

## Some clarifications of the notion of signals: a reply to Richner

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(Received and accepted 30 June 1992;

MS. number: sc-785)

Richner (1993) points out two inaccuracies in my 1991 paper (Zahavi 1991). Although I regret the ambiguity that may arise owing to these lapses, I would like to emphasize that they do not change the two main arguments of my paper, which are that sexual selection is not a useful definition and that Fisher's model cannot explain the evolution of waste in sexual selection.

My first mistake was not to state very clearly (although I believe it was implied) that I do consider body size to be a signal when, as stated in the first sentence of my paper, body size is affected by the information it provides to the receiver. Obviously I could not otherwise have considered the tail of the peacock as well as superterritories to be signals (Zahavi 1975). (The idea concerning the functioning of superterritories as signals, by the way, is an old one, having been first suggested by O'Donald 1963.) Hence, it is clear from my first publication, on the evolution of signals, that I consider body size and territory size as signals when they have evolved owing to the response of the receiver.

Fisher (1930) made the same distinction in his discussion of the evolution of sexually selected signals, dividing the evolution of signals into the preference stage (in which the preferred character has evolved because of selecting factors other than sexual selection) from the runaway process (in which the evolution of the character is affected by the individuals that respond to it). Now that I have clarified my views on the evolution of signals, I believe that the classification and the definition I used for signals are in line with each other.

My second mistake was to omit quality (e.g. resource-holding power) from the dimensions that may be ritualized. In my earlier papers (one of which is cited by Richner) I wrote that 'signals evolve if they

increase the transfer of reliable information concerning differential quality of individuals or differences in motivation' (Zahavi 1977, 1980, 1981). Hence, it is clear that I consider that quality, like motivation, may be conveyed by the ritualized signal.

My comment on ritualization in my 1991 paper, criticized by Richner, was not intended to discuss the concept of ritualization at length, but only to direct the attention of the reader to the more detailed discussion of the evolution of signals (i.e. ritualization) in my previous publications. I regret that the omission of the term 'quality' in the 1991 paper and in some other places gave the impression that I do not consider quality to be a dimension that is subject to the ritualization process.

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