

Aristotelian Chance: what is the something in for the sake of something?

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The English term "chance" is the closest translation for Aristotle's term in Greek. Aristotle's broad concept of includes , luck or fortune, applicable to human actions, and , chance, applicable to natural spontaneity.¹ "Chance" in English contains the meaning of (1) the possibility of something happening, (2) the occurrence and development of events in the absence of any obvious design or cause, and (3) accidental.² "Chance" in English shares with Aristotle's term a sense of absence of design or cause and a sense of being accidental. However, Aristotle's term contains a stronger sense of coincidence with another event than "chance" does in English. In addition, Aristotle's term contains a stronger sense of rarity and unusualness which the English term "chance" lacks. The difference in meaning between and "chance" and the problem of capturing the meaning of a term in another language may be illustrated by attempting to translate both terms into Chinese. To translate Aristotelian into Chinese, either (pengqiao) or (qiaohe), both meaning "by coincidence," would be a better translation than (jihui), meaning opportunity, or (kenengxing), meaning possibility, the two closest terms in Chinese for "chance" in English. The terms (pengqiao) and (qiaohe), meaning "by coincidence," do not contain a strong sense of rarity and unusualness as does the Aristotelian ; a different Chinese term (ouran), meaning "occasional," is needed to express a sense of rarity. The linguistic differences between Greek and English being such that the English term "chance" and the Aristotelian are clearly not identical. Specifically, although both terms express a sense of being accidental, Aristotelian has a more pronounced sense of coincidence and unusualness and the English term "chance" has a more pronounced sense of possibility.

The Aristotelian chance discussed here corresponds to Aristotelian which carries a more pronounced sense of coincidence and unusualness and a lesser sense of possibility than the term "chance" as we know it. Understanding Aristotelian chance is important to understanding Aristotle's other concepts such as his teleology and his doctrine of four causes. Aristotle's main discussion of chance appears in Physics II, iv-vi. His first definition of chance is as follows:

Now things of this sort [i.e. events which for the sake of something], whenever they come to be incidentally, we say are from luck. (For just as in the case of being also, there is being per se and being incidentally, so it is possible for something to be a cause.) As has been said, therefore, whenever this comes to be [i.e. when something comes to be incidentally] among the things which came to be for the sake of something, then it is said [to be] from chance or from luck (196b23-31)

Besides a first condition that a chance event has to "come to be incidentally," a second condition is that a chance event is for the sake of something.^{3 4} However, it

¹James Allen, Aristotle on Chance as an Accidental Cause, 66.

²The New Oxford Dictionary of English.

³James Lennox, Aristotle on Chance, 52, Phys. II iv-vi makes the following claims:

- (1) Whatever might have been due to thought or to nature is for the sake of something.
- (2) Chance events are "among the things that come to be for the sake of something".
- (3) Chance processes are not for the sake of their results.
- (4) Chance processes might have been due to thought or nature.
- (1) and (4) imply that: (5) Chance events are for the sake of something.

⁴James Allen points to Aristotle's passage from Posterior Analytics to claim that Aristotle asserts that "nothing that is by chance comes to be for the sake of something." James Allen, Aristotle on Chance as an Accidental Cause, 70. The point of conflict with Lennox's suggestion that "chance

is not clear and there is no general agreement on what the "something" is in "for the sake of something." This essay attempts to explore this particular question.

I

6

There are four potential alternatives for interpreting "something" in "chance events are for the sake of something." These potential alternatives take into account Aristotle's concept of teleology as well as his writings on chance.

- (1) Chance events are for the sake of their originally expected result. 8
- (2) Chance events are for the sake of their ultimately achieved result. 9
- (3) Chance events are for the sake of what's meaningful for human happiness. 10
- (4) Chance events are for the sake of what's meaningful for their ultimately achieved result. 11

These four alternatives will be examined in turn in the following section. 12

II

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(1) Chance events for the sake of their originally expected result. 14

Philosopher Porphyry (c.234 c.305 AD) indirectly proposes that chance events are for the sake of their originally expected result by suggesting that what the chance events are for the sake of is not what results. There is textual support, at least indirectly, in Phys. II, iv-vi for the interpretation that chance events are for the sake of their originally expected results. In Phys. II, vi, Aristotle says: "chance events do not come to pass for the sake of what actually results." He then follows up with an example "A is for the sake of B, does not result in B."⁵ This implies that chance events are not for the sake of their ultimately achieved result and are for the sake of their originally expected result. A subsequent sentence in the same passage "[t]hese spontaneous events are said to be from chance if they have the further characteristics of being the objects of choice and happening to agents capable of choice." indicates that these examples under the Aristotelian chance, in the human realm concerning , luck or fortune, are limited to object of choice happening to agents capable of choice. 15

In Aristotle's limited sense of chance concerning human actions, he has a well-known example of a man going to the market for a purpose other than collecting a debt, 16

events are for the sake of something" is not a topic of discussion in this essay.

⁵Barnes, *The Complete Works of Aristotle*, Volume One, 337, "[h]ence it is clear that events which belong to the general class of things that may come to pass for the sake of something, when they come to pass not for the sake of what actually results, and have an external cause, may be described by the phrase from spontaneity. These spontaneous events are said to be from chance if they have the further characteristics of being the objects of choice and happening to agents capable of choice. This is indicated by the phrase in vain, which is used when one thing which is for the sake of another, does not result in it. For instance, taking a walk is for the sake of evacuation of the bowels; if this does not follow after walking, we say that we have walked in vain and that the walking was vain. (197b19-25)

but then accidentally recovering the debt from the debtor who is also at the market. In this example, the chance event is the man going to the market, for the sake of a purpose other than collecting the debt. The mans original intended result is for a purpose other than collecting the debt. What ultimately results is the man collecting the debt. By saying that chance events are for the sake of their originally expected result, it illustrates the mans reason for being at the market, which is an incidental cause of what he ultimately achieves, i.e. collecting the debt. In fact, what matters in this example is that the mans ultimate result was unexpected, whether the mans originally intended result is achieved is not relevant. The man may have finished watching the show he intended to watch or may have successfully completed his business before he runs into his debtor. Along these lines, Lennox⁶ provides an example showing the insignificance of having an original purpose: suppose a person is compelled to be at a location for no reason at all. Upon being there, the person discovers the woman of his dreams. The person has no original purpose of being there. Thus, we are tempted to draw the conclusion that, in Aristotles limited sense of chance concerning human actions, it may be acceptable to say that chance events are for the sake of their originally expected result, because saying so states an incidental cause, but the original expected result is not always significant.

We now apply the interpretation that chance events are for the sake of their originally expected result in Aristotles broader sense of chance in the natural realm, i.e. spontaneity in nature or the case of "monsters" where offspring do not resemble their parents De Gen. An. IV, iii-iv (767b 5-6), animal lacking parts (770 b 8-9) or with extra parts or irregular formation (772 b 13-773 a 29). Aristotle has the following definition for spontaneity in Phys. II, vi. 17

Hence it is clear that events which are among those things which come to be without qualification for the sake of something. When they do not come to be for the sake of the result, and which have an external cause, are due to the spontaneous. (197b14-20) 18

In addition to suggesting spontaneous events are not for the sake of what results, Aristotle says: "for a stone falls not for the sake of hitting someone, but it falls automatically because it might have been made to fall by someone and for the sake of hitting. (197b30-32)" What would be the originally expected result of a stone falling naturally which ends up hitting someone? Because the ultimate result is that the stone ends up hitting someone, for the ultimate result to be unexpected or accidental, it may be reasonable to say that the originally expected result is for the stone to fall without hitting anyone. However, saying that the stone falls for the sake of not hitting anyone ascribes something to nature that nature does not have, because the stone simply falls without regard as to whether it hits someone or not. Alternatively, if the originally expected result is for the stone to simply fall without regard to whether it hits anyone, it fails to state a purpose. If stone falling were the originally expected result, we would be making the circular statement that stone falls for the sake for stone falling. Therefore, the interpretation that chance events are for the sake of their originally expected results does not work well with Aristotles broader sense of chance in the natural realm with external natural causes. 19

We further examine a case of spontaneity similar to Aristotles case of "monsters" where offspring do not resemble their parents. Suppose several seeds are planted 20

⁶Lennox, Aristotle on Chance, 55

according to the conditions needed for the seeds to sprout. While most of the seeds sprout as expected, a couple of seeds fail to sprout for no reason at all. Aristotle attributes the cause of being contrary to nature such as failing to sprout as internal in *Phys*, II, vi:

The difference between spontaneity and what results by chance is greatest in things that come to be by nature; for when anything comes to be contrary to nature, we do not say that it came to be by chance, but by spontaneity. Yet strictly this too is different from the spontaneous proper; for the cause of the latter is external, that of the former internal. (198a33-36) 21

Here Aristotle suggests that spontaneity in nature with an internal reason is not "chance." That's because Aristotle is only talking about chance in the limited sense concerning human actions. Scholars have since characterized spontaneity and monsters as part of Aristotle's broader sense of chance in the natural realm.⁷ In the case of seeds failing to sprout, because the reason is internal, perhaps due to defective seeds, there is no external event that is a cause of the chance outcome. It may be argued that an originally expected result of seeds sprouting properly is present when necessary conditions are given for the seeds to sprout. With that presence of purpose and seeds not sprouting as the chance event, under the current interpretation that chance events are for the sake of their originally expected result, we would be saying that seeds not sprouting is for the sake of seeds sprouting properly. We could tell that such a statement is not entirely logical on its face. Therefore, the current interpretation also does not work well with Aristotle's broader sense of chance in the natural realm with internal natural causes. 22

Further, the interpretation that chance events are for the sake of their originally expected result does not seem to express Aristotle's recognition under his teleology that an event must be recognized as being meaningful for it to be a chance event.⁸ In Aristotle's teleological context, man's purpose is to strive to exist in the best possible condition and only ascribes meaning to events relevant to such purpose.⁹ In this context, a chance event needs to either contribute to or subtract from the achievement of a goal. The number of meaningless events, expected or unexpected, is unlimited. Yet very few are meaningful enough to be recognized as chance. As legend has it, Isaac Newton saw an apple fall while contemplating the forces of nature, leading him to discover the laws of gravity. Suppose Newton was not there to see the chance fall of the apple. Even if the unobserved apple fell in a rather particular and unexpected way, e.g. hit a rock and then jumped an exotic loop, the fall of the apple would be meaningless and would not be a chance event. Because the fall of the apple is not expected to be unobserved and observing the fall is not expected to inspire anyone to discover the laws of gravity, stating that chance events are for the sake of their originally expected result would in this case be saying that the fall 23

⁷Lennox, Aristotle on Chance, 55

⁸John Dudley, Aristotle's Concept of Chance, SUNY Press 2012, 24, "One of Aristotle's most profound observations is that intelligibility and purpose go together. He states e.g. that if someone said that he had washed himself in vain because the sun did not go into eclipse, he would be ridiculous. Solar eclipses are not what washing is for."

⁹Lindsay Judson, Chance and Always or For the Most Part in Aristotle, 92: "Our aim of understanding the world about us of making sense of the operations of nature and the strategies of rational agents requires us to distinguish pieces of behavior which are reliably connected with those operations and strategies from those which, even if there appear to be, are not."

of the apple is for the sake of nothing meaningful.¹⁰ Thus, the current interpretation renders a description showing chance events as being meaningless, which both fails to distinguish chance events from meaningless events in addition to taking chance out of the teleological context.

Overall, the interpretation that chance events are for the sake of their originally expected result does not work well. Therefore, I side with Simplicius and Lennox in rejecting this interpretation. 24

We assume that when we say chance is for the sake of something, chance has a purpose because "for the sake of" implies having a purpose. However, contrary to what he implies in Physics, Aristotle asserts in Posterior Analytics that chance does not occur for a purpose or for the sake of something.¹¹ Now that we take on the position that chance events are for the sake of something, the contrary statement and inconsistency in Posterior Analytics is not addressed here. 25

(2) Chance events for the sake of their ultimately achieved result. 26

Philosopher Simplicius (c.490 c.560 AD) proposes that chance events are for the sake of their ultimately achieved result. Simplicius suggests that chance events have the appearance of being goal directed because they are, i.e. they are what might have been done for the ultimately achieved result. Lennox adopts this interpretation, following Simplicius line of reasoning that the end result is what the chance event would have aimed for if there were foresight. Lennox argues that chance events are for the sake of their ultimately achieved result by accident, without causing the ultimately achieved result.¹² Under this interpretation, in the example of the man who accidentally recovers a debt when he goes to the market for a purpose other than recovering the debt, it would be to say that the man goes to the market for the sake of recovering the debt because he would have gone to the market had he known that his debtor would be there. The following passage from Phys. II, v offers support for such an interpretation. 27

Thus, the man would have come for the sake of recovering the money when his debtor was collecting contributions, if he had known; in fact, he did not come for the sake of recovering the money, but he happened to come and to do this for the sake of collecting the money (196b34-36). 28

Perhaps Simplicius and Lennox are correct that chance events in the Aristotelian limited sense of chance in the human realm concerning human actions are for the sake of their ultimately achieved results because the ultimately achieved result is 29

¹⁰The falling apples achieved result is "being observed and subsequently inspiring Newton to discover the laws of gravity." Therefore, the originally expected result is "falling without being observed."

¹¹John Dudley, *Aristotle's Concept of Chance*, SUNY Press 2012, 33, "Accidents, therefore, do not have a purpose. Hence Aristotle states that chance, i.e. chance events, does not occur for a purpose. This tenet is stated very clearly in a series of text outside the Physics." Posterior Analytics II. "Among things that come to be from thought some never arise from chance or from necessity, e.g., a house or a statute, but for the sake of something, while others such as health or safety also arise from luck but nothing by chance comes to be for the sake of something." (95a3-6)

¹²Lennox, *Aristotle on Chance*, 58: "If the result being scrutinized was not the goal of the process leading to it, then it is related to that process only incidentally. However, if the process is one which might have been properly for that goal, if the end result is capable of being the proper goal of that process, and if the process does in fact achieve that end result, there is sense to saying, as Aristotle does, that the process is, by accident, for the sake of that result."

what an agent capable of choices would have wanted, with foresight or retrospective. However, this interpretation can run into practical difficulties in terms of ordinary logical reasoning. With this interpretation, we would say: "the falling apple is for the sake of inspiring the discovery of the laws of gravity upon being observed by Newton." or "Alexander Flemings carelessness in handling the lab sample is for the sake of discovering penicillin." or "My going about my business as usual with no expectation of running into anyone is for the sake of running into my old friend." Even if we add "by accident" at the end of each of these sentences as Lennox would have suggested, there is an apparent lack of logic to these statements under our ordinary reasoning.

This interpretation runs into particular difficulty when chance events have chain reactions. The difficulty is illustrated by the well-known story from ancient China. 30

Near China's northern borders lived a man well versed in the practices of Taoism. His horse, for no reason at all, got into the territory of the northern tribes. Everyone commiserated with him. "Perhaps this will soon turn out to be a blessing," said the man. After a few months, his animal came back, leading a fine horse from the north. Everyone congratulated him. "Perhaps this will soon turn out to be a cause of misfortune," said the man. His son became fond of riding the fine horse and eventually broke his thigh bone from falling while riding. Everyone commiserated with him. "Perhaps this will soon turn out to be a blessing," said the man. One year later, the northern tribes started a big invasion of the border regions. All able-bodied young men took up arms and fought against the invaders, and as a result, around the border nine out of ten young men died. This man's son did not join in the fighting because he was crippled and so the son survived to look after the man in his old age. 31

The chance event of the man losing his horse belongs to Aristotle's broader sense of chance in the natural realm with an external cause. Under the current interpretation that chance events are for the sake of their ultimately achieved result, as the above story develops, would we be saying "the man's loss of his horse is for the sake of bringing back a fine horse," then "the man's loss of his horse is for the sake of breaking his son's thigh bone," and then "the man's loss of his horse is for the sake of preserving his son's life"? The requirement of foresight and retrospective for this interpretation brings about the unwanted burden of having to change the statement as events develop. 32

Overall, although the interpretation that chance events are for the sake of their ultimately achieved result connects chance events to their ultimately fulfilled result rendering chance events meaningful in Aristotle's teleological framework, it contains a logical defect under ordinary reasoning as something unplanned turns into an aim. It also does not work well for scenarios where there are chain reactions. 33

(3) Chance events for the sake of what's meaningful for human happiness. 34

The interpretation that chance events are for the sake of what's meaningful for human happiness maintains chance within Aristotle's teleological context and avoids the logical defect in the preceding interpretation. When interpreting chance events to be for the sake of what's meaningful for human happiness, we recognize that there are unlimited events that are meaningless and that whenever there is a chance event that is meaningful in terms of man's aims, i.e. meaningful in terms of human 35

happiness, the chance event is recognized. This interpretation allows chance to fit well in Aristotles teleological context because it shows that chance events contribute to the purpose of human happiness. In Aristotelian broader sense of chance in the natural realm, this interpretation distinguishes chance events from other meaningless events by highlighting the fact that chance events have a purpose and are meaningful. In this interpretation, the falling apple that Newton saw, the lab sample that Alexander Fleming carelessly put aside, which would have otherwise be meaningless and would not have been noticed, became meaningful and turned into chance events because of their significance to mens aims. What is meaningful to human happiness includes both good fortunate and bad fortune.

Applying the interpretation to the case of the man accidentally recovering a debt at the market place, we would be saying that the man goes to the market for the sake of whats meaningful for his happiness. This is a logical statement as recovering a debt is relevant to the mans happiness. In the case of the man losing his horse in the story from ancient China, all subsequent events are meaningful for the mans happiness, from the lost horse bringing back a fine horse, to his son breaking his bone riding the fine horse, to his sons preservation for not having to join the armed conflict. Therefore, saying that the mans losing his horse is for the sake of whats meaningful to his happiness is logical. 36

It seems that Aristotle makes a broad categorization between what is meaningful and what is not when he says in Phys, II, v: "of things that come to be, some come to be for the sake of something, others not." Based on that, one may attempt to argue that it is justified to simply categorize chance events as whats meaningful. However, "for the sake of whats meaningful for human happiness" may be too general a statement as it makes all chance events indistinguishable. In addition, why would Aristotle use the term something if what he means is the unchangeable whats meaningful for human happiness? Furthermore, for the sake of something is what he uses for the final cause of physics and the something is meant to be different for different things. Turning something into the constant whats meaningful for human happiness for chance events would make a glaring exception to how he addresses the final cause of physics. 37

Therefore, although the interpretation that chance events are for the sake of whats meaningful for human happiness seems logical and works well in terms of maintaining chance within Aristotles teleological framework, it is so general a statement that it make all chance events indistinguishable. It also creates conflict with how Aristotle analyzes the final cause. 38

(4) Chance events for the sake of whats meaningful for their ultimately achieved result. 39

Finally, the interpretation that chance events are for the sake of whats meaningful for their ultimately achieved results not only puts chance events in Aristotles teleological context, it avoids the logical defect of connecting chance events and their ultimately achieved result directly, and it avoids making too general a statement to make all chance events indistinguishable. This interpretation would seem to be our best alternative. Textual support for "chance events are fore the sake of their ultimately achieved result" can support "chance events are fore the sake of whats meaningful for their ultimately achieved result", as latter is a refinement of the former. The difference between "ultimately achieved result" and "whats meaningful 40

for the ultimately achieved result” is the wider array of things that can be relevant to the ultimately achieved result.

Applying the current interpretation to the case of the man accidentally collecting his debt at the market, the mans going to the market is for the sake of whats meaningful for his recovering his debt. In the case of the man losing his horse in the story from ancient China, the mans losing his horse is for the sake of whats meaningful for his lost horse bringing back a fine horse, or for his sons fond of riding the fine horse, or for his son breaking his bone riding the fine horse, or for his sons preservation for not having to join the armed conflict. It may seem that this interpretation also requires a shifting description of what the chance event is for the sake of in case of chain events. However, what is underlying the meaningful for all subsequent chain events can be the same. For instance, the mans lost horse bringing back a fine horse is meaningful for the mans son becoming fond of riding the fine horse, is meaningful for his sons breaking a bone, is meaningful for the sons preservation not having to fight in the armed conflict. In other words, with the current interpretation, what chance events are for the sake of can stay the same while description changes as events develop. 41

The interpretation that chance events are for the sake of whats meaningful for their ultimately achieved result is our best alternative and it is a refinement of the view of Simplicius and Lennox. 42

III

Aristotle holds that chance is an accidental cause and not one of his four causes¹³ According to Aristotle, a chance event is accidental to a substantial cause.¹⁴ In Phys. II, viii, Aristotle considered and rejected chance as a cause of nature. 43 44

Why then should it not be the same with the parts in nature, e.g. that our teeth should come up of necessity-the front teeth sharp, fitted for tearing, the molars broad and useful for grinding down the food-since they did not arise for this end, but it was merely a coincident result; and so with all other parts in which we suppose that there is purpose? Such are the arguments (and others of the kind) which may cause difficulty on this point. Yet it is impossible that this should be the true view. For teeth and all other natural things either invariably or normally come about in a given way; but of not one of the results of chance 45

¹³The terms for Aristotles four causes were imposed on Aristotles work by later Scholastic philosophers:

(1) The material - of what is it constituted? For example, the bowl is made from bronze. Bronze is the material cause.

(2) The efficient - what moves it? For example, the movement of my fingers causes the keys on the computer to move. This is the efficient cause.

(3) The formal - what is it? For example, I am a human being. This is the formal cause.

(4) The final - what is its purpose (telos)? Health, for example, is the purpose of exercising. This is the final cause.

¹⁴Phys. II, vi: It is clear that chance is an incidental cause in the sphere of those actions for the sake of something which involve purpose; Dudley, Aristotles 368: Aristotles account of chance events is metaphysical and epistemological in nature. Chance is not a substance or a per se cause, since it does not exist in the strong sense. For every event, including chance events, there is a per se cause, which is either nature or intellect.

or spontaneity is this true. (198b24-28, 32-25)

Without being considered one of the four causes, Aristotelian chance is an accidental cause pertaining to a substantial cause, i.e. any one of the four causes. Any of Aristotles four causes can be a substantial cause, i.e. a per se cause, which chance can pertain to. Existing in Aristotles teleological context, all of the four causes are goal oriented.¹⁵ A chance event pertains to a substantial cause becomes meaningful as a result of nature or intellect. For example, when Newton saw the apple falling from the tree, Newtons intellect was at work for him to recognize the significance which allowed him to connect the chance event of seeing the falling apple with the forces of nature. His recognition of the significance of the falling apple is the efficient cause of his discovery of the laws of gravity and the fall of the apple that he saw was pertaining to this efficient cause. Similarly, Alexander Flemings intellect recognized that something significant was involved when he observed the aftermath of the carelessly handled lab sample. The recognition was the efficient cause while the carelessly handled lab sample itself, the chance event, was pertaining to this efficient cause. 46

Another characteristic of Aristotelian chance is that it stands in contrast to necessity and it is for occurrences that are not "always or for the most part." He says: 47

First, then, since we see somethings always coming to be in the same way, and some for the most part, it is evident that neither luck nor what is due to luck is said to be the cause of either of these either of what is of necessity and always, or of what is for the most part. But since there are also things which happen in addition to these, and all say that these happen from luck, it is evident that luck and chance are something. For we know that such things are from luck and that the things due to luck and of this kind. 48

Aristotelian chance is of unusual occurrence. When Aristotle rejects the view that nature is a result of chance (Phys, II. Viii), his reasoning is that nature, e.g. teeth are sharp, occurs always or for the most part and therefore is not chance. 49

IV

Aristotles chance, , is distinct from "chance" in English. First, Aristotle deals with a category of chance in the limited sense concerning human actions where "object of choices" are involved and chance events are happening to agents capable of choices. Second, he deals with a category of chance in the broader sense concerning the natural realm which includes spontaneity and monsters. Aristotles chance carries a higher sense of coincidence and unusualness than the English term "chance" while having a lower sense of possibility than "chance." Aristotles chance exists in this teleological context where chance events are meaningful and goal directed. The best interpretation, out of the four alternatives, for "something" in "chance events are for the sake of something" is "chance events are for the sake of whats meaningful for their ultimately achieved result." 50 51

¹⁵Dudley, Aristotles 365: The notion of chance accordingly implies the existence of goal-oriented per se causes. In fact all per se causes are goal-oriented since the only per se causes are substances and human decisions, and the latter are always taken for a purpose.

While Aristotle has been addressing chance on an individual scale, modern technology of big data analysis and data pattern recognition has enabled us to understand chance both on a large scale and on a long time span. From Gaussian distribution to Pareto principle (also known as 80/20 rule), individual occurrences seemingly up to chance fit in predictive models with or without identifiable algorithms for such models. The trend will only increase as technology in machine learning and artificial intelligence grows. Aristotle's concern with chance is out of his need for understanding his world. Like Aristotle, our understanding of chance, not just Aristotelian chance, will have to involve possibilities as well as unknown causes, in predictive models, with or without known algorithms.

Endnotes