Efficient Cheap Talk in Complex Environments*

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Expert advice is vital to decision makers in many aspects of economic, political, and social life. The giving of this advice is problematic when the preferences of the expert and the decision maker are not aligned. The famous result of Crawford and Sobel (1982) is that communication requires a bunching of states into single messages so that information is lost and the resulting equilibria are inefficient. Moreover, in the equilibrium of Crawford and Sobel (1982) the expert gains no leverage from her advantage in knowledge. In fact, the expert would be better off if she could simply transfer her expertise to the decision maker for free.

The weakness of experts in the canonical model does not match the power they hold in practice. In many settings, from car mechanics to doctors to financial advisors, we understand experts as being able to shape decisions in their favor because of their informational advantage. This leverage has been documented empirically for doctors providing C-sections (Gruber and Owings, 1996), to real estate agents selling homes (Levitt and Syverson, 2008), and division managers manipulating bosses in firms (Milgrom and Roberts, 1988).

We argue that this mismatch reflects the simplicity of expertise that is captured by the canonical model. Implicit within the canonical model is that, while the specifics are known only by the expert, the *shape* of knowledge is known to expert and laymen alike. As a consequence, should the expert recommend the action that produces her ideal outcome, the laymen knows exactly in which direction and how far to adjust policy to achieve his own ideal outcome. Thus, the difference in preference over *outcomes* between the expert and decision maker translates into a constant and known difference in preference over *actions*.

In practice, the shape of knowledge is unknown and complex, with the relationship between actions and outcomes following a path that is non-monotonic and far from smooth. In the canonical model of Crawford and Sobel (1982) the implicit assumption is that this function is linear and of slope one. To capture the richness of knowledge in practice in a concise tractable way, we represent the mapping from actions to outcomes by the realized path of a Brownian motion. The expert knows the path, whereas the decision maker knows how the

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path was generated but does not know the actual shape of knowledge that is realized. In this setting, the expert's advantage is not limited to a single variable as it is in Crawford and Sobel (1982), rather she knows a continuum of correlated random variables that the decision maker does not. A large informational advantage resonates more closely with expertise in practice. Indeed, Weber (1922) argued that it is precisely the large information gap that is the foundation of expert power and the essence of bureaucratic politics.[1]

For these *complex* environments, we study the classic sender-receiver game of cheap-talk communication. We establish the existence of a cheap talk equilibrium that reverses the properties of Crawford and Sobel's (1982) canonical model. The equilibrium has full support over the space of actions and, thus, is not in partitions. No information is wasted by bunching of states and the equilibrium is Pareto efficient. In equilibrium, the expert recommends her most preferred action and the decisionmaker accepts the recommendation. The equilibrium is expert-optimal and, in fact, implements the same action the expert would choose were she to also hold formal decision making power, regardless of the state of the world. Thus, in complex environments, the expert obtains leverage and is able to influence the chosen action in her favor, as experts are able to do so in practice. The expert, therefore, benefits from her knowledge and would not simply give it up to the decisionmaker if given the option.

Our result holds for continuous but potentially bounded action spaces. Boundedness is important for the equilibrium. For the complex environments we consider, we show that if the efficient equilibrium exists for an action space that is an interval of some length, then it exists for all shorter intervals. If the expert's bias is positive but not too large, there is no restriction on the length of the interval and the action space can be the entire real line. For larger bias, a maximum interval length exists, and for sufficiently large bias the equilibrium no longer exists. This parallels the property in Crawford and Sobel (1982) that the maximal informativeness of equilibria declines in the expert's bias and reaches zero for large bias.

A key property of the Brownian path is that it need not span the full range of possible outcomes (the function is not *onto*). In particular, it is not certain that an action exists that produces the ideal outcome for either the expert or the decision maker. With a bounded action space, this is the case with strictly positive probability.

This possibility is the foundation for our result. In equilibrium, the decision maker knows that the expert is recommending her own most preferred action. But he doesn't know if there is a better action available for him. If not, there is a common interest between the expert and the decision maker, and the decision maker is best served to follow the expert's advice, even though he knows the expert is self-interested. Common interest in this way can arise in complex environments whenever the status quo outcome is more extreme and in the same

[1] Weber (1922, pp. 991) stated, "Under normal conditions, the power position of a fully developed bureaucracy is always overtowering."

direction as the expert's bias.

It is not necessary for our result that the expert and the decision maker share a common interest, only that it is possible. For many, if not most, states of the world, their interests are opposed. It is only necessary that the decision maker does not know which situation he is in, and as long as the former probability is large enough, he is willing to accept the expert's recommendation. Ironically, the recommended action is better for the receiver when the interests of the players are not aligned. They are aligned only when neither neither player is satiated. As the action space expands, the probability that the sender can obtain her ideal outcome increases, and unless the bias is small, this causes the efficient equilibrium to eventually break down.

The Brownian motion has been used to represent uncertain action-outcome mappings across a variety of applications, from communication games (Callander, 2008; Callander et al., 2021); to search and experimentation (Callander, 2011; Garfagnini and Strulovici, 2016), "attributes" problems (Callander and Clark, 2017; Bardi, 2022; Bardi and Bobkova, 2021), and industrial organization (Callander and Matouschek, 2022). It is not strictly necessary for our results and the underlying intuition it reveals holds in a variety of settings. The advantage of the Brownian motion is that it allows a clean characterization of equilibrium behavior, and this clarity reveals the relationship between the complexity of a domain, the size of the expert's bias, and the size of the action space in supporting efficient cheap talk communication. In the Brownian motion setting, the receiver is not at a complete loss in reasoning about the decision environment. He knows in which direction he should adjust the expert's preferred action, and by how far in expectation, when his interests are not aligned with the expert. Yet, the Brownian structure shows how preference alignment over actions can emerge naturally and endogenously, and to such a degree to override this ability to control the decision making environment.

Our approach is to formally expand and contract the action space in studying the possibility of efficient communication. An alternative approach is to presume the action space is large, say the entire real line, and that one or other of the players can commit in advance to a smaller set of actions. Through that lens, our result says that if the players bind themselves to an interval of actions that is not too large then efficient cheap talk is possible. This result resonates with that of Kolotilin et al. (2013) who show in the canonical Crawford and Sobel (1982) setting that the sender can improve the quality of communication, and make herself better off, by ex-ante committing to a particular set of actions. In complex settings we show that this restriction can be to an interval. The nature of this restriction resonates with results from delegation on the optimality of interval delegation (Melumad and Shibano, 1991; Alonso and Matouschek, 2008; Amador and Bagwell, 2013).

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