Acta Cogitata

Volume 4 | Article 2

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Abstract

This paper will detail how Bayesian epistemology, traditionally a tool of philosophers of science, can be used to select a method of communication that is most likely to produce a desired communication goal from a targeted subject. Using the frame of Bayes' Theorem in the form of Posterior Probability Ratios, it will show how a communicator, focusing on agency and awareness, can use said frame to deliberately and purposefully select an evidentially favored communication strategy, intended to elicit a certain response from the respondent. By translating the epistemic version of Bayes' Theorem into a communication setting, this strategy presents an alternative method to use when navigating typical social interactions that would be useful for those who have trouble grasping traditional communication dynamics. Furthermore, the paper explains how this strategy is easy and natural to use because the human brain has evolved in such a way that it remembers and weights relevant occurrences for any given situation, which can then act as data for the comparative ratios.

The Science of Communication: A Bayesian Account of Communication Strategy Selection

Introduction

It has long been said that communication is an art, as opposed to a science. However, the psychological community has demonstrated that there are many underlying scientific principles that effect communication. This paper will detail how Bayesian epistemology, traditionally a tool of philosophers of science, can be used to select a method of communication that is most likely to produce a desired communication goal from a targeted subject. Using the frame of Bayes' Theorem, in the form of Posterior Probability Ratios, I will show how a communicator, focusing on agency and awareness, can use said frame to deliberately and purposefully select an evidentially favored communication strategy, intended to elicit a certain response from the respondent. This strategy presents an alternative method to use when navigating typical social interactions. For instance, this method could help an individual decide if they should tell a friend that their significant other is cheating on them. This method encourages individuals to pause and review important evidence before deciding how to communicate in any given scenario. This pause and additional consideration enables individuals who are less adept at communicating to consider how their actions will affect the given situation, and it teaches them to make decisions based on how likely it is that the communication strategy will result in their goal.

Bayesian Epistemology

Reverend Thomas Bayes developed the mathematical theorem, which is derivable from a simple definition in probability theory, making it uncontroversial as a piece of mathematics (Sober, 2000). However, it has been applied in other areas, such as philosophy, where it becomes more controversial. The main premise of Bayesian epistemology is that knowledge and belief are not binary (i.e. true or false, known or unknown), but rather are a cohesive system of varying degrees of belief in numerous propositions. The degree of belief in any given proposition is known as a credence value, and credence values allow epistemologists a more nuanced way of considering traditional epistemic concerns.

Credence Values

It is commonsensical to understand that we hold some beliefs more strongly than others. For example consider two propositions:

A: The moon landing was faked.
B: My keys are on the table.

If asked which they were most sure of, most people would reply that they are most sure that their keys are on the table. Additionally, consider someone who has lost their keys. If asked where they believe their keys to be, they would probably say that they are the last place they can remember, such as on the table. The person may not be sure of this, but they say it because they believe their keys to be there *more* than they believe them to be somewhere else, like in the refrigerator (Koolage, 2013). Bayesian epistemology translates these degrees of belief into probabilities so that they can be used in various equations, just like a traditional mathematic probability.

These probabilities do not have to be the objective ones of traditional mathematics; in fact, most Bayesians take the probabilities to be subjective and often unique to the user. The job of the user is to then examine and employ these probabilities in their everyday life. Bayes' Theorem can be used as a tool that allows one to compare competing hypotheses to see which one is better supported by a given set of data. Bayesian Epistemology provides the user with a useful set of parameters that allows them to convert their belief hypotheses into an action guide that assesses the costs associated with acting on a particular hypothesis (Hartman & Sprenger, 2010). Bayes' Theorem also allows the user to introduce new data and see the effect of this data on the probability of the hypothesis. In other words, users can determine whether the new observation makes the hypothesis more or less likely to be true.[1] The traditional mathematic version of Bayes' Theorem is as follows:

$$\Pr(A/B) = \frac{\Pr(A)*\Pr(B/A)}{\Pr(B)}$$

As an equation it states that, the probability of A given that B is true is equal to the probability of A multiplied by the probability of B given A is true divided by the probability of B. As previously noted, philosophers have expanded the use of Bayes' Theorem into epistemology because it allowed them a new manner of considering traditional epistemic concerns. This led philosophers to create an epistemic version of Bayes' Theorem that is as follows, where H stands for a hypothesis and O for a given observation:

$$\Pr(H/O) = \frac{\Pr(H)*\Pr(O/H)}{\Pr(O)}$$

Observation O is considered confirming evidence for hypothesis H if the Pr(H/O) is greater than the prior probability of H (Pr(H)). The prior probability of H is the probability of the hypothesis prior to the consideration of the given observation. According to Bayesian epistemology, an often-updated belief has been through this equation multiple times, and the prior probability of the most current equation is the final probability from previous calculations. Using this equation, one can determine if an observation acts as a reason to believe in a hypothesis. More useful however, are comparative ratios, which allow the user to compare whether a given observation better supports one hypothesis over another. The Law of Likelihood states that a hypothesis is more likely to be true than a competing hypothesis if the observation in question was more likely to occur given that that particular hypothesis was true. Mathematically, that law is represented by the following inequality:

H1 is more likely given observation O iff Pr (O/H1) > Pr (O/H2) (Sober, 2000).

Comparative ratios are derived by dividing the probability function for each hypothesis, and this results in the cancellation of the probability of the given observation. When all of this is done, the theorem looks like this:

$$\frac{\Pr(H1/O)}{\Pr(H2/O)} = \frac{\Pr(H1)*\Pr(O/H1)}{\Pr(H2)*\Pr(O/H2)}$$

Using this updated version of the equation, one can then decide, based on evidential support, which hypothesis is more likely to be true given the noted observation. In other words, is it more likely that Hypothesis 1 or Hypothesis 2 is true given that one has observed Observation O. Though one could conceivably determine objective mathematic probabilities for

[1] It is possible for evidence to neither confirm nor deny a hypothesis, but for simplicity's sake that will not be dealt with in this paper. For further information see Sober citation.

communication scenarios, this is impractical for daily life. Additionally, as real life cases are often complicated and convoluted, it is unlikely that each individual user would make the same determinations as another. For this reason combined with the fact that most Bayesians consider all credence values to be subjective, the probabilities are considered subjective. The step of using subjective credence values in the theorem allows one to consider using the theorem in the realm of communication.

The novel idea this paper details is the translation of the epistemic version of Bayes' Theorem, in the form of comparative ratios, into a communication setting where the communicator can use it to decide which course of action is more likely to lead to their communication goal. Seeing the hypotheses as communication strategies with varying consequences and the observation as the communication goal, one could then use data to decide which strategy was more likely to be observed if the desired response occurred. Furthermore, this paper explains how this strategy is easy and natural to use because the human brain has evolved in such a way that it remembers and weights relevant occurrences for any given situation, which can then act as data for the comparative ratios.

The next step is to now convert the equation into communication terms, as opposed to merely mathematic or scientific ones. In this case, one is deciding which communication strategy, if enacted, would be more likely to produce the communication goal based on prior evidence. The communication goal is now acting as a piece of data. The communication version of the equation would look like the following:

$$\frac{\Pr\,(Communication\ Action\ 1/Communication\ Goal)}{\Pr\,(Communication\ Action\ 2/Communication\ Goal)} = \frac{Prior\ Probability\ of\ (C1) * \Pr\,(Communication\ Goal/C1)}{Prior\ Probability\ of\ (C2) * \Pr\,(Communication\ Goal/C2)}$$

For the communication version of the equation, the hypothesis (H) will stand for the communication strategy being considered. The given observation (O) will be the communication goal, the desired outcome of a particular communication strategy, and the prior probability (Pr (H)) would be the subjective probability of the hypothesis. This probability would be based on all past data, taking into consideration various sources of data such as the success of the hypothesis in obtaining the response in the past, as well as other relevant information related to the given subject. This means that for communication purposes, the equation would read: The probability that the given communication strategy would result given the communication goal (Pr (H/ O)), is equal to the prior probability of the communication goal (Pr (H)) multiplied by the probability that the communication goal would occur given the communication strategy. This then allows the communicator to weigh two or more competing communication strategies to see which is more likely to produce the given communication goal. This would allow the communicator a logical, evidence based reason for choosing to communicate in a certain way. As opposed to the epistemic version of the theorem, which tells the user what to believe, the communication version tells the user how they should act, given the evidence and their communication goal. A simple example of the equation in communication terms would look something like the following scenario. Jenny and Sally are friends. Sally has discovered that Jenny's boyfriend is cheating on her. Sally doesn't know if she should tell Jenny or lie to her. Sally's consideration would then be this:

Goal: For Jenny not to be mad at Sally
C1: Lie to Jenny.
C2: Tell Jenny the truth.

$$\frac{\Pr\,(Lie\ to\ Jenny/Jenny\ not\ mad)}{\Pr\,(Don'tlie\ to\ Jenny/Jenny\ not\ mad)} = \frac{Prior\ Probability\ of\ (People\ being\ mad\ because\ of\ lies) * (Not\ mad/Lie)}{Prior\ Probability\ of\ (Jenny\ being\ mad\ because\ of\ truth) * \Pr\,(Not\ mad/Truth)}$$

The communicator is determining if lying to Jenny makes it more probable that Jenny will not be mad at Sally, or if telling Jenny the truth is more likely to yield that particular communication goal.

The Prior Probability of the Hypothesis

The first part of the equation requires that the prior belief in the hypothesis be taken into account. For the purpose of communication, determining antecedent belief involves looking at how often the given communication strategy has produced the desired response in the past. Figuring this out into a quantifiable number is possible to some degree, but for practical communication purposes is unnecessary as the brain has evolved a system for ranking and weighting relevant occurrences. The brain naturally extrapolates and stores facts about how every person you have interacted with has dealt with certain situations. (Wilson, & Sperber, 2004).

There are two factors that must be weighted when determining the prior probability of a given communication strategy. The first is the number of times the strategy has produced the desired output in the general past. Meaning, how often the communicator is aware that sometime, somewhere, the given strategy has produced the desired behavior. The second is how often the strategy has produced the desired response in the given individual. The data that one has access to for a given individual is obviously increased and more accurate the more one interacts with that individual. That is to say, one will have a higher rate of accuracy in determining the probability that a given communication strategy will succeed with a well-known subject. Even with limited past scenarios, where there is restricted data either on the situation, subject, or both, the human brain is capable of using general past knowledge and small details to assume a reasonably accurate degree of prior belief. It is also interesting to note that most subjective Bayesians would argue that the prior belief doesn't have to be very accurate at all, especially in the initial application (Koolage, 2013). This makes the equation very practical to use in everyday life. Because human interaction is closely tied to factors such as character, values, and norms, even without having the advantage of previously encountering a certain situation one could make a reasonable prediction as to a degree of belief that the given communication strategy would produce the desired communication goal in a given individual. For an example of this, remember Sally and Jenny. Sally has found out that Jenny's boyfriend is cheating on her. Sally doesn't want Jenny to be mad at her. She can lie to Jenny and risk Jenny being mad that Sally didn't tell her, or she can tell Jenny and risk her being mad that Sally told her bad news.

In this instance the consideration looks like this:

Goal: For Jenny not to be mad at Sally.

C1: Lie to Jenny.
C2: Tell Jenny the truth.

Given that Sally has had a conversation with Jenny about how much Jenny disapproves of plagiarism, Sally is able to deduce that Jenny highly disapproves of people who aren't honest. Therefore, Sally can assign a high prior belief that telling Jenny the truth is less likely to make her mad than lying to her, even though the pair has never encountered a similar situation.

The Probability of the Observation Given the Hypothesis

The second portion of the equation is the probability of the observation given the hypothesis. Following the above example, this means that one would obtain the probability for C1 (lying), by determining how probable it is that Jenny would be mad at Sally if Sally lies to her. For C2 (honesty) one would determine how probable it is that Sally telling Jenny the truth, that her boyfriend is cheating, would make Jenny mad at Sally. This part of the equation would involve only general historical considerations. This is because, in order to maintain mental cohesion, the communicator must be able to separate how logical it is for a desired response to happen given the strategy, versus how probable it is that the response is going to happen given the individual.

Constructing A Strategy

Now that it is shown how one could use Bayes' Theorem with communication strategies, it is worth looking at how one arrives at a given hypothesis. It is important to note that for the purposes of this paper, one is using this method of communication as a high level meta-cognitive strategy for making decisions. This means that the individual using the method is considering all of the following information carefully and consciously. Constructing a strategy is then a very deliberate action. Constructing a viable communication strategy necessitates that the user consider the end goal(s), and what action seems to resonate with achieving these goals. The computing of the Bayesian Posterior Ratio then further pushes the user to consider the important past data they have regarding the possible actions. It is this pause to compute that is valuable in practical applications. It requires the user to stop and consider what data, if any, they are considering and if this data is relevant to the situation at hand.

Employing the Chosen Communication Strategy

To increase competence in any communication situation, the communicator must not only know what communication strategy to select, but also how to enact it, once it has been chosen. Knowing how to say or do something, with what phrasing, tone, timing, and place, is just as important in the process as knowing what to do. This means that once a communicator has chosen the favored strategy, they must then decide how to employ that strategy. Communication is a complicated give and take process that involves not only explicitly stated content but also implied content and non-verbal cues, such as body language. "The meaning of a word comes entirely from the word, and entirely from the speaker, although only the latter controls the context which helps determine the word's effective meaning…" (Hamer, 1970). It is this control of context that the communicator must be well aware of as they employ the chosen communication strategy. An error in context determination can result in a well-chosen, evidentially supported strategy that does not result in the given communication goal. A highly simplified example of this importance can be seen in the following case. Alex has broken Kelsey's glass bowl that was left precariously on the counter. Alex wants Kelsey to forgive her for breaking the bowl.

Goal: Forgiveness
C1: Alex should apologize.
C2: Alex should say nothing.

Alex has determined that the probability that Kelsey will forgive her for breaking the bowl is much higher if Alex apologizes. However, this is highly dependent on the manner in which Alex apologizes.

Goal: Forgiveness
C1: Alex apologizes sincerely.
C2: Alex apologizes insincerely.

The probability that Kelsey will forgive Alex is just as dependent on how Alex apologizes as it is on the fact that she apologizes. This is a tricky, added layer that must be considered by the communicator when seeking and implementing a communication strategy that will produce a desired communication goal.

Implications

This method of considering communication certainly creates questions. Some of these questions are areas for further research and some of them are ethical questions that are also worth further inquiry. The claims made in this paper are intended to be normative rather than descriptive. Further research could be done in determining more clearly how a given individual weights competing stimuli; Sperber's research doesn't explain what mechanism does this, or how it does this. Ethically, the communicator using the equation would need to have high standards. There is no question that using Bayes' theorem in this manner represents an element of manipulation. A practiced and sensitive user would be capable of using his or her considerations to deceive or elicit a response that could cause harm. This means that if taught, there should be emphasis placed on choosing constructive as opposed to destructive goals. A truly constructive goal would benefit both the user and the targeted respondent.

Despite these concerns, there are numerous instances in which individuals could benefit from considering communication in this manner. First, it would be beneficial in general, everyday life. Many disputes are caused because there was an error in what was communicated. This method forces the user to carefully examine multiple facets of communication. The user must identify the end goal of their communication, question what is relevant, determine the probability that a given action will occur, and choose how to enact a chosen strategy. This greatly reduces the chances that an unintentional mistake will be made. Additionally, this strategy could be used to explain communication to those who have trouble grasping it in more traditional forms. An excellent example would be a subject that suffers from autistic disorders such as Asperger's Syndrome. They could be taught to look for simple relevance points, and then considering their goal could construct strategies that they could then consider and possibly implement. There is a lot of good that can come from combining disciplines and considering communication in a new framework.

References

Andrews, Kristin. *Do Apes Read Minds?: Toward a New Folk Psychology*. Cambridge, MA: MIT, 2012. Print.

Hamer, Colin. "Meaning Things in Words." Ed. Dermot Moran. *Philosophical Studies* 19.0 (1970): 5-10. Web.

Hartman, Stephan, and Sprenger, Jan. "Bayesian Epistemology." (n.d.): 1-19. 17 Aug. 2010. Web. 5 July 2014.

Koolage, William J. "Likelihood Theorem." Eastern Michigan University. 28 Oct. 2014. Lecture.

Ramsey. "Truth and Probability." *Hugh Mellor* Foundations: Essays in Philosophy, Logic, Mathematics, and Economics. (1926): 58-100. Web.

Sober, Elliot. "Introduction to Bayesian Epistemology". 31 Jan. 2000. Teaching material from University of Wisconsin website.

Wilson, Deirdre, and Sperber, Dan. "Relevance Theory." *Handbook of Pragmatics* (2004): 249-280. Web. 24 Nov. 2014.