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- 20 related field? Nothing gives you better chances of getting it funded than planning your project updates in our *Dissemination corner!* With a similar spirit, you may want to inform the reasoning community about your recent or forthcoming book.
- 21 The [December 2021 issue](#) kicked off our new *Focussed Issues* – collections featuring solicited contributions on an exciting research area. The next Focussed Issue (on The History of Reasoning) is in the pipeline.
- 23
- 26 Last but definitely not least, if you share I.J. Good's view that "It is often better to be stimulating and wrong than boring and right", make sure that you submit your own contribution to *The Reasoner Speculates* section.
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- 27 Instructions about how to submit are available on [The Reasoner website](#).

[HYKEL HOSNI](#)
University of Milan

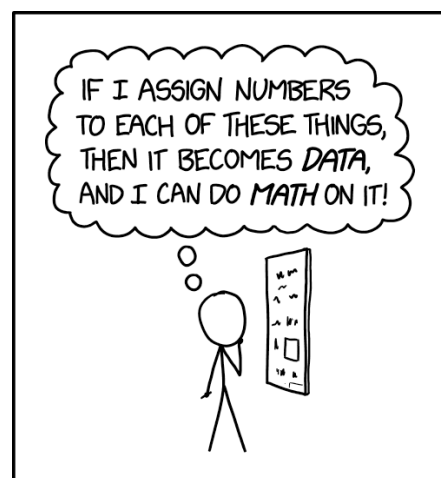
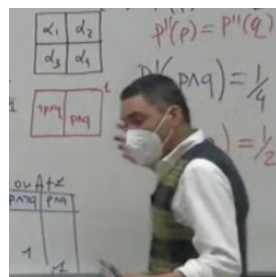
EDITORIAL

Dear Reasoners,

It is the time of the year when I think it is useful to remind you about the many ways in which can contribute to The Reasoner. *Interviews* are perhaps the most recognisable of its features. If you know someone with a particularly interesting take on reasoning-related research, both inside and outside the academia, why not interviewing them?

Another staple feature of The Reasoner is *What's hot in ...*. If your own field is not currently covered by our (semi)regular columns, have a think about it.

Are you unsure about what to put in the "dissemination" field of your brand new and groundbreaking project in a reasoning



THE SAME BASIC IDEA UNDERLIES
GÖDEL'S INCOMPLETENESS THEOREM
AND ALL BAD DATA SCIENCE.

BRIO

The notion of trustworthiness lies at the core of the European ethical approach to artificial intelligence (AI). To design, verify and develop trustworthy AI (TAI) is also the goal of the [BRIO project](#), financed by the Italian Ministry of Research and introduced to the Reasoner readers in the Dissemination corner of the January 2022 issue. The BRIO project aims at investigating means to avoid bias, mitigating risk and overcoming opacity. More precisely, this project focuses on developing design criteria for TAI based on philosophical analyses of trust combined with their symbolic formalization and technical implementation. In this second instalment of the BRIO Dissemination column for the Reasoner, we introduce the analysis of the epistemological and ethical components of trust, Objective 1 of the BRIO Project led by the [META group](#) (Social Sciences and Humanities for Science and Technology) at Politecnico di Milano. As trust is a multidimensional concept, and risks and biases may explicate epistemic as well as non-epistemic elements, the normative analysis provided by the tools of epistemology and philosophy of science is complemented with elements offered by applied ethics.

According to the [ethics guidelines for TAI](#), *prevention of harm* is one of the key principles to achieve trust, together with *respect for autonomy*, *transparency* and *explicitability*. There are several ways in which the prevention of harm can be concretely carried out, but one of the goals of the BRIO project is to focus on the identification and mitigation of risk at both the data



and algorithmic level. The reason is that the notion of risk lies at the centre of the current *Artificial Intelligence Act*, the first ever proposed regulation of AI delineating a legal framework at the European level to make sure that “Europeans can trust the AI they are using” ([Artificial Intelligence Act 2021](#)). The very strong connection between trust and risk is clearly evident, and it is worth noting that, in this framework, risks are categorized into four levels: *unacceptable risk*, *high risk*, *limited risk* and *minimal risk*. Unacceptable risks, which are those contravening the European Union values (e.g., practices that have a significant potential to manipulate persons through subliminal techniques beyond their consciousness), are prohibited. The other types of risks are defined and managed according to the lines and rules set up by the framework. However, the very notion of risk is not fully articulated from a conceptual point of view, notwithstanding its importance in this scenario.

Risk can be defined in different ways. A classical definition of risk conceptualizes it as the probability of an adverse event being evaluated in conjunction with its consequences in a specific lapse of time (Royal Society 1983: *Risk assessment: report of a royal society study group*. Royal Society, London). This classic idea of risk lies at the core of probabilistic risk as-



essment, where the confidence of probabilistic estimations makes predicting and evaluating the consequences of an adverse event possible. Unfortunately, the probabilistic risk assessment of technologies is not always possible and is certainly very difficult in the case of AI technologies, which operate today mostly under high-risk conditions. For this reason, AI can be characterized as an *experimental technology* whose risks and benefits are not only hard to estimate and quantify, but sometimes are also unknown (van de Poel, I. 2016: “[An Ethical Framework for Evaluating Experimental Technology](#)” *Science and Engineering Ethics* 22: 667-686). This is due to, at least, two different levels of uncertainty: one relative to the complexity of the technical artefacts themselves, which is constantly augmenting with the increasing use of machine learning techniques, another relative to the environment, given that AI systems need to interact with other complex technical artefacts and human beings. These two levels of uncertainty often make it very difficult to anticipate and predict possible issues that emerge when AI systems operate within complex environments. This makes it essential to also consider those forms of risk that may resist to (probabilistic) quantification, also known as *uncertainty* (Knight, F.: *Risk, Uncertainty and Profit*. Boston: Houghton Mifflin), that interest experimental technologies like AI.

Dealing with these forms of risk and uncertainty is not only a matter of developing the appropriate technical tools but also of recognizing, as a first step, the multifaceted nature of uncertainty and its lack of uniformity. In a recent article, Sven Ove Hansson discussed different formal models to represent various types and aspects of uncertainty, claiming that it is not possible to have a one-size-fits-all formalization (Hansson, S., O.: 2022 “[Can uncertainty be quantified?](#)” *Perspectives on Science* 30: 210-236). These different types of uncertainty, together with a clear attempt at a taxonomy of them, represent a promising starting point for conceptual analysis, paving the ground for the formulation of epistemic and normative principles for TAI, which is one of the aims of the BRIO project. Moreover, it is important to recognize that this type of uncertainty is connected with so-called “wicked” problems, which are difficult to formulate consistently and sharply, as their understanding and resolution are strictly connected. Many problems in AI have this nature, for example, those concerning decisions of AI policy (Nordström, M. 2021: “[AI under great uncertainty: implications and decision strategies for public policy](#)” *AI & Society*). For this reason, given the complexity and generality of the notion of the wicked problem, it might be interesting to investigate the different types of uncertainties associated with the problem. One possibility is to determine the types of epistemic uncertainties relevant for AI technologies and the determinants of uncertainty, such as the *scale* (local or global) and the *source* (impersonal, individual and collective) (Chiffi, D. & Curci, F.: 2022 “Types of Uncertainty” *New Metropolitan Perspectives*. Cham: Springer, forthcoming). This is one of the first steps the BRIO project will take to deal with those forms of uncertainty that are nonformalizable and non-quantifiable.

Coping with uncertainty is a way to increase trust in AI. Trust is becoming of paramount importance in our societies, where many decisions affecting people’s lives are made with the increasing support of AI systems. Technical solutions are not enough, as it is not always possible to model all important aspects concerning risk and uncertainty in advance, given that some emerge during the use and interaction of AI technologies.

Additionally, neither ethical guidelines nor frameworks are sufficient, as they are very abstract and sometimes lack concrete hints on how to deal with specific problems. A real integration of conceptual analysis—exploiting the strengths of both epistemology and ethics—with the design of an appropriate solution is needed. The BRIO project aims at this integration and acknowledging the intrinsic complexity of these elements, while addressing them with different conceptual tools, is the first step.

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EXPRESS

In the study of language, assertion often occupies center stage. Rejection has traditionally been given a supporting role: the assertion that something is not the case. Seen in this light, rejecting a claim such as (1) simply amounts to asserting (1).

1. a There is intelligent life on other planets.
- b There is no intelligent life on other planets.

There are good reasons to think that rejection and negative assertion are not the same though. To reject (1) for lack of evidence, for example, we need not fully commit to (1). The aim of the **EXPRESS Project** is to study rejection on its own, without reducing it to negative assertion. The theory and logical framework thus developed will be used to establish a new approach to semantics, which ties together the inferential potential of an expression with the speech acts performed by its use. We work at the intersection of philosophy, logic, formal and computational linguistics, exploring several open questions that receive refreshingly new treatment if we approach them using rejection as an analytical tool rather than an appendix to the theory of assertion.



An example of the fruitfulness of this approach is the work I carried out with my co-authors (L. Incurvati and F. Carcassi). We looked at a topic of long-standing philosophical interest: logical expressions in natural language. Among the connectives, English contains conjunction *and*, disjunction *or*, and rejected disjunction *nor*. Linguists have found that no language contains a simple word to express the rejection of conjunction (*nand*). Some languages contain fewer operators than English, but no language is known that contains words for any of the other connectives easily definable in classical propositional logic (the material bi-conditional, exclusive disjunction, and so on). This is surprising: what’s so special about *and*, *or*, and *nor*? Apparently, there is nothing logically “defective” about connectives that are not lexicalized. Yet, this puzzle might teach us something important about logic in cognition: children learning a language have to memorize the words stored in the lexicon and learn to express the rest by grammatical combination.

Our hypothesis is that assertion and rejection are both fundamental to the explanation. We analyze them as belief revision operators. From this perspective, linguistic communication is a cooperative enterprise of shared belief update. By asserting ‘Amsterdam is pretty’, speakers assign high plausibility

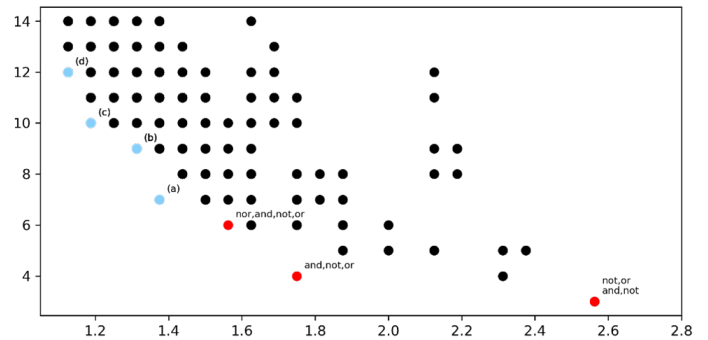


Figure 1: Each dot is a possible language (a combination of connectives), and note that several dots overlap. On the vertical, the complexity of the connectives as belief revision operations; on the horizontal, the complexity of combining the primitives. The naturally attested languages are red dots, occurring on the Pareto frontier of the two dimensions: these are optimal solutions to the problem of achieving both simple and effective communication.

to possible worlds in which Amsterdam is pretty, whereas by rejecting ‘Amsterdam is pretty’, they assign low plausibility to the same worlds. Belief is then revised by restricting attention to the “best” possibilities: the most plausible worlds. On this view, the connectives combine belief revision operations. Suppose for example that p is asserted and then q is asserted: the p -worlds are deemed highly plausible, the less plausible *not-p*-worlds are eliminated, then the q -worlds are deemed highly plausible, and the less plausible *not-q*-worlds are eliminated. As a result of this combination, no possibilities remain in the interlocutors’ belief set on which p or q are false. Indeed, this sequence of actions characterizes the conjunction p and q .

The belief revision view of the connectives, in which assertion and rejection are two types of update, motivate a picture according to which the familiar lexical connectives (*and*, *or*, *nor*) are characterized by simpler epistemic operations than the others. In order to define any other connectives, additional primitives must be added (i.e., additional operations on belief) and so, presumably, more complexity.

It seems that for this reason *and*, *or*, and *nor* are more likely to appear in natural language. The explanation however is not complete. In principle, two languages could work equally well for the purposes I described: one language based on a large set of simple primitives, and another based on a smaller set of more complex primitives. In other words, the disadvantages of complexity in the dimension of belief update could be compensated by having fewer primitives. However, having fewer primitives also means having to combine them more in order to convey the same information. For example, speakers of a language that contains $\{and, not\}$ but not *or* will have a harder time expressing p or q than English speakers: they will have to assert the convoluted *not both not-p and not-q*.

By comparing these two measures of complexity, we can show that languages optimize between them: languages are systems that, on the one hand, minimize the complexity of the connectives as belief update operations, and on the other hand, minimize the complexity induced by combining their primitives. The results are shown in Figure 1.

Logical expressions in natural language have long attracted

the attention of philosophers, linguists, and logicians. Not all operators that can be defined by common logical standards have equal status in natural language. We have looked at what might explain the puzzling distribution of connectives in world languages. The answer, we submit, has to do with a dynamic and doxastic conception of logic, tied to belief update, in which we can formalize the idea that assertion and rejection are on a par. This is a simple illustration: there are many other questions in language, cognition, and reasoning, that we can investigate with fresh new insight if both assertion and rejection are taken in as tools for analysis.

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WHAT'S HOT IN . . .

Uncertain Reasoning

Logic and Probability have a turbulent history of marriage, separation and getting back together. As it may be perhaps already known to the readers of *The Reasoner*, one of the first works on modern mathematical logic, namely Boole's Laws of Thought, treated in a unified manner logic and probability. The marriage was not an easy one, though, and Boole's approach is notoriously flawed, as shown in particular by Hailperin (1976: *Boole's Logic and Probability*, Elsevier). Few decades afterwards, the focus in mathematical logic was shifting from the general investigation of patterns of inference, to the foundations of mathematics. In this kind of endeavour, uncertainty and probability had little if no role to play.

The last years have seen however a call for reconciliation of logic and probability. This is hard to underestimate in Artificial Intelligence, where merging probabilistic and logical methods is a fundamental challenge for the integration of symbolic and subsymbolic approaches, De Raedt et al.(2016: *Statistical Relational Artificial Intelligence*, Morgan & Claypool), S.Russell (2015: *Unifying Logic and Probability*, Communications of the ACM, 88-97). Also in philosophy, an important trend has been attested in the last years towards the use of probabilistic methods, in addition to logical ones, see Fletcher et al. (2021: *Changing Use of Formal Methods in Philosophy: Late 2000s vs. Late 2010s*, philsci-archive.pitt.edu/19575/).

Kyburg is one of the major figures in the study of the interaction of probability and logic. His well-known "lottery paradox" illustrates problematic aspects at the interface of qualitative, (non-monotonic) logic-based and quantitative, probabilistic-based representations of belief. Less known is his system, developed in collaboration with C. Teng, for representing uncertain inference, on the basis of statistical information, Kyburg and Teng (2001: *Uncertain Inference*, Cambridge University Press). To illustrate how this handles the connection between probability and logic, let me first contrast it with a different, perhaps more familiar approach.

There is a long tradition of investigations connecting proba-

bility and logic, centered around the idea that probabilities are to be taken as rational degrees of belief in a formula, and that uncertain inference is to be construed as the update of such degrees. More concretely, given a prior degree of belief in a hypothesis, if some further information (i.e. data) is provided, an inference is just the computation of the posterior probability of the hypothesis, given the data, using Bayes' theorem. Once a prior belief is settled, this is a sharp procedure, determining the degree to be assigned to a formula.

Kyburg and Teng's system proceeds differently, in alignment with frequentist approaches to statistical reasoning. Here a concept of evidential probability is put forward, which is based *only* on known frequencies. Furthermore, evidential probabilities are required to take into account *all* the available statistical information about an event of interest.

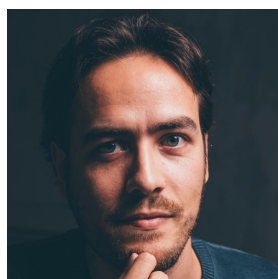
Evidential probability is taken as a guide for "safely jumping to conclusions", i.e. for adding new, risky, beliefs, on the basis of evidence. Inference is here uncertain and the system is non-monotonic, since new information may lead to retract risky conclusions. On the other hand, the evidential probability is not to be identified with degrees of belief: it is here a binary issue whether a formula is added or not to one's stock of belief, and may then be used as a basis for decision or further inferences.

More concretely, Kyburg assumes that probabilistic information is presented in the form of intervals of frequencies (e.g. "between one third and one half of a population is taller than 1,70m"), and that conflicting information needs to be handled applying few general principles, before endorsing risky conclusions.

Let me illustrate the functioning of the system and one such principles with an example. Assume you want to assess whether Luca is vaccinated against Covid-19. If all you know is that Luca is Italian, and that 84 % percent of the Italian population is vaccinated, you may be inclined to judge such proportion high enough, and add the (risky, revisable) proposition that Luca is vaccinated to your stock of information. Afterwards, however, you find out that Luca is 5 years old, and that 34% percent of the population in the range 5-11 years old is vaccinated. Since this is a smaller reference class, it makes sense to give this new information priority in your assessment, and lead you to reasonably retract the belief that Luca is vaccinated.

The example illustrates how selecting a suitable reference class is essential for uncertain inference: when conflicting frequencies concerning an individual are available, one is required to discard the information concerning the less specific reference class. The latter information is said to be *sharpened by specificity*. Furthermore, when frequencies concerning a marginal and a joint distribution conflict, one has to discard the marginal, which is said to be *sharpened by richness*. One has then to remove information that provide broader, hence less precise frequency intervals, which are said to be *sharpened by precision*. Finally, the evidential probability associated to a formula is determined by picking an interval covering all the survived frequency intervals. If the resulting interval is above a certain threshold, the formula is accepted.

The system allows to reconstruct classical statistical methods in a logical setting, and I believe that it deserves larger appreciation. While its strictly frequentist interpretation of probability may be unappealing to some, its insights may be embedded also in different approaches to probabilistic logic, see e.g. Haenni et al. (2011: *Probabilistic Logic and Probabilistic Networks*, Springer). Another obstacle to its diffusion may be in



the formal apparatus and the terminology employed, which is in some places rather idiosyncratic. I believe that important insights in its principles, and a simplification of the language may be attained by devising a system admitting intermediate degrees of truth in the semantics. These need not be related to vague propositions, but may be neatly used for representing frequencies. As it was shown recently, Baldi, Cintula, Noguera (2020: Classical and fuzzy two-layered modal logics for uncertainty: Translations and proof-theory, IJCIS, 988 - 1001) in the setting of a different probability logic, intermediate degrees of truth may indeed be a helpful formal device to simplify the language of probabilistic logics, at the price of enriching its semantics with a richer, non-classical, basis.

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Mathematical Philosophy

The debate about *logical exceptionalism* aims to settle whether and in what respects logic is unique among the sciences. Traditionally, exceptionalists (e.g. Frege) have held that logical truths are special in that they're epistemically foundational, analytically true and knowable a priori, while anti-exceptionalists (e.g. Quine) have upheld a view of logic as revisable and continuous with other sciences.

In a recent paper, Gil Sagi defends an alternative version of exceptionalism that doesn't presuppose the Fregean foundational picture ("[Logic as a Methodological Discipline](#)", *Synthese* 2021). On this view, what makes logic special isn't its allegedly privileged epistemic status, but rather its role in providing a *methodology* for science. Physics, psychology, economics and the rest turn to logic to obtain tools for correct deductive reasoning, and not vice versa. As Sagi shows, this conception of logic predates the exceptionalism debate—it harks back to the Aristotelian view of logic as a tool or *organon* for scientific inference—and it can appeal to traditional exceptionalists and anti-exceptionalists alike, since it makes no controversial claims about the nature of logical knowledge.

What makes a given discipline methodological, according to Sagi, is that it "produces tools, methods or a methodology for some practice" (9736). Logic fulfills these criteria because it provides formal languages for representing scientific claims and methods for reasoning with such formalisms. Other disciplines—statistics or Bayesian inference theory, say—may sometimes play a methodological role with respect to particular sciences, but logic is unique in that its methods apply to any science whatsoever.

This characterization might seem apt enough for the branches of logic concerned with the representation of natural-language sentences and arguments; it's certainly plausible that every science relies on reasoning in this form. What's less clear is that the characterization applies to modern *mathematical* logic in all its abstractness, sophistication and variety. Sagi tries to meet this challenge by arguing that even a paradigmatically mathematical subject like model theory can be understood to play a methodological role. For instance, model-theoretic methods have proven useful in linguistics, computer science, philosophy, and other branches of mathematics.

True and interesting as this last claim is, though, one might wonder whether it actually amounts to a partial admission of defeat. The hallmark of logic for Sagi was supposed to be

its universal methodological relevance—the fact that every science depends on its tools and methods. Model theory, on the other hand, seems directly relevant to only a handful of sciences. (Geology, gerontology and genomics seem to be getting on fine without invoking quantifier elimination or the stability hierarchy.) So it's hard to see how model theory counts as exceptional in Sagi's methodological sense.

To avoid this outcome, Sagi could of course reclassify model theory as non-logical; it wouldn't be crazy to call it a branch of mathematics instead. But doing so would be at odds with logicians' own reckoning. And it's perhaps unclear where to draw the line between mathematics and logic even if one wanted to.

Actually, while we're on the subject: is *any* branch of mathematics methodologically universal in Sagi's sense? Not all the sciences rely on differential geometry or Fourier analysis, but basic arithmetic, at least, seems inescapable. I'm unsure whether this is a problem for Sagi. Is his view that logic alone is exceptional in the relevant sense (as the name 'exceptionalism' would seem to suggest)? For a traditional exceptionalist like Frege, note that this question doesn't arise, since the logicist component of that ideology declares arithmetic to be part of logic. But I doubt that Sagi is a logicist. So he'll have to address this issue somehow.

Sagi's paper isn't the only work on this topic in recent years—see also Hjortland and Martin's "[Anti-exceptionalism about logic as tradition rejection](#)" (*Synthese* 2022), McSweeney's "[The cost of closure: Logical realism, anti-exceptionalism, and theoretical equivalence](#)" (*Synthese* 2021) and Read's "[Anti-exceptionalism about logic](#)" (*Australasian Journal of Logic* 2019). I don't have the space to discuss these fine papers here, unfortunately. But stayed tuned for more hot takes on exciting new philosophy of logic in my next column.

WILLIAM D'ALESSANDRO
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Multidisciplinary Reasoning

A debate between pessimism and optimism structures the analytic landscape of cultural studies. There's a question of how to formalize an account for a physical, material, connection between models and the cultural phenomenon they explain. A connection between information and knowledge allows us to treat



pessimism as a physical entity. The mathematical theory of information utilizes entropy to discuss the reduction of alternatives with each signal. We'll consider the capacity to convert information to knowledge through an encoding/decoding process. A relation between features of experience is encoded, indexing a concept. That frame is projected into subsequent contexts, organizing future experience so that the output received from using that frame can be decoded with respect to previously encoded concepts. Analog experience, amplitudes of sensation registering over thresholds calibrated by past experience, is converted into decidable (=digital) categories (=encoded concepts). These categories are updated as prior cognitive output organizes what is of interest later on. Deciding on a category forgoes extraneous information. What we gain from that loss of information is the capacity to

manipulate our environment. Our primary concepts adapt, are associated and combined, to form more complex systems as our cognitive output organizes what future phenomenal input comes available relative to output from prior actions.

The concept of knowledge, then, is information produced belief. (Dretske, Fred: 1981, "Knowledge and the Flow of Information," Basil Blackwell) Information travelling over some channel is encoded as one thing despite that signal carrying other information. Only some features of that signal encodes a concept for the receiver. However, concepts can be applied in a way that one can generate false beliefs, despite, with respect to the encoding/decoding mechanism used, that concept being correct for that subject given the conditions to which it was previously indexed. How can the receiver *know* with *certainty* that the object of their belief is the case?

Information theory models the reduction of possibilities of a set of options over a channel. Given 10 options, each yes/no decision reduces alternatives. Ten options carry with it +3bits of information as it takes 3 rounds of questions to reduce alternatives to approximately 1. The link between probability and information means that this connection models that of entropy.

We shouldn't conflate information with meaning. Meanings can evolve. Information's objective. The connection between information (=input) and knowledge (=output) via the encoding of information is a concept that when projected into a domain organizes what input is available for the de/re-encoding of that domain in terms relevant to the receiver. Thus,

A subject *S* knows *a* is *F* if and only if *S*'s belief that *a* is *F* is caused (sustained) by the information that *a* is *F*.

The concept, "*x* is *F*," encodes information indexing that concept to the conditions in which *F*-propositions apply. What *is F* depends on the relation an object obtains in the context in which it appears, satisfying *F*-conditions although possibly appearing differently from what *F* was abstracted from originally. The object of that proposition is its function of its application. So,

A function *f* determines an objective relationship where *x* indexes a set of conditions and *y* (=x-successor) indexes a context of application, such that the pair (*x*,*y*) are members of *f*. When *x* indexes conditions and the pair (*x*,*y*) and (*x*,*y*-successor) are both members of *f*, then that *y* and *y*-successor are functionally-equivalent.

Functions are abstract objects. Indexing a concept's conditions of application, *f*(*x*)=*x* encodes *X* at its zero, i.e. prior to use, and determines what counts in an *X*-domain. As such, *X*(0)=*X*. Some *X*-proposition, an *X*-successor=*X*₁, references the conditions of its application through a line of citation up to *X*_{*n*}. If *Y* represents a context of assertion, and if *X*₁ ≠ *X*, therefore *X*₁=*Y*, then when *Y* of *X*, *X* is the name of the concept and *Y* the context of application. As such, *Y*(*X*) is appropriate. Functional-equivalence explains how the same function obtains of different things across contexts, the same thing different functions.

The information that *X* is the case is calculated by the average contribution of each *x*_{*i*} contributing to the amount of information *X* carries. But how do we know which *x*? Can we be 100% certain? Uncertainty seems foundational for knowledge.

If a concept is applicable universally, it contributes no new information. We *know* not where and when it applies. An alternative with 0% possibility is undefined, cannot produce knowledge. Informationally, absolutism leads to cynicism. Certainty annihilates information.

We treat pessimism physically by considering it an informational channel. Speaking with poet Donovan Munro, etymologically, pessimism marks the greatest point of corrosion within that channel. For pessimists, the investiture of significance by the receiver fails, causing a collapse of certainty. (Gilroy, Paul: 2004, *After Empire*, Routledge, 6) Cynicism towards information results, producing nihilism.

Consider optimism (= alternatives must exist) and pessimism (= alternatives must not exist). Both attribute 100% certainty towards existing alternatives within/to a state of affairs. An informational paradox arises. No new information is generated by an event with no alternatives. Consider,

An *S*-expression (*s*_{*i*}) such that the probability *p* of *s*_{*i*} approaches unity with the state of affairs itself, i.e. approaches 1, makes log*p*(*s*_{*i*}) go to 0.

If a state is necessarily determined one way, then regardless of how often that state's produced, if coupled with the decision that it can be no other way, then no information is associated with that state. As information sustains what we know, and it is by what we know that we invest a state with meaning, the annihilation of knowledge by virtue of absolute certainty entails that no meaning is possible. The road to nihilism from cynicism passes through pessimism. (To be continued.)

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smbc-comics.com

EVENTS

MAY

SLACRR: St. Louis Annual Conference on Reasons and Rationality, St. Louis, Missouri, 22–24 May.

WPOS: British Twentieth Century Women Philosophers on Science, Durham University (and online), May/June.

JUNE

TRUTH: Truth 2022 Online Conference, virtual, 13–16 June.

TRUSEM: Truthmaker Semantics: What, What for and How? University of Geneva, 19–20 June.

INEP: Institutional Epistemology Workshop, University of Helsinki (and online), 20–21 June.

RR&A: Syracuse workshop on Reasoning, Reasons and Agency, King's College London, 23–24 June.

CITLS: New Perspectives on Causation in the Life Sciences, University of Kent, 27–28 June.

TAD: Fact and Fiction, Trust and Distrust, Tilburg University, 29–30 June.

JULY

IRSI3: 3rd International Rationality Summer Institute, Landau, Germany, 24 July–5 August.

PCCR: Parameterized Complexity of Computational Reasoning, Haifa, Israel, 31 July–1 August.

KR: Principles of Knowledge Representation and Reasoning, Haifa, Israel, 31 July–5 August.

AUGUST

BMA: Bayesian Modelling Applications, Eindhoven, Netherlands, 5 August.

SCI PROG: Scientific Progress: Individual and Collective, Amsterdam, 24–26 August.

HPSM: MA in the History and Philosophy of Science and Medicine, Durham University.

MASTER PROGRAMME: in Statistics, University College Dublin.

LOPHISC: Master in Logic, Philosophy of Science and Epistemology, Pantheon-Sorbonne University (Paris 1) and Paris-Sorbonne University (Paris 4).

MASTER PROGRAMME: in Artificial Intelligence, Radboud University Nijmegen, the Netherlands.

MASTER PROGRAMME: Philosophy and Economics, Institute of Philosophy, University of Bayreuth.

MA IN COGNITIVE SCIENCE: School of Politics, International Studies and Philosophy, Queen's University Belfast.

MA IN LOGIC AND THE PHILOSOPHY OF MATHEMATICS: Department of Philosophy, University of Bristol.

MA PROGRAMMES: in Philosophy of Science, University of Leeds.

MA IN LOGIC AND PHILOSOPHY OF SCIENCE: Faculty of Philosophy, Philosophy of Science and Study of Religion, LMU Munich.

MA IN LOGIC AND THEORY OF SCIENCE: Department of Logic of the Eotvos Lorand University, Budapest, Hungary.

MA IN METAPHYSICS, LANGUAGE, AND MIND: Department of Philosophy, University of Liverpool.

MA IN MIND, BRAIN AND LEARNING: Westminster Institute of Education, Oxford Brookes University.

MA IN PHILOSOPHY: by research, Tilburg University.

MA IN PHILOSOPHY, SCIENCE AND SOCIETY: TiLPS, Tilburg University.

MA IN PHILOSOPHY OF BIOLOGICAL AND COGNITIVE SCIENCES: Department of Philosophy, University of Bristol.

MA IN RHETORIC: School of Journalism, Media and Communication, University of Central Lancashire.

MA PROGRAMMES: in Philosophy of Language and Linguistics, and Philosophy of Mind and Psychology, University of Birmingham.

MRES IN METHODS AND PRACTICES OF PHILOSOPHICAL RESEARCH: Northern Institute of Philosophy, University of Aberdeen.

MSc IN APPLIED STATISTICS: Department of Economics, Mathematics and Statistics, Birkbeck, University of London.

MSc IN APPLIED STATISTICS AND DATAMINING: School of Mathematics and Statistics, University of St Andrews.

MSc IN ARTIFICIAL INTELLIGENCE: Faculty of Engineering, University of Leeds.

MSc IN COGNITIVE & DECISION SCIENCES: Psychology, University College London.

MSc IN COGNITIVE SYSTEMS: Language, Learning, and Reasoning, University of Potsdam.

MSc IN COGNITIVE SCIENCE: University of Osnabrück, Germany.

MSc IN COGNITIVE PSYCHOLOGY/NEUROPSYCHOLOGY: School of Psychology, University of Kent.

MSc IN LOGIC: Institute for Logic, Language and Computation, University of Amsterdam.

MSc IN MIND, LANGUAGE & EMBODIED COGNITION: School of Philosophy, Psychology and Language Sciences, University of Edinburgh.

MSc IN PHILOSOPHY OF SCIENCE, TECHNOLOGY AND SOCIETY: University of Twente, The Netherlands.

MRES IN COGNITIVE SCIENCE AND HUMANITIES: LANGUAGE, COMMUNICATION AND ORGANIZATION: Institute for Logic, Cognition, Language, and Information, University of the Basque Country (Donostia San Sebastián).

OPEN MIND: International School of Advanced Studies in Cognitive Sciences, University of Bucharest.

COURSES AND PROGRAMMES

Courses

CIe: Computability in Europe 2021: Connecting with Computability Tutorials, 5–9 July.

LAIS: Logic for the AI Spring, 12–16 July.

Programmes

MA IN REASONING, ANALYSIS AND MODELLING: University of Milan, Italy.

APHIL: MA/PhD in Analytic Philosophy, University of Barcelona.

MASTER PROGRAMME: MA in Pure and Applied Logic, University of Barcelona.

DOCTORAL PROGRAMME IN PHILOSOPHY: Language, Mind and Practice, Department of Philosophy, University of Zurich, Switzerland.

DOCTORAL PROGRAMME IN PHILOSOPHY: Department of Philosophy, University of Milan, Italy.

LOGICS: Joint doctoral program on Logical Methods in Computer Science, TU Wien, TU Graz, and JKU Linz, Austria.

RESEARCH MASTER IN PHILOSOPHY AND ECONOMICS: Erasmus University Rotterdam, The Netherlands.

JOBS AND STUDENTSHIPS

LECTURER: in Logic and/or Philosophy of Science, King's College London, deadline 2 May.

Studentships

DOCTORAL PROGRAMME IN PHILOSOPHY: Language, Mind and Practice, Department of Philosophy, University of Zurich, Switzerland.

LOGICS: Joint doctoral program on Logical Methods in Computer Science, TU Wien, TU Graz, and JKU Linz, Austria.