

# Signaling without Cooperation

Marc Artiga

## Abstract

Ethological theories usually attribute semantic content to animals signals and it is standardly assumed that teleosemantics can account for this fact. However, this picture that has recently came under attack: while mainstream teleosemantics assumes that representational systems must cooperate, some biologists and philosophers argue that in certain cases signaling can evolve within systems lacking complete (or even partial) common interest. In this paper I defend the standard view from this objection.

## 1 Introduction

Many living beings have evolved certain mechanisms that allow them to inform others. The bright red color of the Granular Poison Frog (*Oophaga granulifera*) warns predators of its noxious taste and certain kind of vocalizations produced by meerkats (*Suricata suricata*) indicate that danger is approaching (Hollen and Radford, 2009). Ethological studies are pervaded with attributions of semantic content to animal signals (Seyfarth et al. 2010). The challenge is how to account for the nature and content of these representational states.

In that respect, teleosemantics is probably the most promising naturalistic theory of representation. Its main goal is to explain in virtue of what process certain states qualify as representations and how their content is determined. Mainstream versions of teleosemantics (most prominently Millikan's, 1984, 1993, 2004) assume that (at least, in simple signaling systems) representations originate within cooperating systems. This view is also popular in ethology (Maynard-Smith and Harper, 2003; Searcy and Nowicki, 2005). However, this thesis has been challenged by some biologists (Dawkins and Krebs, 1978; Rendall et al, 2009) and philosophers (Sterelny, 1995; Stegmann, 2005, 2009; Cao, 2012), who have pointed out several examples that suggest that signaling can take place within uncooperative systems. In addition, this objection has motivated a different sort of naturalistic approach, which departs from the standard teleosemantic framework. In this paper I would like to clarify and address this issue.

The paper is organized in the following way. In the first section, I outline the main tenets of the basic teleosemantic framework, as defended by Millikan (1984), Papineau (2003), Shea (2007), Price, (2001) and Godfrey-Smith (2006, 1996). In the second section I present the main objection based on some alleged cases of uncooperative signaling systems in relatively unsophisticated biological mechanisms. In the final part, I defend teleosemantics from this objection, and discuss to which extent the cooperation requirement is justified.

## 2 Teleosemantics

The central notion in teleosemantics is that of function.<sup>1</sup> Nonetheless, in order to properly understand how the existence of functions contributes to the analysis of the phenomenon of representation, there are two other concepts that need to be defined in some detail: Reproductively Established Family, and Sender-Receiver structure.

**Reproductively established family** The first notion concerns the relation between individuals and kinds which, as we will see, plays a fundamental role in the argument of the paper.

On the one hand, notice that functions are primarily ascribed to kinds rather than individuals (i.e. *the heart's function is to pump blood*). Indeed, it is reasonable to claim that individual traits have functions in virtue of belonging to certain kinds (Millikan, 1989). However, it is not obvious what grounds the fact that certain entities are grouped into kinds. If we look at the natural world, we will only find a set of scattered individuals. For this reason, before any function can be ascribed, we need to define a principle for classifying individuals into kinds.

In that respect, the notion of 'Reproductively Established Family' is supposed to capture an interesting and substantive way in which entities are naturally organized, so that they can be said to constitute kinds in the relevant sense. The concept of Reproductively Established Family ('REF', in short) provides a grounded criterion for typing entities.

Very roughly, a REF is a set of entities that are alike in some crucial respects because they are the product of some underlying process of copy, that is:

**REF** A group of individuals  $d_1, d_2, d_3, \dots, d_n$  form a reproductively established family D iff  $d_1, d_2, d_3, \dots, d_n$  tend to resemble each other in important ways because they are the result of some causal process of copy.<sup>2</sup>

The car *Ford Fiesta*, the species *Canis Lupus* or the action of shaking hands constitute examples of REF (Millikan, 1984, 2005). All Ford Fiesta tend to have certain properties in common in virtue of being copied from the same model. Similarly, members of the species *Canis Lupus* tend to share many properties primarily because of an underlying process of copy (heredity). Examples could be easily multiplied.

The idea, then, is that many kinds are REFs. Traits (lungs, brain,...), for instance, form REFs. Individual traits (John's heart) belong to certain kinds (the kind *heart*), because there is an underlying process of copy that links John's trait to past traits and this causal connection explains why this individual trait tends to have certain properties. Of course, many details should be added in order to get a more precise definition, but I hope the main idea is clear enough.

**Function** Once we have established the principle for classifying individuals into kinds (REFs), we are in position to define a notion of function and show how it applies to certain entities. The relevant concept of function here is the so called *etioloical*. According to the etioloical definition of function, functions are selected effects (Neander, 1995). On this view, a trait's function is the effect that explains why past traits of the same kind (i.e., past individuals that belong to the same

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<sup>1</sup>Like any other philosophical theory, teleosemantics comes in different versions. For simplicity, here I will mainly rely on Millikan's view, which is the most influential and popular version.

<sup>2</sup>The notion of REF is vague, due to the indeterminate the number of properties involved, the degree of resemblance or the process of copy. However, that should not be regarded as a problem; after all, 'being a heart' seems to be a vague concept as well.

REF) have been selected for by natural selection (Wright, 1973; Millikan, 1984).<sup>3</sup> For instance, the function of kidneys is to filter wastes from blood because this is the effect that explains why kidneys (i.e. why members of the REF-Kidney) were selected for by natural selection. The appeal to functions is the distinctive feature of teleosemantic theories (Neander, 2012; Millikan, 2004), that distinguishes them from causal and counterfactual theories (Stampe, 1977; Dretske, 1981; Fodor, 1990; Margolis, 1998).

**Sender-Receiver** The last important notion is that of a sender-receiver structure. According to teleosemantics, representations are states of affairs that stand between a sender and the receiver (Millikan, 1984, 1993; Godfrey-Smith, 1996, 2006; Shea, 2007). Senders and receivers form two different REFs and are endowed with different etiological functions. The function of the sender (or producer system) is to produce a representation R when certain state of affairs obtains. The function of the receiver (or consumer system) is to perform some activity (e.g. some behavior) when representation R is produced.

What determines the content of state R? In order to ascertain R's representational content, we need to look at those historical cases that explain why the consumer system has been selected for. In other words, we need to consider those occasions in which the action of the consumer system (e.g. some behavior) provided a crucial advantage to the organism. If we focus on those occasions, we will usually find a state of affairs that causally explains why the activity of the consumer was successful. Teleosemantics claims that this is the state represented by R. That is, if we want to know what state R represents, we have to look at the history of the selection of the consumer system; the state of affairs that explains why consumer systems performed its activity successfully when R was tokened is the state represented by R.

Let me illustrate this theory with a well-known example. Beavers splash the water with their tail so as to warn other beavers that danger is approaching.<sup>4</sup> Here the sender is the beaver which splashes the water (or, rather, *some mechanism within the beaver that is responsible for producing the splash*); the receivers are the rest of beavers (or, rather, *some mechanism within beavers that is responsible for the interpretation of the splash*); finally, the representation is the water splash. In this case, the function of the sender is to produce a water splash (that is, the representation R) and the function of the receiver is to help the beaver to escape from danger.

Now, what is the content of R? If we look at the historical situations that explain the selection of the consumer system, the explanation of how the splash-consuming-mechanism was favored by natural selection surely mentions the fact that there was danger approaching. In other words, when there was no danger, escaping was a waste of time and energy; an explanation of why the splash-consuming-mechanism has been selected for must appeal to the fact that there was a danger around. That is the condition that causally explains why having the interpreting mechanism was beneficial. Hence, according to teleosemantics, *danger approaching* is what the water splash represents.

On this account, the content of R (what R is supposed to map onto) is determined by the needs of the consumer system. R represents the presence of the state of affairs that the consumer *normally* needs. The notion of 'normality' employed here is technical. Normal conditions (with a capital 'N', to mark that it is a technical notion- Millikan, 1984, ch. 2) are those circumstances that must be mentioned in a Normal explanation. A Normal explanation is an explanation of how

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<sup>3</sup>Of course, many REFs have not been selected for by natural selection (e.g. *Ford Fiesta*). That just means that only a subset of all REFs are endowed with etiological functions.

<sup>4</sup>It is important to notice that a sender-receiver structure can be instantiated within a single organism or in different organisms..

a particular trait has historically performed its function. More precisely, 'a Normal explanation is a preponderant explanation for those historical cases where a proper function was performed' (Millikan, 1984, p. 34). The Normal explanation of how a heart performed its function must mention the fact that it was supplied with blood, it was connected to the rest of the body through the right vessels, and so on. Note that Normal conditions need not be the most common ones. The Normal circumstances for sperm to perform its function involves the presence of an ovum, since this is a condition that was present in those cases in which sperm performed its function, but obviously the presence of an ovum is not a statistically normal condition. Indeed, the occasions where there is an ovum to be fertilized are extremely rare. For a trait to evolve, it suffices if Normal conditions obtain usually enough.

We are now in position to define in more detail what is the minimal structure required for a representational system to originate:

**TELEOSEMANTICS** R is a representation of S iff there are two systems P (for *producer*) and C (for *consumer*) such that:

1. P and C belong to a REF-P and a REF-C, respectively.
2. P and C have etiological functions:
  - (a) P has the function of producing R when a state S obtains.
  - (b) C has the function of producing an effect E. The Normal explanation of how C performs the effect E involves the state S.
3. P and C have coevolved in such a way that a Normal condition for the proper performance of each system is the presence and proper functioning of the other.

I have already justified conditions 1 and 2 of TELEOSEMANTICS, but 3 remains unexplained. This is the condition that appeals to the cooperation of the systems. Let consider it in some detail.

## 2.1 Cooperation

Condition 3 claims that a Normal condition for the performance of P's and C's function is the presence and proper functioning of the other mechanism. That means that the fact that the producer P has performed its function helps to explain why the consumer C historically complied with its function, and the fact that C performed its function helps to explain why P historically complied with its function. That is the relevant sense in which P and C must be cooperating devices.

Why should we think producer and consumer systems have been cooperating? The intuitive idea behind this claim (which is also supported by abstract models of signaling systems such as Lewis, 1969; Skyrms, 1996) is that, on the one hand, senders acquire the capacity of producing signals only if they are interested in the receiver performing its functions; otherwise, they would stop producing signs (Millikan, 2004, 2005). If the sender were not benefited by the action of the consumer system, it seems it would not evolve a mechanism for informing the receiver about the presence of some state of affairs. Similarly, receivers are of course interested in the senders performing their functions, because they can act successfully only when the representation is true, that is, when the producer fulfills its function. Thus, since consumers are obviously interested in the representation being true, they are also interested in the producer system performing its function successfully. If receivers

did not benefit from the the representation, they would probably stop attending to it. That shows that a Normal condition for the proper performance of each system (producer and consumer) is the presence and proper functioning of the other. In other words, sender and receiver must have evolved as cooperating systems.

The idea that sender and receivers should cooperate is entrenched in scientific reasoning as well:

If there is, on average, no information of benefit to the receiver of a signal, then receiver should evolve to ignore that signal. If receivers ignore the signal, then signalling no longer has any benefit to the signaller, and the whole communication systems should disappear. (Searcy and Nowicki, 2005)

An analysis that allows the signaller's behavior to evolve but does not permit any evolution in receiver's response does not make sense (...). In fact, receivers should evolve responses to signals only when it is advantageous to do so. And if it does not benefit receivers to respond in a particular way to a specific acoustic feature then selection will favor receivers that attend to some other cue. (Seyfarth et al., 2010)

Finally, notice that the requirement of cooperation is such that it could be equally satisfied by a sender and a receiver that only have partial interest in common. It suffices if one is somehow benefited from the activity of the other, and that benefit partially explains the selection of the mechanism. The contribution of each, however, might be suboptimal (some models of partial interest can be found in Skyrms, 1996, 2010).

As was pointed out earlier, some people have recently argued that condition 3 should be dropped from the theory. Their criticism is motivated by some cases that apparently illustrate the existence of signaling without cooperation.

### 3 Uncooperative systems

The cooperation paradigm has been attacked by many biologists and philosophers. From the scientific domain, the idea that signaling must assume a certain degree of cooperation among participants has been seriously challenged from a general perspective on evolution (Dawkins and Krebs, 1976) as well as a different ethological approach (e.g. Rendall et al., 2009). Here I will leave aside the general problem of selfishness and manipulation (which, I think, has already been sensibly replied in the evolutionary field by Godfrey-Smith, 1996, 2009 and in the ethological perspective by Sefarth and et. 2010) and I will focus on a set of counterexamples that philosophers have raised against the teleosemantics framework that is supposed to account for animal signaling.

The objection raised by some philosophers is based on the phenomenon of mimicking. Mimicry (or mimetism) is the similarity of one species to another which benefits one or (less frequently) both. Usually, this similarlity is in appearance, scent, behaviour or sound. There are different kind of mimicry; sometimes organisms mimick another species in order to look less dangerous (*Batesian mimicry*), to look more dangerous (*Mertensian mimicry*) or in order to be confuse its predator (*Müllerian mimicry*). For instance, the Ash Borer (*Podosesia syringae*) is a Batesian mimick of the Common wasp, because it has copied the wasp's black-and-yellow strips, but it is unable to sting. Similarly, the Viceroy butterfly (*Limenitis archippus*) mimicks and it is mimicked by the Monarch butterfly (*Danaus plexippus*); since both are to some extent unpalatable butterflies, they both benefit from the fact that predators confuse them.

This objection to teleosemantics, however, is based on what ethologists call 'aggressive mimicry' (Marshall and Hill, 2009, Eberhard, 1977). In aggressive mimicry, a predator or parasite initiates the signal of another species in order to exploit the recipient of the signal. A species of Australian katydid (*Chlorobalius leucoviridis*) initiates the mating sound of female cicadas in order to attract male cicadas and devourate them (Marshall and Hill, 2009). Similarly, the bolas spider (*Mastophora* sp.) attracts male moths by initiating the sex pheromones of female moths (Eberhard, 1977). All these cases seem to involve signaling without cooperation.

The problem was originally raised by Sterelny (1995) and has been extended by Stegmann (2005, 2009). In order to develop the objection in some detail, let me focus on the case of fireflies, which is the example appealed to by Sterelny and Stegmann:

Among the fireflies are some species that prey on other fireflies. Females of the species *Photuris versicolor*, for example, prey on the males of several *Photinus* species. Predation involves the deceptive use of mating signals (Lloyd, 1975). The aptly named 'femmes fatales' lure the males by sending the sort of mating signals that the males' conspecific females would send. So, for instance, if a predator perceives the flashes of a male *P. macdermotti*, and if she's hungry, then she will emit the sort of flash that a female *P. macdermotti* would emit if she were willing to mate. (...) From an ethological point of view, the predator's female-*macdermotti*-type flash carries the information that there is a female *P. macdermotti* willing to mate.(...) But the co-occurrence of a female *macdermotti* type flash with the presence of a hungry predator is clearly not the normal condition for the male's consuming device to achieve its function. (Stegmann, 2009, p. 868)

Let us try to describe more carefully the case having in mind the sender-receiver structure sketched earlier (for simplicity, let us use 'PV' for *Photuris versicolor* and 'PH' for *Photinus*). First, if we set aside for a moment the parasiting behavior and focus on the usual behavior of the PH species, the schema described in TELEOSEMANTICS happily applies. PH females (producer) Normally send a signal (light) to PH males (consumer). Since the behavior of the PH males (i.e. mating) was historically successful only in those occasions where there was a PH female ready to mate and *because* there was such a female, then TELEOSEMANTICS predicts that the light emitted means something like *PH female willing to mate*. So far so good.

The problem arises when we focus on the parasiting behavior. The light emitted by the 'femmes fatales' of the PV species (*Photuris versicolor*) seem to be a representation. Indeed, it intuitively means the same as the light emitted by the parasited bug, namely something like *there is a PH female willing to mate*. This is the reason PH males are attracted to PV females, which do not hesitate in devourating them. In fact, it seems that only if we assume that the light emitted by PV females (the parasiting bug) has the same content as the light emitted by PH females (the parasited bug) can we explain the behavior of PH males. Hence, the following claim seems to be true (and widely assumed by ethologists):

**MIMICRY** The light emitted by PV females is a representation, which means something like *PH female willing to mate*.<sup>5</sup>

The key problem Sterelny and others point out is that it seems TELEOSEMANTICS cannot accommodate MIMICRY. First of all, notice that the receivers of the light emitted by PV females are the PH

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<sup>5</sup>I focus on the particular case of *Photuris versicolor* and *Photinus* species, but notice that the problem pointed out here concerns (at least) any case of aggressive mimicry. This example is supposed to highlight a broad and significant set of cases that teleosemantics cannot account for.

males, so in this case the sender and the receiver are instantiated in two organisms that constitute predator and prey. Since we can reasonably assume that in this case predator and prey have no common interest,<sup>6</sup> it seems MIMICRY entails that a state can be representation even if the sender and the receiver are not cooperating devices. That clashes with condition 3 of TELEOSEMANTICS.

Furthermore, notice that the content of the light signal emitted by PV females does not seem to be the state that the consumer has historically needed in order to perform its function in a Normal way when the signal was present. The content of the light seems to be *PH female willing to mate*, but if we look at the past cases in which PV signals were produced, there were no PH females willing to mate, but only hungry PV females. Surely, nothing like the presence of a PH female willing to mate obtained in the historical circumstances that explain the selection of the producer system of PV females and the consumer system of PH males.

Consequently, the following claim seems to be true:

**INCOMPATIBILITY** TELEOSEMANTICS is incompatible with MIMICRY.

We have, then, three plausible thesis that are mutually inconsistent: TELEOSEMANTICS, MIMICRY and INCOMPATIBILITY. At least one of them should be given up.

One option is to reject MIMICRY and maintain that, strictly speaking, the mimicking system does not produce representations, but meaningless states. I think that option is unappealing, since ethologists usually explain the behavior of PH males by assuming these signals are representations and mentioning its particular meaning. Furthermore, that move would seem entirely ad hoc.

Alternatively, one could hold that this counterexample suggests that the whole framework set up in TELEOSEMANTICS must be entirely rejected. This is also an extreme position, because TELEOSEMANTICS seems to yield the right results in a wide range of cases and has independent support.

A more popular and refined version of the latter option consists in modifying TELEOSEMANTICS in order to make it compatible with MIMICRY. For instance, one could argue that TELEOSEMANTICS specifies a set of sufficient but not necessary conditions for representational systems to arise (e.g. Sterelny, 1995; Sterelny and Griffiths, 1999). Defenders of this proposal are committed to a 'splitting account' of the phenomenon of representation. A different option along the same lines is to alter the sender-receiver structure described in TELEOSEMANTICS. Stegmann (2009) and Cao (2012), for instance, suggest that content is only determined by the consumer system. According to them, coevolution and cooperation is not required; what a state represents depends only on the state of affairs that a consumer systems needs.<sup>7</sup>

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<sup>6</sup>It has been argued that, in some special situations, predator and prey may have some common interest. For instance, according to the Perception Advertisement Hypothesis, some organisms inform their predators that they have been perceived, so that hunting per surprise becomes futile (Radner, 1999, p. 129-130). Gazelles, for example, perform a set of controlled jumps (called 'stotting') so as to communicate to the predator that it has been detected (Sterelny and Griffiths, 1999). Some people argue this sort of signs benefit both predator and prey; the former does not attempt an attack that will probably fail and the latter avoids a possible threat (Millikan, 2004).

Even if these examples exist, parasitism seems to be a different sort of case. It is extremely plausible that the light emitted by PV-females in order to lure PH-males only benefits the former.

<sup>7</sup>Even though the main goal of the paper is not to criticize these other approaches but the defend standard teleosemantics from an objection, let me point out two serious difficulties of those views that claim that representation and content entirely depend on the consumer system. First of all, it is not easy to see how these theories can distinguish a state not representing anything from a state being false (this problem is specially pressing for Cao, 2012). Secondly, this analysis seems to be extremely promiscuous in the attribution of representations and content. Any state can qualify as a representation (a rock standing at certain place, wind blowing in a certain direction, smoke,...) as soon as there is a consumer system that uses it in order to get information about a certain event. Similarly, any state can represent any kind of information, if there is a suitable consumer that uses it in a certain way (Stegmann, 2005, p. 123) In any event, I think that if standard teleosemantics can overcome the problem of

I will defend a different option. I think INCOMPATIBILITY must be rejected. That is, I will argue TELEOSEMANTICS is perfectly compatible with MIMICRY. Thus I have show that cases of parasitism like the one depicted earlier are not in tension with the standard version of teleosemantics. This is the task of the remainder of the paper.

### 3.1 Accounting for Uncooperative Mechanisms

Let me argue why I think it is coherent to endorse TELEOSEMANTICS and MIMICRY at the same time.

First of all, it is usually assumed by philosophers and ethologists that the content of the representation emitted by the parasiting organism (light emitted by PV females) is the same as the content of the representation emitted by the mimicked females (PH females). Indeed, they would probably accept this is not a mere coincidence; it seems that the content of the light signal of PV females completely depends on the content of the light emitted by PH females. If the representational content of the signal produced by PH females were different (e.g. *there is food nearby*), we would conclude that the content of the signal of PV females would change accordingly. This is a point that needs explaining.

Secondly, notice that not only the content of the representation, but the non-intentional properties of the signal itself (light intensity, brightness,..) entirely depend on the features of the parasited representational system. The representational system of the mimicking system must resemble as much as possible the representational system of the mimicked organism. There is a strong tendency to copy any feature of the parasited sign. If the intensity of the light emitted by PH-females were to change, there would probably be a strong tendency for the PV-females to change the intensity of their signals accordingly. In fact, not only the physical properties of the signal are initiated, but also some of its functions (Stegmann, 2009, p. 871-2). All flashes have the function to attract PH-male. Consequently, the similarities of parasiting and parasited system are anything but accidental.

Indeed, this relation of dependence is not accidental, because the properties of the parasiting representational systems are (historically) caused by the properties of the parasited system. Proof of that causal relation is that if the parasited representational system were to change in relevant aspects, the parasiting system would also change accordingly. The fact that there is a counterfactual dependence relation between one and other indicates that there is a causal relation between them (Sober, 1984). This causal relation to a great extent explains the commonalities between the mimicking and the mimicked system.

Now, if we admit that much, then the crucial step in the argument is not very far. In order for TELEOSEMANTICS to account for cases of parasitism, we must simply realize that parasitic representational systems *belong to the same reproductively established family as their parasited systems*. In other words, both the producer system of the PH-females and the producer system of the PV-females (which prey on PH-males) belong to the same REF. The proposal, then, is that the parasiting reproductively system is a mere copy of the parasited one.

Remember that two entities belong to the same REF iff they tend to have important properties in common in virtue of some causal process of copy. We have already identified a strong causal process of copy that links the signaling system of PV females and PH females. Since we might think this is a robust and non-accidental link that has been active during the evolution of the whole

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uncooperative systems, it will definitely be preferable to these modified versions.



representational system, the producer systems of PV females and PH males seem to clearly satisfy the criteria for constituting a single REF.

Now, once we accept that the producer system of PV females and the producer system of PH females belong the same REF, then MIMICRY can be perfectly accommodated with TELEOSEMANTICS. Let me show why each of the conditions set up in TELEOSEMANTICS are satisfied:

**TELEOSEMANTICS Condition 1 (on REF)** The producer system P (formed by the light emitting system of PV females and PH females) and the consumer system C (constituted by the light interpreting mechanism of PH males) form two independent REFs. This is the main point I just argued for.

**TELEOSEMANTICS Condition 2 (on Function)** Is the function of P (which includes the signaling systems of PV females and PH females) to produce a state R when another state obtains (in particular, the state *PH female ready to mate*)? Although this question has an affirmative answer, it might look odd at first glance to claim that the light producer P (which includes the mimicking system of PV females) has the function of producing a flash when there is a PH female ready to mate. Why should we think teleosemantics warrants such a function? This point needs some elaboration.

On the etiological understanding of functions, functions are selected effects. That is, the function of a trait is the effect that explains why past tokens of this trait were selected for (and hence, it partially explains why the trait exists). Now, the explanation of the selection of producers P relies on the fact that usually enough light emitted by PH females corresponded to a female ready to mate. Crucially, only the light emitted by PH females (and not the flashed emitted by PV-females) helps to explain the existence of the representation system; the producer system in PV females rides piggyback on the success of the system in PH females. In other words, the producer P in firefly signaling exists *despite the fact* that that this kind includes PV females, which reduce the overall reliability of the whole representational system. What causally explains the selection of mechanisms P is the presence of PH females ready to mate. Signaling systems in PV females just take profit and copy the system in PH females; and, since they do not positively contribute to the selection of the whole mechanism, the activity of PV females does not alter the function of the representational systems. Consequently, even if the the producer system of PV females and the producer system of PH females belong to the same REF, its function is exclusively determined by the effects of PH females.

**TELEOSEMANTICS Condition 3 (on Cooperation)** Given that the function of P and C is not altered by the presence of some P that do not contribute to the overall fitness, it seems condition 3 is also satisfied: the Normal condition for the proper performance of each system is the presence of proper functioning of the other.

Here is the way TELEOSEMANTICS can be shown to be compatible with the truth of MIMICRY. Let me now turn to two objections.

## 3.2 Objections

**Stegmann's reply** Interestingly enough, Stegmann shortly considers and rejects this kind of reply. In particular, he (Stegmann, 2009, p.869, emphasis in the original) says:

Might the predator's flashes have content because they inherit it from the cooperative flashes they mimic? The notion of copy of 'reproduction' plays an significant role in Millikan's (1984) account. The predators' flashes, however, do not qualify as 'reproductions' in her technical sense. 'Reproductions' share properties with the model due to the fact that the model is *directly* causally responsible for the reproductions' properties (Millikan, 1984, p.20). Imitations like the parrot's 'hello' are reproductions in this sense. But there is no such direct causal link from cooperative to mimicking flashes. Nor do the predators's flashes form a 'higher-order reproductively established family' together with the females' flashes. For this would require that either all flashes are produced by the same device or, if produced by distinct devices, the devices are reproductions of one another (Millikan, 1984, 24-5). Neither is the case.

I think this reply is clearly unsatisfactory. First of all, the flashes of PV-females do seem to be a reproduction of the flashes of PH-females. They have the same physical properties (intensity, frequency..) and they share certain functions. Furthermore, the systems of PV-females that emit these flashes have been designed by evolution in order to match the signals emitted by PH-females. That much seems to be pretty uncontroversial. The question now is the following: Why are these similarities and causal relations between signals and producer systems insufficient for establishing the relevant 'reproductive family'? Stegmann seems to assume an unwarranted too narrow understanding of 'reproduction'.

Let me put the question in a different way. We follow Millikan in defining a technical notion of 'reproduction' that is supposed to group entities into kinds, in such a way that these kinds can be said to acquire etiological functions when certain selection processes take place. If the paradigm were the parrot's 'hello', this notion of reproduction could not play the role in the naturalization of content that we want it to play. So we need a different notion. For this reason, the paradigm that we use in order to define the relevant concept of 'reproduction' is the process of copy that accounts for the existence of traits. Now, once we accept a notion of reproduction that applies to traits, which are being copied (with slight modifications) from generation to generation in evolution, I see no reason for thinking that the flashes of PH females and PV females or their producer systems cannot constitute a reproductive family in the *this* sense.

There is a different reason for thinking Stegmann's reply is mistaken. The problem of mimicking assumes that the content of the mimicking signals is the same as the content of mimicked signals (this is presupposed in MIMICRY). The only way of explaining this fact is by assuming that both signals belong to the same type. How else could we explain that the content of the signal of PV-females is *PH female ready to mate*?

Indeed, interestingly enough, Stegmann (2009p.871) claims they belong to the same type (what seems to be in tension with the previous objection to teleosemantics):

The first condition [of Stegmann's account] endows female-*macdermotti*-type flashes with representational content irrespective of whether they were generated by females or predators.

Since Stegmann assumes that the signs emitted by mimicker and mimicking systems belong to the same type, we might wonder why teleosemantics cannot accept that. In fact, as I said, I think this is an assumption that any plausible account of aggressive mimicking should make. Therefore, Stegmann's objection against the kind of proposal I just offered seems to be mistaken.<sup>8</sup>

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<sup>8</sup>Indeed, if we look carefully, we will see that Stegmann's proposal solves the problem of aggressive mimicking, not because he modifies TELEOSEMANTICS, but because he assumes all signs belong to the same kind. And, once we

**Content Change** First, if the parasiting system is a member of the same REF as the parasited one, does not that alter the meaning of the representation? Since, according to teleosemantics, a sign represents the state that explains the success of the consumer, one might argue that in some cases what explains the success of the action by PH males is the presence of a female willing to mate, but in other situations what explains the success of PH males is another feature related to the presence of a predator (the fact that the predator was at a certain distance, for instance). As a result, is the content of the light a disjunction of both states?

Of course not. First of all, remember that content is determined by the state the explains the success of the consumer *in Normal conditions*, that is, in those conditions that explain the selection and existence of the system. But the cases in which PH males escaped a PV female do not contribute in any way to the explanation of why the representational system was selected for. Hence, they do not play any role in the determination of content, and the flashes still represent *there is a PH female willing to mate*. The key insight is that cases of parasitism do not contribute to explaining why the mechanism nowadays exist. The mechanism keeps being reproduced in the population *despite the fact* that some of its members decrease the overall fitness of organisms having such representational systems. As a result, including the mimicking systems within the same reproductively established families as the mimicked ones do *not* change the function or the meaning of the representations, because they do not positively contribute to the explanation of the selection of the whole representational systems exists.

**Different Functions** Finally, I argued that the producer systems in PV females and PH females belong to the same REF and hence have the same function (*to produce an R when state S obtains*). However, one might worry that there is a sense in which the function of the signaling system in PV females is to *prey* on PH males, while the function of PH females is to *mate* with PH males. Is it coherent to accept that the producer systems of PV females and PH females belong to the same kind, and at the same time, claim that the organisms pursue radically different goals with them?

Yes, it is. There are many ways this fact can be accommodated. First, the same trait belongs to many kinds and, accordingly, can have many functions at the same time. Secondly, it is possible to accept that the function of the particular mechanism that produces light signals in PV females is to do one thing, and at the same hold that this mechanism is included within a larger system (perhaps a 'prey detecting system', which includes many subsystems) that has a different function. Consequently, the solution I am offering the problem of uncooperative systems is compatible with PV females having different goals from PH females.

Let me mention a last issue in relation that that point. If one accepts that the phenomenon of representation is to be analyzed in terms of function (i.e. the basic insight of teleosemantics) and also accepts that the mimicking light signal misleads PH males because it means *PH females ready to mate*, then she is committed to the view that one of the functions of the mechanism in PV females is to produce R (light) when PH females are ready to mate. So, those who accept this fundamental thesis teleosemantics, must accept that the mechanism in PV females and PH females share a function, namely the one that determines the content of the representation. Therefore, anyone assuming some version of teleosemantics must hold that the mechanism in PV females and the mechanism in PH females share some functions and differ in other functions. So this last problem concerns any teleosemanticist.

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accept the latter, Millikanian Teleosemantics (that is, TELEOSEMANTICS) can also offer a satisfactory reply.

## 4 Conclusion

In this paper I have argued that examples of parasitic representational systems do not constitute a counterexample to the idea that representational systems require certain amount of cooperation between sender and receivers. Even if there is only partial interest between sender and receiver, a Normal condition for the performance of one system is the proper performance of the other, and that is the only cooperative requirement included in TELEOSEMANTICS. Consequently, cases of parasitism can be perfectly accommodated within mainstream teleosemantics.

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