Animal Signals Carry Information Without Encoding It

by Andrea Scarantino

Commentary on (1) Owren and Rendall, (2) Fischer and (3) Morton, Coss and Owings

I welcome Rendall and Owren's (RO) criticism of the encoding-decoding model (EDM) of animal communication, but I reject their inference that if information is not encoded in a signal, then it is not carried by such signal.

According to EDM, a signaler encodes some piece of information by transforming it into an arbitrarily selected equivalent suitable for transmission, and a recipient decodes the signal transmitted by applying the code in reverse to recover the original piece of information.

This model applies poorly to animal communication. Senders and receivers of animal signals do not have access to any shared system of rules for transforming pieces of information back and forth into arbitrarily selected equivalents.

As RO have argued in other publications, animals often communicate in competitive contexts in which a cooperative convergence on a shared code cannot be posited. Furthermore, the ability to communicate by means by a shared code demands a network of communicative intentions beyond the reach of non-human animals.

RO suggest that some of EDM's proponents endorse a looser understanding of encoding and decoding, according to which "signals can be said to encode information anytime there is a predictable relationship between a signal and some event or state of the world that receivers can pick on [i.e. decode]" (5).

This is the notion of information I discussed in my paper, where I argued that signal X carries *predictive information* about state of affairs Y just in case Pr(Y given X)≠Pr(Y). When this is the case, X and Y are said to be statistically correlated.[1] A 'predictable relationship' is instantiated between X and Y when the correlation between them is strong enough for X to allow the reliable prediction of Y (or not-Y).

If this is what is meant by information transmission, the encoding and decoding metaphors are positively misleading. To say that an alarm call encodes information about predator type is like saying that smoke encodes information about fire. This phrasing wrongly suggests that some process of rule-based transformation takes place between the occurrence of fire and the occurrence of smoke. We know instead that a straightforward causal relation underlies their correlation.

The same holds true of the correlation between predator types and alarm calls, with the difference that whereas fires cause smokes directly, predators cause alarm calls by courtesy of signalers.

I conclude with RO that the encoding and decoding metaphors should be eliminated from the animal communication literature. From this it does not follow, however, that information is not carried by animal signals. RO disagree and argue that information "does not reside in the signals themselves but rather in the relationship between them and the events they co-occur with" (5).

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[1] They are positively correlated when Pr(Y given X)>Pr(Y), and negatively correlated when Pr(Y given X)<Pr(Y).

This view has been voiced by several other contributors to this volume. According to Fischer, "in the very strict sense, animal communication does not consist of information transmission, and animal signals do not contain information" (5).[2] Morton, Coss and Owings have also warned against inferring that "there must be information in the signal" from the fact that "individuals produce signals" and that "individuals that perceive these signals extract information from them". These remarks are motivated by an important realization, but they go too far.

The realization is that what information can be extracted from a signal crucially depends on the background knowledge of the recipient. RO point out that a light predicts shock for a rat who has been fear conditioned, but not for a rat who has just been introduced into the conditioning box. Similarly, the snake alarm call of a vervet monkey predicts a snake for an adult recipient, but not for an infant recipient.

Since recipients in different states of background knowledge make different predictions (or no predictions) upon receiving the same signal, there is a temptation to conclude that the information is not in the signals themselves. We should resist such temptation.

Predictive information resides neither in the recipient independently of the signal nor in the signal independently of the recipient. Rather, it is in the signal by virtue of what a potential recipient can predict upon receiving it. This makes the capacity to carry predictive information fundamentally relational: it is a capacity that a signal expresses when paired with the right recipient.

This suggests that, when fully spelled out, the predictive information relation is a three-place relation: signal X carries predictive information about Y *relative to background knowledge k* by virtue of a capacity of such signal to allow a potential recipient in background knowledge k to predict Y or not-Y from the signal.

If so, the probability functions Pr(Y given X) and Pr(Y) that determine whether or not X carries information about Y must be assigned so as to reflect *all* the background knowledge relevant to the context of inquiry (e.g. inquiry into the behavior of a fear conditioned rat or of an adult vervet monkey).

Encoded information (a.k.a. non-natural meaning) and predictive information (a.k.a. natural meaning) are different in several respects (see Grice 1957). The one I wish to emphasize in conclusion is that whereas in the case of encoded information it is up to senders what information recipients receive, and all recipients decode the same information from the same signal, in the case of predictive information recipients can pick up predictive information senders never intended to provide, and the same signal can carry different predictive information to different recipients.

[2] Fischer also allows for a "more relaxed" use of the information concept, according to which signals themselves have information content. I will argue instead that "strictly speaking" animal communication consists of information transmission.