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The future in the mirror and behind it: Scientists and more

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ABSTRACT

This paper argues that the framework of entrepreneurs-*as*-scientists, portraying entrepreneurs as tasked with making precise and reliable inferences, and expressed in certain mathematical language, trivializes entrepreneurial practice. I highlight the challenges that arise from replacing the abstract notations of mathematical language with names from ordinary language of entrepreneurship. Co-opting of ordinary language for mathematical purposes distorts our understanding of business ideas, venture development, and entrepreneurial processes. At stake are different conceptions of the future. One creates the future within language, the other accepts that the future lies outside of language as an untameable realm of perpetual novelty.

> "Whereof one cannot speak, thereof one must be silent."
>
> Ludwig Wittgenstein

A defining challenge for entrepreneurs is the uncertainty of the future, in which their projects will be rendered successes or failures (Packard et al., 2017). Ideally, entrepreneurs should stick with "good" projects and abandon "bad" ones (Dimov, 2010), but uncertainty exposes them to the possibilities of committing errors of commission or omission (McMullen and Shepherd 2006). A recent theory suggests that a scientific approach to entrepreneurial decision making "improves precision – it reduces the odds of pursuing projects with false positive returns and increases the odds of pursuing projects with false negative returns" (Camuffo et al., 2020: p. 564). Such superior inferential power arising from the systematic method of science enables an entrepreneur-*as*-scientist to reduce uncertainty and create value (Zellweger and Zenger, 2023). While it sounds too good to be true, one wants it to be true – it delivers a hopeful message that uncertainty can be defeated. But hope is not enough.

Magic tricks exploit cognitive weaknesses. One can't help wondering about gaps in reasoning that might underpin the magic of scientific entrepreneurship. Careful retracing of the argument reveals two main premises. First, following a scientific method produces better theories of a given phenomenon of interest. Second, the task of entrepreneurs is to make inferences about something given (but not yet known). Therefore, combining the two premises leads to the conclusion that entrepreneurs who follow the scientific approach make better inferences. The first premise is intuitive: it is grounded in our understanding of science as a self-correcting enterprise, whereby knowledge is improved via the gradual calibration of theoretical models through rigorous experimentation and response to feedback. We can safely eliminate this premise from our suspicion, which leaves us with the second premise.

To describe what entrepreneurs do, we deploy certain language as the expression of an adopted conceptual framework (Carnap, 1950). We move, so to speak, from a model of reality (our description of something external) to the reality of the model (the world of our description).[1] While questions *internal* to the model harness the expressive power of the deployed language, *external* questions relate to whether the very deployment of the language is worthwhile. Such questions are ultimately decided on pragmatic grounds

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[1] By describing entrepreneurs as artists, we invoke discussion of the world of art; by describing them as engineers, we invoke discussion of the world of engineering. Similarly, we can describe entrepreneurs as risk takers or visionaries.

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(Quine, 1951), based on whether the language provides a useful depiction of entrepreneurial practice and thus helps deal with incoming experience.

In this paper, I argue that the framework of entrepreneurs-*as*-scientists, portraying entrepreneurs as tasked with making precise and reliable inferences, and expressed in certain mathematical language, trivializes entrepreneurial practice. In the next section, I outline the framework proposed by Camuffo et al. (2020) and highlight the challenge of replacing the abstract notations of mathematical language with names from ordinary language of entrepreneurship. I then discuss how the co-opting of ordinary language for mathematical purposes distorts our understanding of business ideas, venture development, and entrepreneurial processes. The last section outlines pragmatic considerations for entrepreneurial scholarship, the limits of the entrepreneurs-*as*-scientist perspective, and the future as an untameable realm of perpetual novelty.

1. The framework

Camuffo et al. (2020) provide the most elaborate articulation of the scientific approach to entrepreneurial decision making in the form of a mathematical model. The model enables them to "theorize that a scientific approach to entrepreneurial decision making leads to superior inferential power, because it reduces false positives and false negatives compared with the typical decision heuristics followed by entrepreneurs" (p. 565). On this basis, the authors propose that entrepreneurs following a scientific approach are more likely to exit and pivot. These propositions receive empirical support in an impressive randomized control trial (RCT) study, in which the treatment group of entrepreneurs receive certain training to discipline their thinking. The study has been recently replicated on a larger scale (Camuffo et al., 2024). Notably, the interpretation of exit and pivot in these RCT settings as "better" outcomes rests on accepting the mathematical model that explains why following a scientific approach leads to superior inferential power in entrepreneurial decision making. Is this mathematical model a useful depiction of entrepreneurial practice?

In the setup of the mathematical model, Camuffo et al. (2020) make an opening linguistic move that – although intuitive at a first glance – proves problematic on closer inspection. Specifically, they state the following:

> "We study the early-stage decision of entrepreneurs who consider whether to develop a business idea. The value of the business idea is $v = \overline{v} + \varepsilon$, where $\overline{v}$ is the expected value of the idea and ε is a stochastic term … [that] captures factors exogenous to the actions and choices of the entrepreneur, such as states of demand, competition, technology, or other environmental conditions … If the entrepreneur develops the business idea, she will eventually observe the true value." (p. 6).

The key implicit conceptualisation in this passage is that a business idea is related to some ultimate, ***true*** value (v). The business idea is something that the entrepreneur considers before and during an entrepreneurial process, while the value is something that is revealed at the end of that process, once the idea is developed. Value, in this sense, reflects the evaluation as a going concern of the business venture into which an idea is developed: an operating venture will have a positive value and a failed or abandoned venture will have zero value. In other words, the above equation portrays a unique functional mapping of business ideas into ventures, and of ventures into (venture) values. We can thus speak of (1) an entrepreneurial function that transforms business ideas into ventures, and (2) a valuation function that transforms ventures into values based on their appraisal as going concerns. This is illustrated in Fig. 1. Different ideas are transformed into different ventures; and different ventures are transformed into different valuations.[2] Such mapping is consistent with a definition of venture idea as "an envisioned venture in and of itself, disregarding any agent with whom it may be associated" (Davidsson et al. (2021, p. 2).

At this point, we can set aside the valuation function (a core subject of financial economics) and focus on the entrepreneurial function. There are three key characteristics of this function as a mapping between ideas and ventures. First, it requires fine differentiation of business ideas. Second, it spans type of entity, turning abstract entities (business ideas) into concrete ones (ventures). Third, it is a time-extended object in that it spans the time it takes to transform or develop an idea into a venture. These characteristics pose significant challenges for the alignment of mathematical language of functions, integration, and differentiation, and the ordinary language of business ideas and ventures.

Language is indispensable for discussing ideas, ventures, and their mapping to one another as it is a means for expressing the content of thought. In this regard, Fig. 1 connects two different languages, namely the language of mathematics and ordinary language. In the ideal, formal language of mathematics, we deploy x, y, and $f(x)$ as abstract notations for variables and functions with which we can perform various operations. The names of the variables are arbitrary – "x" and "y" are just useful shorthand – and they have meaning only within the framework in which they are used; they are not meant to "connect" to the outside world (so to speak).

And herein lies a cognitive weakness that a magic trick can exploit. By giving a mathematical variable a name that is referentially significant in ordinary language, one can be led to believe that a mathematical model using the name somehow reaches outside of its scope. For example, if a triangle ABC were named "Switzerland", then talk about "the area of Switzerland" might produce some confusion. Thus, when Camuffo et al. (2020) interchange the variable name v with "the value of the business idea", one begins to think about business ideas in ordinary language terms. But there are important distinctions between "business idea" as used within a mathematical framework and as used in ordinary language.

[2] This does not prevent the valuations of different ventures from having the same value.

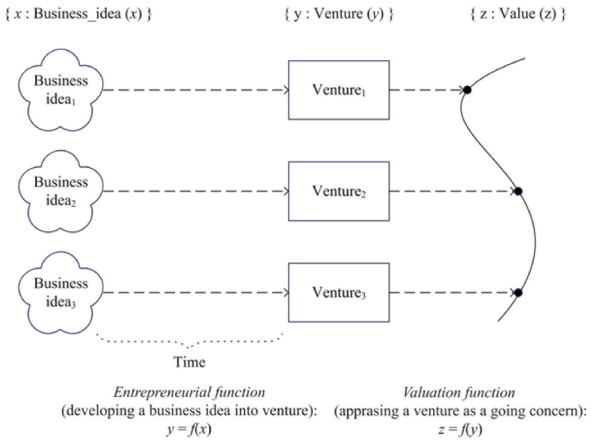

Fig. 1. Entrepreneurship as domain of mathematical functions.

2. X vs business idea

In both mathematical and ordinary language, we commit to the existence of business ideas by stating, "there is something which is a business idea". This is a general existence statement, in which the reference to "something" is made by a variable as an analogue to the pronoun "something which" (Quine, 1939).[3] This variable is associated with a realm of entities (business ideas), which constitutes the range of values for the variable. The range of values consists of all possible and distinct business ideas – an infinite set. Indeed, we might say that, to the extent that it can be articulated, any business idea is possible (as a business idea) – it is, after all, just an idea and thus an abstract entity that does not refer to anything physical. How we represent this infinite set is where mathematics and ordinary language begin to diverge.

In mathematical terms, we can simply speak of all distinct business ideas as the set of all x ($\{x\}$) in which no two individual members are identical and for which the number of members is infinite. Individual values can be named by using the notation x_i where i is an integer. Thus, x_{100} uniquely picks out the 100th member of the set. In ordinary language, however, each value is to be represented as a linguistic expression through which one can grasp a business idea: for example "a coffee shop at the corner of Broad Street and George Street in Bath, serving a range of hot drinks and fresh pastries". This expression can be given a unique name, e.g. "Coffeelicious", which could then be used to pick out this particular idea. It is insufficient to say, "I have a business idea" for this simply states that I have something in mind, without specifying what that is (i.e. which value from the range of possible values). In Quine's maxim, "no entity without identity."

While business ideas can be easily told apart in mathematical language by virtue of its abstract notation (e.g. x_{23} vs x_{316}), how can such distinction be made in ordinary language? There are two aspects to this problem: (1) the categories we use for making distinctions and (2) linguistic descriptions that convey a specific set of chosen categories. Broad categories such as 'bank', 'restaurant', 'shop' or 'manufacturing plant' provide a useful first step in making distinctions. But they are not enough, for many different businesses are lumped together within each category. Indeed, two businesses can be different in an infinite number of ways as we consider more and more categorical distinctions (product/services features, geography, street location, market segments, quality, etc.). However, we have to draw a line somewhere and ignore any further distinctions due to the linguistic burden of expressing what we have in mind.

Thus, unlike the high resolution that a mathematical set provides by simply stating that its members are distinct in ever more refined ways, the ordinary language set has a relatively low resolution: its distinctions are clear when one is sufficiently zoomed out, but become blurry when one zooms in. When we connect the high resolution "video" of the mathematical language to the low resolution "screen" of ordinary language, the high resolution is simply lost. Rather than the discrete cataloguing of business ides (and thus of possible futures) that the mathematical framework requires, we have at best a coarse lumping of what can be envisaged.

3. From abstract to concrete

Business ideas are abstract entities – they do not refer to anything physical, but to the concept of a possible business. For example, the idea of a coffee shop on a currently empty plot is meaningful and can be perfectly understood, but there is no coffee shop currently there. In contrast, ventures are concrete entities – there are various physical elements that make up an operating business. The move from abstract to concrete poses a new set of challenges.

Let's consider how each idea is to be developed into its corresponding venture. We could imagine that different entrepreneurs could take the above idea of "Coffeelicious" and turn it into differently performing ventures: some could develop a lacklustre brand, some could make bad coffee, some could offer bad pastries, some could provide bad customer service, and some could run inefficient operations. All these point to issues associated with the development process. It is one thing to have an idea of "great coffee" and an-

[3] In logical language, $\exists x$: x is a business idea.

other to actually make great coffee. If a prospective customer affirmed demand for "a great coffee place", this does not mean that they would like the atmosphere of a particular place or the taste of its coffee. This suggests that it is difficult to differentiate the idea as an abstract entity from the execution that turns it into a concrete offering – "the devil is in the details", as the expression goes. Thus, in Camuffo's equation, when an entrepreneur observes the value v at the end of the development process, v reflects not just the inherent merits of the idea but also how it is executed by the entrepreneur. As practitioners regularly point out, ideas are cheap, but execution is everything.

In mathematical terms, it is sufficient to say that idea x_i is developed into venture y_i, but in ordinary language terms we say that a venture is one of many possible materializations of the idea, given the inevitable ambiguity (coarseness) of how an idea is described. More broadly, the material and formal causes (in Aristotelian terms) of the eventual venture (Dimov, 2011) are left largely open: one could use different resources and different "templates" to materialize a given business idea. Thus, one can aspire to create a "high-quality" cereal bar or deliver "outstanding" broadband service while finding out eventually that what they offer is not good enough. This is not a problem of inference, but a problem of performance. It is not that one did not know what one needed to do, but that one could not deliver it.

Camuffo et al. (2020) highlight that science seeks to solve inferential problems, related to developing knowledge of the world as it is. Understanding what people want is thus an inferential problem. But delivering what they want is not. This is an engineering problem of production, of making things that work. When we add a layer of culture that captures what people value and how they live together in a society, then additional problems arise, related to persuasion, new meaning, affordances, etc. These are problems of art and design. Therefore, although entrepreneurs sometimes fail because they did not know, more often they fail because they could not make it work, could not communicate, or could not leverage existing practices. Entrepreneurs may be good scientists, but not good enough engineers, artists or designers.

It is notable that the lean start-up approach (Blank, 2006), which seems to have inspired the scientific entrepreneurship perspective largely overlooks the engineering, art, and design problems. The language of "customer discovery" as the main task of start-ups implies that there is a (broadly) ready solution looking for a problem. This is indeed an inferential problem of finding the person who wants the solution. At the same time, another popular methodology – design thinking (Brown, 2008) – can be best described as a problem looking for a solution. Here, there is no uncertainty on who the customers are – one is committed to solving a problem for a certain community. At issue is how this is to be done, which is a question of understanding the problem more closely and *making* the solution.

Unlike mathematical language, ordinary language recognizes that the moves from venture to business idea (concrete to abstract) and from business idea to venture (abstract to concrete) are qualitatively different. Abstraction entails the removal of detail from the concrete to reveal certain pattern or essence. In contrast, concretization or materialization entails the addition of detail to produce something tangible. Entrepreneurs need to be able to traverse in both directions: thinking what to make and making what they think.

4. Time extension

Another linguistic move by Camuffo et al. (2020) is to distinguish in the ultimate value of a business idea an expected value $\bar{v}$ that is free from possible exogenous contingencies (captured in the stochastic term ε) and thus attributable only to the series of actions and choices[4] by an entrepreneur in developing the business idea. This creates yet another clash between mathematical and ordinary language. Again, it is easy to speak of $\bar{v}$ and ε in mathematics, as these are non-referring terms that play a role of enabling certain operations within the mathematical framework. But when we give them names from ordinary language – entrepreneurial actions and environmental contingencies – we need to consider the practical limits of their referential power. To distinguish the results of actions as separate from any external contingencies in which such actions are undertaken is to isolate the entrepreneurial function from the specifics of the context in which it takes place.

In mathematics, this is easily done by the very specification of a function as a transformation from a set of inputs into a set of outputs. A function here is an abstract notion that dictates how certain operations are to be done and thus not a vehicle for reference. But when we call the function *entrepreneurial*, transforming business ideas into ventures – one located in the present and the other in the future – we are committed to a time-extended object, a process connecting present and future. Observing it at different points in time, and thus in different circumstances, we need to be able to say that this is the same process.

To posit a time-extended object is to presume certain identity (Quine, 1961). To illustrate what is at stake, Quine uses the example of the river Cayster (in Lydia in 400 BC) and the water that flows in it (a multiplicity of water molecules). Quine refers to the momentary stages – i.e. at a particular point in time – of river and water as *river stages* and *water stages* respectively. If a is the momentary stage of the Cayster at t_1, b is the momentary stage of the Cayster at t_2, and c is the momentary stage at t_2 of the water that was in the Cayster at t_1, it is clear that a, b, and c are variously related. The relationship between a and b is river kinship, while the relationship between a and c is water kinship.

By presuming identity of a and b, one fixes an ostensive reference for the river Cayster. Similarly, by presuming identity of a and c, one fixes an ostensive reference for a particular multiplicity of water molecules. In this sense, cueing Heraclitus, one can bathe in the same *river* twice, but not in the same *water* twice (unless one catches up with the water somewhere downstream). The point that Quine emphasises is "the direct connection between identity and the positing of processes, or time-extended objects. To impute identity rather than river kinship is to talk of the river Cayster rather than of a and b." (1961, p. 67).

[4] In what follows, I will use actions as a shorthand for actions and choices.

In Quine's example, we have an intuitive distinction between river and water. The river represents what is stable over time, while the water captures what is different. In the case of the entrepreneurial function, Camuffo et al. (2020) make a similar distinction between stability and variation in the ultimate value of a business idea: a stable term $\bar{v}$ for the actions of the entrepreneur and a stochastic term ε for the exogenous contingencies. The stable term is akin to a river in that it represents a pathway between a business idea and its future venture, outlining steps to be followed, just like the instructions for assembling IKEA furniture. The variable term is akin to the water in that it represents what actually happens along the pathway, which might prevent one from following or fulfilling the instructions.

The analytical move of assigning value – which is a property of concrete, future ventures – to present, abstract business ideas commits us to the existence of "rivers" that connect present and future, i.e. grooves to be followed as one sets out to develop business ideas, in which one has to endure the elements of exogenous contingencies. Just like the existence of infinite sets and imaginary numbers, the existence of such imaginary rivers can enable new mathematical operations. But even though these operations use entrepreneurial names, they are completely detached from experience and thus have no bearing on entrepreneurial practice.

5. Where does this leave us

Connecting the logical abstractions of mathematical language with the referential function of our ordinary language creates a clash that exposes different conceptions of the future: as something constructed within a framework or as something that lies outside of it. To deal with the future – which we intuitively grasp as something that will happen at a time yet to come – we need to speak about it. In this sense, the future is a sort of unknown territory and our language acts as a map. A choice of language for describing the future lies at the foundation of entrepreneurship theory since entrepreneurship is future-oriented activity. As scholars of entrepreneurship, our description of the future implicates certain conception of entrepreneurial practice, which may or may not resonate with entrepreneurs. We need to remember that "the map is not the territory" (Korzybski, 1933).

In constructing the future within a mathematical framework, one moulds it and tames it as a roadmap with precise destinations and defined routes. The map becomes the territory. Although there is a lot to be discovered within it, from the outside one appears to be looking at the future through a mirror. The magic of the entrepreneur-*as*-scientist – a promise of superior inferential power that enables us to reduce uncertainty and create value – is ultimately built on a domestication of the future and thus on trivial conception of entrepreneurial practice. It pulls the trick by giving mathematical models entrepreneurial names. Following the switch, we begin to think of business ideas as something into which we can zoom at high resolution, of ventures as a matter of deciding what to do, and of the entrepreneurial journey as a road trip with obstacles. In this we find ourselves unhooked from entrepreneurial practice.

Quine (1951) speaks of the totality of our knowledge as "a man-made fabric which impinges on experience only at the edges. Or, to change the figure, total science is like field of force whose boundary conditions are experience" (p. 39). Mathematical models, given their abstract nature, lie away from the edges of our knowledge – they do not hook directly onto the world. Their utility comes from their connection with the periphery, i.e. with activity that meets the flow of experience. The issue with the entrepreneur-*as*-scientist perspective is that such a connection is missing. It proposes a model of entrepreneurial reality but ultimately confines itself to the reality of its model.

The significance of entrepreneurial practice lies in accepting that the future – just like the horizon – always remains outside our attempts to bind it in language. It remains an outlet for our (unconstrained) imagination and thus a magnet for human aspirations. As entrepreneurship scholars, we can express solidarity with entrepreneurs by retaining awe of the future as an untameable realm of perpetual novelty and seeking to enhance the art and skill of entrepreneurial practice. Business ideas can be expressed only coarsely, materializing them into ventures is non-trivial, ambiguous task, and there are no pathways to be followed. Accepting these premises will ensure alignment of the "future" of theory and the "future" of practice. Once this is done, we can unleash the generative power of our theories (Munoz and Dimov, 2023), combining our ability to provide rigorous answers with our ability to ask potent questions. In this, the scientific perspective of entrepreneurship has an important role to play.

To develop the perspective, we need to connect it to experience and recognise it as one tool in a toolbox. This poses a number of questions. When should entrepreneurs act as scientists? When is precise inference the most pressing problem they should tackle? What are the things they should know reliably? It took James Dyson's 5127 prototypes and 15 years to perfect his idea of a bagless vacuum cleaner and find a workable business model (Kircher, 2016). The eventual success of the Dyson company is a triumph of engineering, science, art, and design. Entrepreneurship should embrace all of these.

CRediT authorship contribution statement

Dimo Dimov: Writing – review & editing, Writing – original draft, Visualization, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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