence to the contrary as a consequence of some motivation, and who may display behavior suggesting some awareness of the truth (Deweese-Boyd, 2021). We will notice that most philosophical and psychological research on self-deception describes humans exclusively (cf. Hållén, 2011; McLaughlin & Rorty, 1988; Deweese-Boyd, 2021; Barnes, 1977), which is the reason that it mostly deals with the notion of *person* and *identity*, of which there is no consensus regarding non-human animal species that it might be attributed to.

Mitchell (1986, p. 21) asserts that the *first level of deception* is the level at which an animal acts because it cannot do otherwise, for example, palatable butterflies that look like unpalatable ones to experienced blue jays, or the appearance of various false eyeballs and markings deterring predators. For Maran (2017), mimicry is both a biological and a semiotic phenomenon. *Mimicry* is usually defined as the resemblance of one organism to another or a similar natural object. However, mimicry can take place in auditory, chemical, tactile or any other channel and frequency that animals use for communication. Although most mimicry cases are based on prey and predator relations, it exists within other functions such as symbiosis, parasitism, or competition. The resemblance does not have to be species-specific, for example, there are more abstract features such as mammalian eyes, such as eyespots in caterpillars and fish, or specific movements, like the worm-like movements of anglerfish (Maran, 2017, p. 8).

Second-level deception is a certain programmed act of false behavior. In this level, an organism's behavior is still considered programmed, but according to the registration of acts of another organism, i.e. "the influence of the receiver's actions on the sender's action" (Mitchell, 1986, p. 24) is different from the first-level deception. That means that the sender needs to come into contact with the receiver for the preprogrammed action to take place. For example, Mitchell (1986, p. 24) mentions Steger and Caldwell's research (1983) about deceptive mimicking or a case of bluffing by stomatopods, in which they act as if they are capable of inflicting harm upon other stomatopods. New molts were attempting to defend their cavities by bluffing: lean out of their cavity and laterally spread the raptorial appendages while facing an opponent. Such sequences support the conclusion of attempted deception since such actions caused intruders to coil in defensive postures and the most of them swam away rapidly (Steger and Caldwell, 1983). Classic examples include snake-mimicry in various birds, for example, Møller, Flensted-Jensen and Liang (2021) have shown that the incubating female of the *Paridae* family performs a hissing display when threatened, by hissing vigorously while lunging their head forward and shaking their wings and tail repeatedly. Another classic example is distraction display,[2] where some birds such as the Killdeer simulate a broken wing, and many of the warblers appear to be sick or seem to simulate helpless baby birds by quivering their wings (Davis 1989, p. 126).

Third-level deceivers are capable of learning and such actions are based upon trial and error. Mitchell (1986, p. 25) states that some instances of this level-three deception can be considered *intentional*, though *not intentionally deceptive*: an animal can act because it believes its action will have a particular result. To conclude, *learning* is the most important characteristic here and many animals learn to take different actions based on previous experience. Mitchell (1986, p. 25) mentions that blue jays learn to ignore palatable butterflies similar to unpalatable ones after experiencing the nausea connected to eating the latter. Do note, the learning process here does not have to happen for a single individual only, for example, for Mitchell (1986, p. 25), Krebs's hypothesis (1977) – by which some birds' song repertoires evolved because they were able to create the illusion of a crowded habitat and dissuade new birds from nesting nearby – is also an example of third-level deception. One recent example includes deceptive behavior in Tonkean macaques (Canteloup et al., 2017), where subordinates used distraction to lure away the dominant macaque from the food. Sometimes the border between this level, and the next one that includes awareness of other organism's beliefs seems blurry, but in this case, authors believe it was a learned behavior that triggered success previously. Mitchell (1986, p. 25) mentions a similar example in which

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[2] Mitchell (1986, p. 24) calls it "injury-feigning", but according to Davis (1989, p. 125), ornithologists generally use the term "distraction display" rather than "injury feigning" or "broken-wing act".

Hediger (1955) has described a captive gorilla who lured her keeper to her cage by acting if her arm were stuck. This is an example that is *at least* at the third level but might be even of a fourth level. Let us now examine the next stage.

The most interesting level is the *fourth level of deception*, in which the recognition of other animal's beliefs happens. This is where, of course, humans excel, since it involves programming and reprogramming based on past and present actions of the organism being deceived (Mitchell, 1986, p. 26). From a philosophical standpoint, there is a strong *intention to deceive* the receiver. In the animal world, Mitchell mentions Menzel's (1974) research that shows a series of deceptive interactions between two chimpanzees in order to avoid communicating about hidden food, after studying the same nine chimpanzees for six years, who were later brought together in a one-acre field cage. Rock, the most dominant chimp, and Belle were interacting, and Belle became slower in her approach to the food, since as soon as Belle uncovered it, Rock would race over and take it all (Menzel, 1974). In order to investigate the difference between the last two levels, the notion of *intentionality*[3] needs to be emphasized.

For Dennett (1983, p. 345), the *first-order intentional system* has beliefs and desires, but no beliefs and desires about beliefs and desires: such a system has the form of *x believes that p* or *y wants that q*, where *p* and *q* contain no intentional idioms. For example, a subordinate monkey might believe that a dominant one wants his food. Such cases would usually correspond to the third level of deception. *Second-order intentional system* possesses beliefs and desires (and other intentional states) about beliefs and desires, agent's own and of others, for example: x *wants* y *to believe that* x *is hungry* or x *fears that y will discover that* x *has a food cache* (Dennett, 1983, p. 345). Finally, a *third-order intentional system* is capable of states such as x *wants* y *to believe that* x *believes he is all alone*, while a *fourth-order intentional system* "might want you to think it understood you to be requesting that it leave" (Dennett, 1983, p. 345). Cognitive ethologists usually discuss the question whether monkeys or apes are second- or third-order intentional systems (Dreckman, 1999, p. 94). This paper does not deal with the complex notion of intentionality in detail, but the concept itself is needed to better differentiate between the third and fourth level of deception. In the third level of deception, we can only find the lowest order of intentionality, while the second and higher orders of intentionality are connected to the fourth level of deception.

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[3] In philosophy, *intentionality* is usually connected to *directedness* or *aboutness* related to a certain object. However, animals certainly display directedness towards objects in their surroundings, but that does not mean we have to credit them with thought (Beisecker, 1999, p. 281). Dennett's levels of intentionality seem to at least try to clarify between different levels of such a concept.

Dreckmann (1999, p. 105) warns about an important *caveat*: there are always alternative explanations regarding the differentiation of higher orders of intentionality, for example, instead of intending to bring about a false belief in its companion, the animal could just have learned to react in a particular way. Mitchell (1986, p. 25) has classified Hediger's (1955) example of a captive gorilla luring her caretaker into the cage by acting injured as third-level deception. In this case, we might stick to conservative notions such as Mitchell and classify this as a learned mechanism without any beliefs on how the caretaker should behave, since it was always a successful action and the animal remembers the consequences, without any higher-order thinking. An alternate and feasible explanation would be to see the gorilla as an illustration of the fourth level of deception, possessing beliefs that the caretaker will believe she was injured. I will emphasize the possibility of alternative explanations by introducing the notion of intentionality into each of the levels, where feasible, since this research has to remain work in progress, and go along with current scientific data.

My argument is as follows. First, I will go through all the levels of deception in more detail and see whether such deception exists in other kingdoms, especially seeing whether different notions of deception exist in plants or fungi. The goal is to see that a general hierarchy of deception can be established, which does not include only the animal world. A new classification might be revised in light of new evidence, but according to current research, it is necessary to talk about *deception* as a broad biological phenomenon, which differs in hierarchical levels from species to species. Second, I will propose how new biological studies fit into the classical notion of self-deception, which is almost exclusively concerned with humans, and possibly simians.

First-level deception

The first level of deception includes actions designed by natural selection or differential replication. Such adaptations created to deceive other organisms can be conceptualized as a *mime*: an instance of correlation among a trait or behavior of one organism, the simulation of that trait or behavior in another organism and the type of behavior enacted by certain organisms towards both beings bearing the original trait or a simulated one (Mitchell, 1986, p. 21). Various examples of mimicry have been thoroughly studied: cf. stomatopod meral spreading (Steger and Cardwell, 1983) mentioned by Mitchell as defensive mimicry belonging to the second level of deception (Mitchell, 1986, p. 24), or typical *Batesian mimicry* examples in butterflies (Jeffords, Sternburg and Waldbauer, 1979) and coral snakes (Greene and McDiarmid, 1981).

There is also a type of mimicry where no deception is involved, the so-called *Müllerian mimicry*, in which organisms profit from nothing by simulating each other's warning signs (cf. Benson, 1972). Müllerian mimicry refers to a phenomenon of evolved similarity among unpalatable species, that often share a common predator, in which the species mimic each other's honest signals to their benefit (Forbes, 2009, p. 42). For example, *Heliconius* butterflies are different species wearing the same patterning to give a standardized warning to predators that they are unpalatable (Forbes, 2009, p. 221).[4] *Automimicry* refers to cases in which one body part mimics another in a certain organism, for example, if organism develops adult-like traits to decrease predator attacks (Sordahl, 1988), various patterns and eye spots to confuse the predators where the butterfly's head is (Robbins, 1981, given by Mitchell, 1976, p. 22), and similar evolutionary stable strategies (Svennungsen and Holen, 2007).

Such a level of deception belongs in the plant word as well. Pannell and Farmer (2016) have grouped mimicry in plants into two cases: those that confer protection against herbivores, and those that exact rewards from mutualists, such as pollinators, without providing a reward. Pannell and Farmer (2016) demonstrate this using two examples. First is the uncanny resemblance by the Australian mistletoe parasite, *Amyema cambagei* of its *Casuarina* host, since the foliage of the mistletoe is hard to distinguish from the better defeated shoots of the host from nocturnal herbivores. A second example involves *Passifloraceae* where yellow spots mimic the eggs of *Heliconidae* butterflies, since the butterflies would avoid ovipositing on leaves that already have eggs.

Pasteur (1982) presents different models of plant mimicry classification, according to functionality, the type of impact on the deceived organism and similar conditions. One classic example is the example of Pouyannian mimicry, in which some flowers mimic a potential pollinator's mate, cf. orchid flowers who mimic female *Hymenoptera* and attract males, where a deceived male bee or wasp tries to (pseudo-)copulate with a mimetic flower (Pasteur, 1982). Lev-Yadun (2003) has shown an example of automimicry, previously known only in animals, related to thorns within *Agave* genus, an example of anti-herbivore Batesian mimicry. For classic mimicry studies, see Dodson and Frymire (1961), Baker (1976), Boyden (1980), and Williamson and Black (1981). The

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[4] An illustrative example is reported by Forbes (2009, p. 51) citing Poulton (1890): "A Batesian mimic may be compared to an unscrupulous tradesman who copies the advertisement of a successful firm, whereas Mullerian mimicry is like a combination between firms who adopt a common advertisement to share expenses".

next type of mimicry, aggressive mimicry, actually belongs to the second level of deception.

There are examples of mimicry in Fungi as well. Ngugi and Scherm (2006) have described the use of visual and olfactory signals to attract insects to fungus, i.e., pseudoflowers on which fungal gametes or infectious spores are produced. For classic studies, see Roy (1993) and Raguso and Roy (1998). Fungi have also developed a form of the mentioned aggressive mimicry, which we will visit in the next section.

Second level of deception

For Mitchell (1986, p. 24), the organism is programmed here by another organism registering the act, the organism is programmed to do *p* given that *q* is the case. In the case of aggressive mimicry, the organism, usually the predator, is programmed to employ a certain level of mimicry when another organism, often the prey, is present. Unlike defensive mimicry, in which the prey acts as a mimic, aggressive mimicry involves predators doing so, often being labeled as the *wolf-in-sheep's-clothing strategy* (cf. Eisner et al., 1987). *Aggressive mimicry* is a way for predators or parasites to share similar signals as their prey to avoid being correctly identified (cf. Wickler, 1968). In defensive mimicry, the mimic benefits from such an act, while in aggressive mimicry, the signal receiver is inevitably indirectly manipulated (Jackson and Cross, 2013). Jackson and Cross (2013) connect this signal sending to Krebs and Dawkins (1984) model of communication, where it was seen as dealing with indirect manipulation: the sender makes a signal to which the receiver responds in a way that is beneficial to the sender. Pietsch and Grobecker (1978) show that the anglerfish of the genus *Antennarius* utilizes a lure that mimics a small fish. For detailed studies, see, for example, Nelson and Jackson (2009) for spiders, Eisner et al. (1978) for larvae, Boileau et al. (2015) for cichlid fish, and Salazar et al. (2015) for aphids.

Jamie (2017) states that aggressive mimicry is found in non-rewarding plants that look like a rewarding species, thus duping pollinators to visit them. A classic example is the Venus flytrap, along with similar carnivorous plants (Di Giusto et al., 2010). One interesting example in the animal world uses the same tactic of looking like a bright, luring flower: the orchid mantis resembles a flower in order to lure its prey (Hanlon et al., 2014).

Molecular mimicry can be seen as a special case of aggressive mimicry (Ngugi and Scherm, 2006).[5] By *molecular mimicry*, we refer to certain pathogens that have evolved proteins that imitate specific eukaryotic cell proteins, allowing them to manipulate host pathways (Mondino, Schmidt and Buchrieser, 2020). Ngugi and Scherm (2006) illustrate molecular mimicry with an example of *Xanthomonas axonopodis* pv. Citri mimicking plant natriuretic peptides from a study by Nembaware et al. (2004). Nembaware et al. (2004) consider this a case of molecular mimicry that enables the pathogen to manipulate plant responses to bring about favorable conditions to the pathogen. This can again be seen as an application of the Krebs and Dawkins model of communication dealing with indirect manipulation.

Stebbins and Galán (2001) show that many bacterial pathogens mimic the function of host proteins to manipulate host physiology for the microbe's benefit. Bacterial virulence factors were probably acquired horizontally, perhaps from a eukaryotic host, while virulence factors that use molecular surfaces that mimic host protein surfaces are more likely to have been obtained by convergent evolution (Stebbins and Galán, 2001). Tayal et al. (2021) show that molecular mimicry operates at four distinct levels: 1) similarity in both sequence and structure of a full-length protein or a functional domain (cf. *Legionella pneumophila*, *Chlamydia trachomatis* and *Burkholderia thailandensis*) 2) only structural similarity without sequence similarity 3) similarity in the sequence of a short linear motif 4) similarity of binding-site architectures.

Aggressive mimicry is found in Fungi as well, where one of the best examples is pollen mimicry, where pathogens infect flowers via the gynoecial pathway (Ngugi and Scherm, 2004). According to Ngugi and Scherm (2006), another example of molecular mimicry is seen in the case of plant-parasitic fungi *Rhizoctonia solani* and *Phoma lingam* (Pedras and Okanga, 1999). Ngugi and Scherm (2006) connect the aggressive mimicry to specialized plant-parasitic fungi mimicking host structures to gain access to resources. When the host is present (*q* in Mitchell's description), *M. vaccinii-corymbosi* infect via the gynoecium without eliciting a host defense-response.

Aggressive mimicry can, indeed, be also seen as an edge case between first level and second level of deception if we give up on it being seen as an employment of indirect manipulation. Better examples are cases of the defensive *thanatosis* or playing dead as a common tool among animals, usually triggered by an imminent threat of predation

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[5] One might object by stating that Mitchell's (1986, p. 24) classification seems to point out active perception or reaction to the *q* being provided (do *p* given *q*), but he employs the word *registration* correctly since there does not have to be any active perception involved (even though it usually is) except for a basic reaction, which might be seen in terms of any biological system.

(Rogers and Simpson, 2014). Various cases of apparent death have been thoroughly studies in many species, for example, spiders (Hansen et al., 2008), wasps (King and Leaich, 2006), ants (Cassil et al., 2008), frogs and toads (Toledo et al., 2010), sharks (Watsky and Gruber, 1990), fish (Whitman et al., 1986), ducks (Sargeant and Eberhardt, 1975), and many mammals.

In cases of thanatosis, the predator has seen the prey alive and can differentiate between the former and the new status. In plants, thanatosis is not investigated, but a borderline example could be the dead succulent plant, *Cynanchum marnierianum*, where a predator would not look at a bunch of dried twigs. However, this could be better seen as the first-level mimicry as well, since there is no contrast between the "alive" state, as in animal-world thanatosis. Similarly, Rupp et al. (2021) have shown that *Aristolochia microstoma* releases compounds known to be released from decomposing insects, where pollinators are deceived thinking they are going to find a carcass. This is again a combination of first-level deception, along with the ability of pollinators to recognize death.

Third level of deception

Third level includes trial and error and observational learning. This is the level in which we can talk about non-edge cases of *intentionality*. For Mitchell (1986, p. 25), one description of the third-level deception might be "do any action *p* given that this *p* has resulted in some desired consequence *q* in our past". Courtland (2015, p. 124) emphasizes the important of a *time component* since this level involves learning. In order to learn, the organism must be able to recognize the connection between the particular act (*p*) and the desired effect (*q*), that is, the organism learns that some acts "pay" better than others (Courtland, 2015, p. 124). However, even if the acts are itself *intentional*, here we do not seem to find *intentional deception* itself.

Tomasello and Call (1997, reported by Courtland, 2015) give an example of a primate that will only attempt to mate while the rival is not in sight, given the history of it being attacked every time it tried to mate. Bee, Perill and Owen (2000) have shown how male green frogs lower the dominant frequency of their calls since it is negatively correlated with male body size. In their experiment, males significantly increased their apparent size by lowering the frequency and sending the dishonest signal. Classic examples, given by Mitchell (1986, p. 25) include dogs deceiving humans due to the fact that previous limping had more petting as a consequence. Unsurprisingly, this level seems to completely comprise animals only, because of both learning and intentionality. In this case, we would still be left with Dennett’s first-order intentionality since an animal agent might possess beliefs about future outcomes of its current acts, but that does not mean the action is verifiable to be shown as a deliberate act of manipulation and does not have to, therefore, include knowledge of other side’s mental states.

It is important to note that some examples might be seen as both third-level and fourth-level deception, for example, the mentioned case of a gorilla luring its keeper to the cage. Mitchell (1986), I believe, was opting for more conservative explanations without additional presumptions, but this, of course, does not have to be the case until we find a way to verify second-order thinking for such cases. For the purpose of our ontological argument, this does not change the fact that third level seems to be restricted to animals only, the claim that is suited for the fourth level as well.

Fourth-level deception

Philosophically the most interesting deception is the one that involves thinking, planning and the act of intention. Besides humans, this is a common primate trait. Hatchett (2001) states that the simplest form of deception is found in ceboids and cercopithecoids like *Macaca mulatta* and *Cebus apella*, where a subject discovers an aiding technique or a tactic, which is repeated when it is beneficial. Such an action does not provide mental-state attribution for other primates. Second form involves a conscious effort to trick another individual in order to realize a certain goal, which is thought to require recognition of self and others.

It was often argued that rhesus monkeys practice deception by withholding information, usually about the location of food, but Hauser (1992) states that withholding such information has more cost than benefit, for example, such an individual might be chased away or eat less food, so that would explain the rarity of such events. Hatchett (2001) considers baboons the most complex cheaters of the cercopithecoid taxa. Byrne and Whiten (1985) have provided the definition of *intimate tactical deception*: 1) acts from the normal repertoire of an individual, 2) used at low frequency, and in contexts different from high-frequency (honest) versions of the act, 3) such that another familiar individual 4) is likely to misinterpret the meaning of the acts 5) to the advantage of the actor.

Byrne and Whiten (1992) show that Papio and Pan show high levels of tactical deception, unlike no evidence for Strepsirhini. Even though most examples were anecdotal, it is interesting to see that in a recent study, Genty and Roeder (2006) have shown that some lemurs may learn to cheat.

Of course, along with somewhat obvious Mitchell's (1986, p. 27) conclusion that fourth-level deception is prevalent with humans, this level also corresponds to the possible realization of higher-order intentionality. Dennett (1983, p. 347) mentions that Seyfarth reported an incident in which one of the losing-side monkeys issued a leopard alarm during a fight, in the absence of any leopards, leading all vervets to head for the trees. This is where theory of mind comes into play, namely, what level of intentionality are we talking about here? If we see it as first-order intentionality, then the vervet monkey *wants* the other monkeys to run into the trees. We might even consider this a certain third-level deception since it might have been successful before, perhaps after an erroneous detection. If we see it as second-order intentionality, then we must describe it as: the vervet monkey *wants* the other (inamicable) monkeys to *believe* there is a leopard near.[6] It seems that, even though the fourth level of deception is applicable to animals, there is much more research needed regarding specific orders of intentionality and the possibility of verification in the animal world.

Levels of deception: overview

Mitchell (1986) has created the classification for Animalia. However, I have demonstrated that other domains of life can be included as well. First-level deception includes plant and fungi examples. Second-level deceptions, intriguingly, also include the bacterial world and fungi. We have expected the third and fourth level to be attributed only to animals, which does seem to be the case, but there is more research to be done in both levels regarding orders of intentionality (cf. Dennett, 1983). The first conjecture I have is that *deception seems to be omnipresent in various domains of life* (Archaea excluded, without any conclusive research known to us so far), and that we should talk about domain-level or kingdom-level deception, rather than animal deception. Plant deception has been studied as plant mimicry, along with fungi, but mostly only connected to the notion of mimicry, without any general common denominator of *deception*.

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[6] We could go even further in developing the theory of mind and think about what the alarm call does for mental state or mental images. For example, the sound of an alarm call might conjure a mental image of a leopard in a vervet monkey. In such case, we would be talking about *representations* in such a theory of mind, which would make it comparable to the human mind in some degree.

Classical philosophical studies are mostly concerned with lying and deceiving, with the necessary notion of beliefs and truth. Lying is often connected with intentionality (cf. Mahon, 2016; Morris, 1976), but I see deception as a broader category, where intentionality (and hence possibility of lying) happens at the higher levels (partly level three and mostly level four). In theory of lying, there are two important views. One is *deceptionism*, in which the intention to deceive is necessary for lying, and the second is *non-deceptionism* where such intention is not necessary (Deweese-Boyd, 2021). Animals and other organisms deceive each other all the time, but for the definition of *deception*, unlike the definition of *lying*, intention is not a necessary part of the definition. In this case, *lying* would be a special case of deception, connected to higher levels, whether it has intentionality or not. If we do not posit intentionality for *lying*, then it could occur at lower levels of the hierarchy, including evolutionary mechanisms of deception such as mimicry. If this is the case, then the theory of lying needs to be modified, since it would seem that notions of *person* or *belief* in that case would not be parts of an appropriate definition. If the definition only refers to humans or higher primates, then last two levels might be further analyzed with respect to intentionality.

Self-deception

Mitchell (1976) has proposed that self-deception occurs if the deceiver and the object of deception are the same organism. There is much controversy in philosophy and psychology about the correct definition and prerequisite of self-deception, but it minimally involves a person who seems to acquire and maintain some false belief in the teeth of the evidence to the contrary as a consequence of some motivation, and who may display behavior that suggests some awareness of the truth (Deweese-Boyd, 2021). I will once again emphasize that most studies reflect on *persons*, i.e. people.

In philosophy of self-deception, two main approaches are *intentionalism* (self-deception is an intentional act) and *revisionism* (the opposite). The former cases attribute intentionality to such acts, while the former talk about our adjustments of attitude or revision of belief. If we revise our beliefs, there is no apparent contradiction in place regarding self-deception. However, both accounts will provide a higher-level theory of mind for the bearer of self-deception. Namely, intentionality is related to the third and fourth level of deception, especially the fourth. Mitchell (1986) presumes that an animal's act can be considered intentional at stage three, but not *intentionally deceptive*, i.e., having recognition of what the other animal effecting that result believes about the action. If we take revisionist stance into account, we are still talking about possessing certain beliefs and changing stances, which is a higher cognitive ability.

In 2019, Angilletta et al. (2019) have combined modeling and an experiment to confirm the necessary conditions for self-deception in slender crayfish, *Cherax dispar*. Those necessary conditions were established as follows: 1) dishonest individuals must escalate aggression using the same signals that honest individuals do 2) both honest and dishonest individuals must escalate aggression according to the quality they have signaled, regardless of their actual quality. Angilletta et al. (2019) presuppose that natural selection might have favored genotypes with little or no awareness of their deceptive signaling. They discovered that many crayfish with large claws were quite weak, and staged fights for 97 adult males, 20 selected ones and 77 opponents. The hypothesis was that if a crayfish knows it has a weak claw, it should be less aggressive. However, deceptive signalers ignored their own real strength when escalating or evading aggression.

Trivers (2011) has proposed that the most evolutionarily successful deceivers in nature are those who self-deceive first because they pay significant cognitive cost to avoid involuntary responses, such as blushing, diverting eye contact, voice tone etc. Trivers states that birds may show greater physiological arousal to their own or close relative’s voice than to others and could be trained to peck when they “thought” they heard their own voice instead of another’s (Trivers 1991).

Bekoff (2000) has studied animal emotions in general, and regarding grief, he states that many animals display grief at the loss or absence of a close friend or a loved one, providing a classic example given by Goodall (1990), who observed a young chimpanzee Flint withdrawing from his group, stop feeding, and finally dying after his mother died. King (2013, p. 51) mentions that in the wild, great ape babies nurse from and ride on the mother for four years or more, and when the babies die, they may continue to ride on their mother's body simply because the mother refuses to part with them. For example, in 2003 at Bossou, a respiratory epidemic swept through the chimpanzee community and two infants were among the victims. Their mothers carried the infants' bodies for 68 days and 19 days respectively, shooing away flies and borrowing the body for other chimpanzees to "play" with (King, 2013, p. 51). King doubts that this is the case of chimpanzees not discerning that the infants had died, focusing on their complex reasoning. In this case, we might see it as a case of self-deception.[7] Since the genus Pan seems to be the best candidate for higher-order intentionality, this does not seem

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[7] I would like to thank Reviewer 2 for pointing this out.

implausible. However, the example with the crayfish shows that higher-order intentionality and complex reasoning might not be the necessary prerequisite for self-deception.

I have emphasized that almost every philosophical or psychological theory of self-deception is focused on humans. However, by attributing self-deception to animals, we may need to think about ontological and epistemological differences between deception levels. For example, crayfish attacking others while pretending to be stronger than they are, might be an accidental correlation. In that case, there is no intentionality present, just aggressive mimicry and second-level deception. If we consider this the case of self-deception in the classical psychological and philosophical sense, then we are acknowledging *beliefs*. That is, a crayfish possesses a *belief* to be stronger and acts accordingly (even though the belief is obviously wrong). In that case, we must be talking at least about first-order intentionality (cf. Dennett, 1983) and at least third level of deception.

It is interesting to note that philosophical debate often emphasizes moral responsibility regarding self-deception. Intentionalists will hold that self-deceivers are responsible since they intend to acquire this sort of behavior, while non-intentionalists seem to remove the agent from responsibility by rendering the process subintentional: the agent has no (direct) control over his actions (Deweese-Boyd, 2021). If philosophical theories of self-deception are necessarily linked to ethical questions, and we attribute self-deception to certain animals, such questions need to be distinguished for all possible agents.

If cases of crayfish or possibly birds turns out to be a conclusive example of self-deception in animals, then, according to the theory of self-deception we pursue, we must incorporate non-human animals into self-deception, the same way we needed to incorporate plants, bacteria and fungi into classes of deception. The second conjecture is, then, that *self-deception, if it is continued to be analyzed from a philosophical perspective, must take into account examples from non-human animals*. In such cases, a proper definition needs to illustrate a theory of mind applicable to both humans and non-human animals. If self-deception deals with revising beliefs, and if a crayfish is proven to self-deceive and we take the revisionist stance into account, does it possess beliefs? If so, we must consider the possibility of belief revision for animals as well. Research so far has mostly focused on forming (first-order) beliefs (cf. Stich, 1978; Dreckmann, 1999; Fellows, 2000). However, since the studies on animal mind are fruitful, inclusion of new biological findings will strengthen philosophical intuitions as well.

Deception modeling

Animal cognition is often centered around mirror recognition, epistemology and social interactions (cf. Andrews and Monsó, 2021). It is no wonder that theories of deception are also greatly studied in animal cognition, biology, cognitive science and philosophy. However, the theory of deception, we conclude, should be a general theory that should incorporate all the living forms up to some degree. We have followed Mitchell's (1986) classification and have demonstrated various studies that confirm the existence of deception in other domains of life, such as plants, fungi or bacteria. Such a model is expected to narrow towards the fourth level to include higher primates and humans only, but a general model would follow the proposed schema in Figure 2.

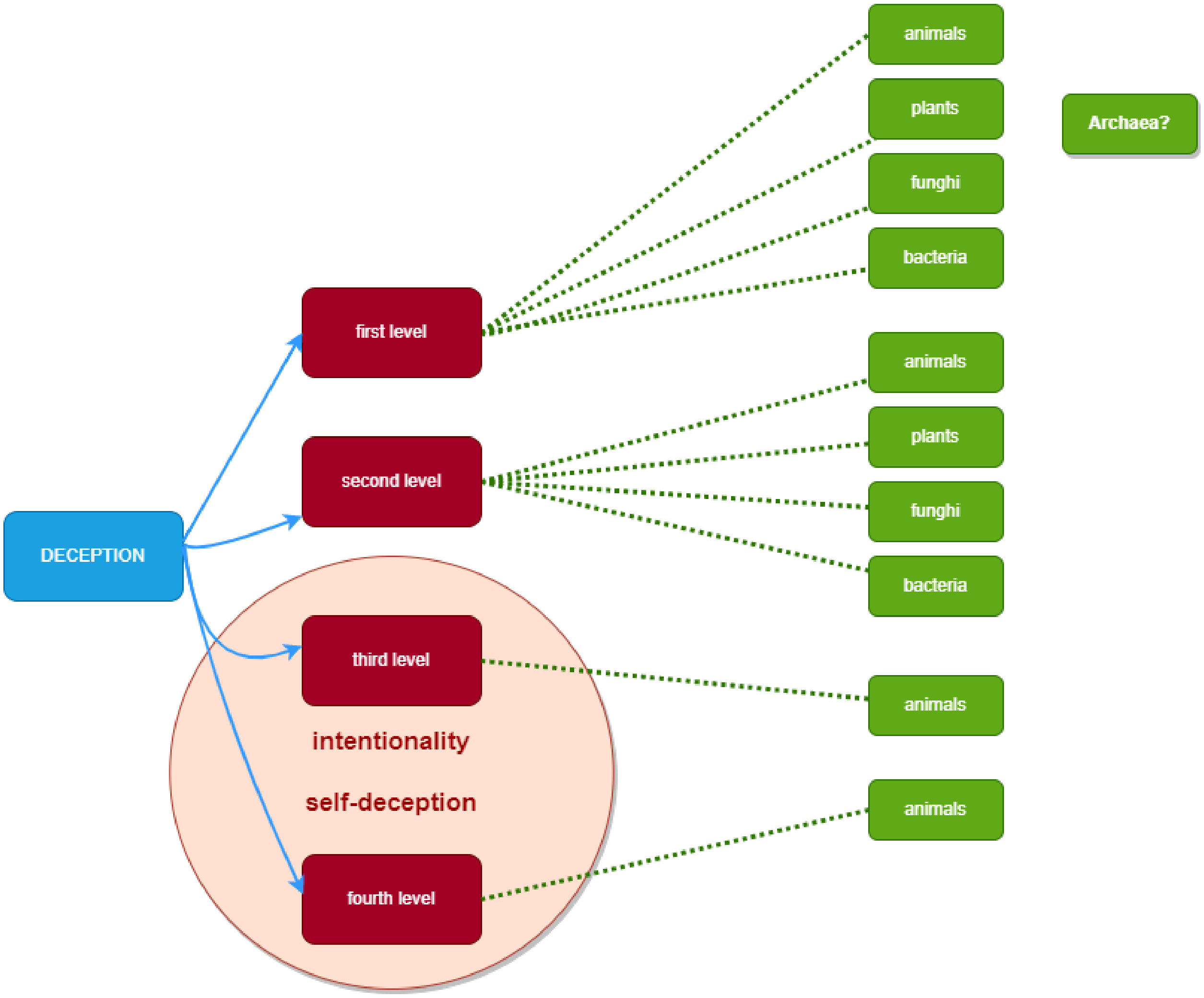

Figure 2. A proposed schema for the new classification of domain-level deception.

Self-deception can occur at the intersection of level 3 and level 4 for both non-human and human animals. These are also the levels of intentionality, either as first-order or higher-order intentionality levels. As other biological studies investigating deception and self-deception arise, schema can be revised to better incorporate the data, especially regarding the inclusion, for example, of Archaea at the lowest level of deception, or finding bacterial examples of third-level deception. The example with crayfish shows us that if we consider this the case of self-deception, then either it is an example of third-level deception, or there is intentionality involved in the second level as well.

I consider the modeling of deception incomplete if talking about animal deception, human deception, or plant deception, since studies show that deception seems to be a universal and evolutionary stable strategy, and therefore a general model is needed to better explain the philosophical notion of deception. I also believe that self-deception, as a cognitive phenomenon, must be investigated at lower levels of the deception hierarchy, and not as something exclusive to human animals.

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