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## Probability Logic Fails in Immitigable Uncertainty, but Strategic Logic Does Not

We are grateful to Professor Arend (2020) for his engagement with our work on uncertainty and the choice of strategic logics (Packard & Clark, in press). We easily acknowledge that there are reasons to disagree with our conclusions as they imply a minimization, if not outright rejection, of much of modern behavioral research. It was not surprising, then, to receive Professor Arend's (2020) criticisms, which appear to be based in what we might call the "epistemic camp" (contra our own "aleatory camp") of behavioral research.<sup>1</sup> The epistemic camp holds all

<sup>1</sup> We are unclear whether Professor Arend would place himself fully into this camp, as he concedes the existence of immitigable uncertainty, but supposes it cannot be managed whatsoever. Whether he recognizes aleatory uncertainty or not, then, the implications are (for him) the same—only epistemic uncertainty matters in practice.

uncertainty to be what we, in our article, describe as "epistemic uncertainty" and has elsewhere been called "ambiguity" (Packard, Clark, & Klein, 2017)—that is, there is always a probability distribution that can be applied to a decision, even if it is unknown and/or subjectively generated in the mind of the decision-maker. This assumption is quite seductive, as it allows probabilistic models to be applied to literally any choice situation and lends the appearance of scientific rigor. Professor Arend elaborated this position to conclude that any uncertainty that falls outside of it is essentially chaotic and cannot be managed by anything beyond luck.

Our contrary position in the aleatory camp is that this epistemic uncertainty or ambiguity should *not* be confused with aleatory uncertainty—they are different in nature. Thus, there is no valid way to "convert" aleatory uncertainty into ambiguity by imposing a probability distribution onto something that *cannot have one*. Most business uncertainty involves such *aleatory uncertainty* due, in Knight's (1921: 311) words, to "the inherent, absolute unpredictability of things, out of the sheer brute fact that the results of human activity cannot be anticipated and then only in so far as even a probability calculation in regard to them is impossible and meaningless." Thus, while the probabilistic approach to decision-making preferred by the epistemic camp has a place, we, like most managers (Harrison, 1977), reject it as unrealistic for the majority of real-world choice scenarios. In the language of set theory, we hold the typical set of options available to an actor to be "open" or, more precisely, "infinite" (Packard et al., 2017), and not "closed," as is required by probability theory. This renders the probability-based logic employed in the epistemic camp's behavioral research, and in Professor Arend's critique, "impossible and meaningless."

### ONTOLOGICAL VERSUS EPISTEMOLOGICAL UNPREDICTABILITY

Epistemic theorists sometimes accuse aleatory theorists of erroneously theorizing predictive behavior in uncertainty, where prediction is supposedly impossible. True (ontological) prediction could of course be impossible, but this is quite different from epistemic prediction—or imaginatively forming a mental expectation. Thus, their criticism is based in understanding unpredictability as "epistemic," meaning the mind cannot form a prediction whatsoever. But aleatory theorists, in fact, reference an *ontological* "unknowability" or "unpredictability," wherein a (future) state of affairs is strictly unforeseeable. As Lachmann

(1977: 19) put it, “the future is unknowable but not unimaginable.” That is, one cannot truly *know* the undetermined reality that is yet to come—but we are *not* claiming that such futures cannot be imagined. As stated in our article, “attempts to predict aleatorically [immitigably] uncertain outcomes are possible . . . The human mind is capable of imagining possibilities and, from them, forming expectations, even for and within indeterminate circumstances” (Packard & Clark, in press: 26).

Let us justify our contention that “unknowability” and “unpredictability” are ontological claims, as they might appear to be epistemological claims. What do we mean when we describe a future state of affairs as “unpredictable”? A simple answer to this might be that the causal knowledge needed to predict such an outcome is unattainable, but let us dig a bit deeper. Why is that knowledge unattainable? In all such cases, the states of affairs and causal mechanisms necessary to sufficient causal knowledge are both unobservable and non-deducible a priori. In many such cases, as in the case of free will, its unobservability is due to the fact that such conditions are yet to be fully determined. Thus, what is meant by “unknowability” or “unpredictability” is an *ontological* state of affairs that is epistemically inaccessible—there is not now any observational mechanism (whether or not you believe we might someday devise one) whereby that ontological state of affairs, including causal mechanics, can be rationally or empirically discovered.

Epistemic unpredictability is a largely useless concept, a rare result of ontological unpredictability and extreme anxiety where an individual is unable to make predictions. In games such as roulette, the player can and, in fact, *must* make an outcome prediction when placing a bet. Such an outcome is not unpredictable in an epistemological sense, but it *is* unpredictable in the ontological sense—the player cannot know what the specific outcome will be without cheating.

When considering the uncertain contexts of business decisions, which depend on human decisions and actions, this distinction becomes even more meaningful. Suppose an entrepreneur has a commitment from a buyer. On this basis, the entrepreneur has a reasonable *epistemic* prediction of a sale. However, this epistemic predictability does not extend to *ontological* predictability—future human behavior is not utterly knowable because of the problem of free will, as we put forth in our article. The entrepreneur does not *know* the buyer will follow through because the buyer can change their mind. Human action is, ontologically, undetermined until the action

is actually taken. Contracts and assurances may reduce such propensities, but perfect predictability is always impossible due to reasons we outline in our article.

### PROBABILITY LOGIC FAILS IN UNCERTAINTY

A second and perhaps more important challenge to the epistemic camp concerns its insistent usage of probability logic in its theorizing of uncertainty—a context decidedly unfit for such logic. The epistemic camp has developed extensive theory on the tenuous presumption that we act as if every decision were based in probabilities (Berg & Gigerenzer, 2010). It is on this basis that Professor Arend (2020: 702) supposes that, in aleatory uncertainty, “*any* approach must be as (in)effective as any other when it comes to predicting or controlling the outcome of the event.” In other words, all uncertain outcome probabilities are equal, there are no greater or lesser likelihoods, and so there are no better or worse choices—only luck. This conclusion is a misapplication of probability logic to an open-set (non-probabilistic) context. Ontological unpredictability or unknowability does not imply that “*any* outcome can occur,” as Professor Arend (2020: 702) claims, nor does it imply an utter randomness of outcomes, a presumption that the epistemic camp simplistically draws from probability theory.

The epistemic camp makes two erroneous inferences with such claims—(1) that an infinite set includes literally everything and (2) that all elements of an infinite set are equally likely—both of which are easily discredited. First, infinite sets do not contain *everything*—an infinite choice set does not mean that “*any* outcome can occur.” The set of whole numbers is infinite, yet excludes all non-whole numbers—a much larger infinite set (note that infinite sets can be larger and smaller). A jailed convict, standing in the middle of their cell, would have literally infinite possible directions and distances in which they could move—a circle has infinite points, as does a geometric area. However, this does not mean that the convict could go literally *anywhere*. An infinite set of options is *constrained* by the limits of possibility—a convict, in fact, has a very small set of infinite options available to them. That an entrepreneur may have limited resources need not logically imply that the possible uses for those resources are finite, nor does it mean that the infinity of possibilities available to the entrepreneur are unconstrained. Thus, aleatory uncertainty does *not* mean “that *any* outcome can occur.”

Second, we can similarly reject claims that, under conditions of aleatory uncertainty, “*no* actions

taken by the decision-maker can affect the range or the probability of what can occur at the event” (Arend, 2020: 702) such that all possible outcomes are equally likely and can only be capitalized on by luck. This inference is based in the faulty presumption that all undefined probabilities are definitionally equal and, thus, cannot be altered. That is, if we do not know the precise probability of an outcome—if a defined probability does not exist—then the true probability is (or must be assumed to be) equal for each unknown outcome. Again, this conclusion is contrived from the epistemic camp’s closed-set probability theoretic tradition, which we reject for the open-set human experience. Such a simplification imposes a uniform probability distribution for uncertain outcomes, an assumption we decidedly reject—probabilities not only are not known in uncertainty (in which case, it would still be unsatisfactory to cast such unknown probabilities as logically uniform), but *do not exist*. Except in extremely limited circumstances of pure Knightian risk, human expectation and judgment are not properly characterized by probabilities at all, but by *possibilities*. Possibilities reflect what *can* occur, and are characterized on a spectrum of degrees ranging from *impossibility* to *perfect* possibility (Shackle, 1949, 1969). Even in radical uncertainty (wherein the set of outcomes is infinite), some outcomes are more “possible” than others, and yet other outcomes are literally impossible.

Professor Arend infers from this logic that we suppose that human action cannot alter the possibility of an uncertain outcome. In fact, we act precisely because we believe that we can alter the possibility of an outcome—if possibilities could not be altered, we would have no reason to act at all (von Mises, 1998). The epistemic camp’s reduction of aleatory uncertainty to “anything could happen” ignores all that we know about causality and our ability to manipulate it. The point we make in our article is not that we cannot or should not predict outcomes or seek to bring them about; it is merely that any outcomes dependent on the voluntary action of others cannot ever be perfectly known a priori (i.e., ontological unpredictability), which lends to especial difficulties for social theorists, such as economic actors (Felin & Zenger, 2017).

Because it is clear that some possibilities are more likely than others, the epistemic camp has for a century attempted to apply the framework of

statistical probabilities to such outcomes, thereby reducing all behavior to problems of “risk.”<sup>2</sup> But doing so is and has always been a mistake. If behavior can be creative, if the options available to the actor are infinite (but not unconstrained), then there can be no set-theoretic completeness from which probabilities can be derived. Probability theory has little bearing on human behavior, except in the most limited (“risky”) contexts. We, like Shackle (1949, 1969), advocate a turn away from probability language and theory in behavioral science, and favor instead a science of comparative “possibility.”

### THE POSSIBILITY OF PRESCRIBING ‘BETTER’ STRATEGIES

Let us conclude by rebutting Professor Arend’s (2020: 702) specific quarrel against us, that “theoretical prescriptions for better dealing with immitigable uncertainty should *not* be attempted, as logic appears to indicate it is *not* possible.” The premise of his argument is that we attempt to “*optimize*” entrepreneurial behavior, as if our recommendations for pursuing a non-predictive decision logic in contexts of comparatively greater immitigable uncertainty entailed some kind of definitive statement of what is to come. Our goal is, of course, not “optimization”—we agree with Professor Arend that “optimization” is impossible, which we believe is clear from our article.

Professor Arend’s objection that “theoretical prescriptions for better dealing with immitigable uncertainty should *not* be attempted” runs counter to the entire fields of strategic management and strategic entrepreneurship—prescriptive (design) sciences intent on offering theory-based tools for better navigating unpredictabilities. In fact, such tools and strategies are useful precisely *because* of the context of ontological unpredictability. It is true that a business manager cannot “optimize” their strategic actions because they cannot perfectly predict the outcomes of their actions, nor the actions of their competitors, consumers, or

<sup>2</sup> Friedman (2007: 282) exemplified this view: “In his seminal work, Frank Knight drew a sharp distinction between risk, as referring to events subject to a known or knowable probability distribution and uncertainty, as referring to events for which it was not possible to specify numerical probabilities. I have not referred to this distinction because I do not believe it is valid. I follow L. J. Savage in his view of personal probability, which denies any valid distinction along these lines. We may treat people as if they assigned numerical probabilities to every conceivable event.”

other market actors (Milliken, 1987). But it is precisely this ontological unpredictability that strategic tools—such as those provided by the resource-based view, for instance—are designed to manage, and only within ontological unpredictability do such strategies become meaningful at all; otherwise, optimization calculus would clearly be preferred. By mustering particularly valuable resources and capabilities, by contingency planning, through more organic organizing, or by developing and maintaining dynamic capabilities, a firm puts itself in a stronger position to respond to and survive unpredicted events. This is not “optimization,” of course. Some unpredicted event could still cause the firm to fail, in spite of employing best-known strategies, while another firm with a “bad” strategy might get lucky. Certainly, better epistemic prediction would allow better strategic organization, but, in ontological unpredictability, such predictions are innately unreliable. A good strategy, then, is one intended to deal with the *aleatory* uncertainty also, and not just the epistemic uncertainty, by providing the firm with tools for navigating ontological unpredictability.

But the conclusion we draw in our article, that firms and entrepreneurs should normatively prefer non-predictive decision-making logics when confronted with immitigable aleatory uncertainty, and a predictive or uncertainty-mitigation strategy where the uncertainty is predominantly epistemic—our “advising firms to be flexible in the face of immitigable uncertainty,” as Professor Arend (2020: 702) put it—was not our intended contribution. Such strategies, of course, have been well accepted for years, both in strategic management (e.g., Mintzberg, 1973) and in entrepreneurship (e.g., Sarasvathy, 2001) contexts. Instead, our intended contributions are twofold. Our first aim was and is to advance the case for a scientific turn from the epistemic camp to the aleatory camp. And our second goal was precisely in laying out the case for why the argument—that “theoretical prescriptions for better dealing with immitigable uncertainty should *not* be attempted, as logic appears to indicate it is *not* possible” (Arend, 2020: 702)—is wrong. Such prescriptions, such as those put forth in effectuation theory, are very possible once you have the meta-theory right.

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