

The basic components of communication are now widely recognised – signaller, signal and receiver. To confirm that communication has occurred, it is thus necessary to show that one individual has produced a signal – a pattern of stimulation – to which another individual has responded.

It is probably not a coincidence that the three components of communication – signaller, receiver and signal – were first identified in the decades following the invention and deployment of the telegraph. De Saussure's (1916 [1959]) diagram takes the telegraph as a metaphor for human language, and Ogden and Richards (1923) elaborate the model by emphasising the mental processes of the signaller and receiver. Linguists and philosophers now use these models routinely in their discussions of communication. Further advances in engineering and the widespread adoption of telephones and electromagnetic radiation for human communication eventually led to competition for communication. How many radio stations could simultaneously operate in one area? How many conversations could simultaneously use one telephone line? Investigation of these practical issues revealed that communication had limits. To understand these limits, it was apparent that communication had to be measured. Shannon's (1948, 1963) pioneering contribution was to propose a measure of information and then to use it to demonstrate mathematically that the properties of the connection between signaller and receiver – the channel – imposed a limit on the amount of information that could be transmitted in any period of time.

Shannon's measure of information in a set of i signals (H_o) equals $\sum p_i \ln p_i$, with p_i being the probability of the i th signal. As Shannon explains, this particular expression is the simplest one possible that can satisfy our intuitive requirements for a measure of the amount of communication. This measure (H_o) is the number of binary decisions required to specify which signal in a message is next, or in other words to specify the occurrence of any one signal. It is thus the uncertainty in predicting the occurrence of any one signal. An informative message would have high uncertainty about the occurrence of any one signal (it would require many binary decisions to specify each signal's occurrence). Frequent use of just a few signals conveys less information than would many less frequent signals. An infrequent signal increases the amount of information in a message more than does a frequent signal.

A set of signals could consist of a sequence of signals in time or an arrangement of signals in space. Shannon's measure applies to both cases. In either case, identifying a set of signals often requires some method for segmenting the temporal or spatial continuity of an animal's actions into components. As Shannon shows, this segmentation is not necessary, because his conclusions still apply in the limit of continuously varying signals and responses.

The concept of information as a measure of the degree of uncertainty in a pattern of signals contrasts with the usual concept of information as the degree of certainty a receiver acquires from signals. Shannon's definition of information thus seems contrary to any definition that others might accept as intuitively appropriate. The issue is whether information is a property of the structure of signals or of the state of the receiver.