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Hybrid frameworks of reasoning: normative-descriptive interplay

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Abstract

The investigation of reasoning involves the study of what is rational as well as the empirical study of human reasoning. We are interested in rational answers to reasoning problems but also in the way human reasoning works. While the first aspect is typically covered by logic or formal epistemology, the second is a matter of empirical psychological research. However, many approaches relate both aspects. This paper discusses these hybrid approaches, their motivation, general criticism that has been raised against them as well as the kind of philosophical commitment behind choosing such kind of framework.

Keywords: Normativism, Bayesianism, Carnap, Frameworks

Introduction

Hardly anything seems as obvious as the fact that humans are not perfectly rational. Accordingly, there is a difference between the inferences and beliefs one is willing to ascribe to logical omniscient and perfectly rational agents and those we would expect to occur in human beings (or other animals). The study of the former belongs to the domain of logic and formal epistemology and is dominated by analytic arguments. It is normative in the sense of an evaluation of good and rational reasoning versus flawed reasoning. The descriptive side of reasoning is addressed by behavioural science and a matter of empirical research. However, when we look at cognitive science research in the last decades, we see combinations and interactions between normative and descriptive approaches.

Analytical and computational analysis is highly influential in the empirical study of cognition. Examples are computational level explanation (Marr, 1982), rational analysis (Anderson, 1990), and ideal observer models (Geisler, 2003). While all these approaches are embedded in an overall descriptive research, they include a formal analysis of optimal solutions to a certain task. They are *not* mathematical formulations of descriptive facts (as many laws in science are), but use formal methods to address questions of adequacy, functionality and potential optimal solutions to cognitive tasks. The prominence of such normativist approaches peaked in Bayesian cognitive science (Tenenbaum, Kemp, Griffiths, & Goodman, 2011), a trend not without critics (Bowers & Davis, 2012; Jones & Love, 2011).

While optimal-solution-based research can be found in all areas of cognitive science, reasoning and argumentation research is a quite salient domain in this respect. There are disciplines such as logic and epistemology that explicitly deal

with the normative aspects of reasoning, argumentation and belief formation, which makes the normative-descriptive interplay even more influential since it involves several well-established fields of research impacting behavioural science or being impacted by it.

At the same time, many logicians and (formal) epistemologists advocate a *cognitive turn* in their field of study, with considerable interest in connections between normative systems and psychological findings (Leitgeb, 2008; Schurz & Leitgeb, 2005; van Benthem, 2008; Douven, Elqayam, & Krzyżanowska, 2022). This trend stands in contrast to the earlier Fregean anti-psychologist dogma (Frege, 1884), dominant in 20th century logic, according to which logic is not to be confused with a study of (human) thought.

To summarise, the distinction between normative and descriptive research on cognition has become less strict on both sides, empirical science and normative analysis. At the same time, the normative-descriptive interplay seems problematic from a conceptual perspective. It is a well-known insight from Hume (1740) that one may not infer from one to the other. The aim of this paper is to address this conflict by investigating *hybrid approaches* in the research of reasoning and argument. By ‘hybrid’, we mean research that combines normative and descriptive aspects. The majority of these approaches are Bayesian (Hahn & Oaksford, 2007; Oaksford & Chater, 1994, 2007) or at least concerned with probabilities (Pfeifer & Kleiter, 2005; Pfeifer, 2021). However, there are also hybrid approaches that are not probabilistic, but based on logic (Stenning & Van Lambalgen, 2012) or other frameworks, such as conceptual spaces (Osta-Vélez & Gärdenfors, 2022).

In the first part of the paper, we will look at the motivation and achievements of hybrid approaches and critical responses to them. In the second part, we will take a more general perspective by analysing the approaches and their critiques from a Carnapian perspective and discussing the role of philosophical commitments.

Virtues and vices of a separation

To understand the motivation behind hybrid approaches, it is necessary to have a look at the benefits and limitations of strictly separating the normative and the descriptive realm.

The separation from psychology was an essential aspect in the development of modern logic as a mathematical disci-

pline. Frege (1884) as well as many other scholars of modern logic turned against a psychological notion of logic (see Kusch, 2020). As a theory of *correct* reasoning, logic cannot be based on empirical facts. Logical criteria such as truth-preservation do not refer to psychological facts, and they are in principle applicable to arguments no one even had thought about. Psychology, on the other hand, developed into a science that is mainly concerned with empirical facts about the human mind. The criteria for evaluating normative and descriptive models are thus entirely different. From this perspective, it seems quite appropriate to keep the empirical and the analytical normative realm separated, as argued by Elqayam and Evans (2011).

On the other hand, several anti-psychological arguments from the early days of mathematical logic are no longer convincing. For instance, the claim that there is only *one* correct norm of reasoning, but many intuitions has fallen out of time in view of the contemporary plurality of logical and probabilistic systems of reasoning. Rather the multitude of normative systems now raises the question of psychological relevance: Which of the many logics and other formal systems of reasoning is *the one* we should view as relevant for evaluating human thought? It also needs to be doubted whether separation from psychological facts benefits the normativity of logic, as argued in classical anti-psychologism. Indeed, it would be a naturalistic fallacy to infer norms from psychological facts. However, normative systems that are formulated in ignorance of psychology run the risk of being irrelevant to humans. This is not just an abstract possibility. Gigerenzer (2021) explicitly argues against the normative force of axiomatic systems such as decision theory or logic for human cognition. The ‘fast and frugal’ heuristics brought forth in human evolution is in his view more successful and more adequate in real-world scenarios. In this way, the normativity of logic is not necessarily saved by keeping psychology out, it can even be harmed by becoming irrelevant.

From the perspective of descriptive research, normative aspects seem to make an explanatory contribution for phylogenetic questions (Why did this type of entity or process succeed in evolution?) as well as questions about specific behaviour (For what reason did a person act this way?). In both cases, optimality and adequacy contribute to a teleological explanation that is hard to integrate from a purely descriptive perspective.

A more practical motivation of overcoming a strict separation is that scholars from analytical-normative and empirical-descriptive disciplines seek cooperation. Of course, having separated approaches does not necessarily exclude some degree of interdisciplinary discourse. Purely descriptive psychological work can be inspired by a normative background theory from which experimental work proceeds. We would not call such an approach hybrid as long as there is no implicit or explicit claim of relevance that the facts speak for some norms or that the norms might contribute to the explanation of the facts. This irrelevance assumption that separates

strictly between norms and facts, however, keeps the extent of fruitful interplay limited. The hybrid approaches, presented in the following section, transcend this separation in different ways.

Some hybrid approaches

Bayesianism is a common framework among the hybrid approaches. Within it, Oaksford and Chater (1994) famously provided an extensive metastudy of Wason’s card selection task, where subjects need to evaluate a rule such as ‘If a card has an even number on one site, it has a vowel on the other’ (Wason, 1968). People’s responses often *seem* to violate logic because they prefer to turn the apparently uninformative vowel-card over the non-vowel card, which potentially falsifies the rule.¹ Oaksford and Chater reinterpret the task as reducing uncertainty about conditional dependencies in a deck of cards. By an information theoretic analyses, they show that the choice of participants is rational if the so-called rarity assumption holds, namely that there are only few vowel-cards and even less even-number-cards in the deck. As work within the paradigm of rational analysis, it uses optimality analysis to derive a descriptive hypothesis, i.e., that ‘subjects behave as Bayesians with the rarity assumption’ (Oaksford & Chater, 1994, p.627). While this work thus targets an empirical psychological debate, it also inspired further normative work by formal epistemologists (Fitelson & Hawthorne, 2010; Vindrola & Crupi, 2021). Moreover, in further work, Oaksford and Chater (2007) make more general (and more normative) remarks on Bayesianism as the new paradigm of reasoning.

Another example of a Bayesian approach is the argumentation analysis by Hahn and Oaksford (2007). They figure that prominent argumentation fallacies vary in strength depending on their content, and that Bayesian analysis helps to distinguish stronger from weaker variants. For instance, the strength of an argument from ignorance ‘There is no evidence for *A*; thus *A* is not the case’ can be evaluated by the prior plausibility of *A* as well as the likelihood of having no evidence contra *A* if *A* were true. The higher these probabilities are, the weaker is the argument. Oaksford and Hahn (2004) confirmed that subject’s judgements are sensitive to these criteria. Note that the normative component plays a dominant role in this work, which is essentially an account of argument *quality* in real-world arguments, even though it also uses empirical testing to add the descriptive claim that humans are sensitive to these norms.

A probabilistic but not Bayesian hybrid approach is exemplified by probability logic (Pfeifer & Kleiter, 2005). It uses probabilistic semantics within a logical setting: What inferences are probabilistic informative, i.e., preserving high (or low) probabilities?² One notable feature of probability logic

¹More specifically they violate a Popperian falsification approach and material conditional semantics that are common in formal logic.

²For an overview on the relation between logic and probability, see Demey, Kooi, and Sack (2019).

is that it validates the following connexive principle, which is not valid in most logical systems (Wansing, 2022):

Aristotle's thesis: *It is never true that: if A is not the case, then A is the case*

With probabilistic semantics of the conditional, this rule is obviously true because $P(A/\neg A) = 0$. Pfeifer (2012) empirically investigated this principle. Subjects with different background knowledge in logic endorse it. Rather than viewing this as a failure of subjects, Pfeifer interprets this finding as support for a probabilistic interpretation of the conditional. He suggests to treat such empirical results as 'external quality criteria for logical theories which are beyond the purely formal ones' (Pfeifer, 2012, p. 637). The (descriptive) fact that a normative theory, e.g. probability logic, fits wide-spread intuitions is viewed as an argument in favour of it, also as a normative system. This might sound as outright fallacy. Note, however, that intuitions of scholars always play a role in the acceptance of normative frameworks. The novel point here is that lay-people's intuition is considered as well.

Finally, let us have a look at a non-probabilistic account. Stenning and Van Lambalgen (2012) discuss the extent to which logic, construed as the science of correct reasoning, is relevant to psychology. Their preferred system for studying human cognition is closed-world reasoning, where one supposes that given information is complete. Much of their work, however, is not based on a particular logical system but on a detailed logical analysis of experimental material, such as the card selection task. They argue that the task in its normal formulation is hard to understand, as it leaves open several interpretations (including the statistical one of the Bayesian analysis). Without knowing the *subject's* interpretation, it is not even clear whether they committed a fallacy. In light of their logical analysis, Stenning and Van Lambalgen (2012) criticise descriptive theories of reasoning such as evolutionary psychology (Cosmides, 1989) or mental models (Johnson-Laird, 1981), which are both heavily concerned with apparent logical fallacies. In Stenning and Van Lambalgen (2012), logical analysis plays a methodological role in evaluating descriptive theories. This is effective because deviations from logical norms are already a main explananda of descriptive reasoning theories. To account for them is considered as evidence in favour of them. Hence, these descriptive theories are challenged by normative work that casts doubts on whether there are any fallacies to explain in the first place.

Characteristics of hybrid approaches

The presentation in the last section provided an impression of how descriptive and normative aspects relate in some exemplary hybrid approaches to reasoning. Let us now look at these approaches on a more general level. Is there an essence common to all hybrid approaches?

By definition, hybrid approaches combine normative work and descriptive work, but they still respect the distinction and are usually focused on one of the aspects. For instance, probability logic is a normative theory of coherence that builds

on the descriptive assumption that the natural language conditional is best interpreted in terms of conditional probability. The rational explanation of the card selection task by Oaksford and Chater (1994) and the analysis by Stenning and Van Lambalgen (2012), on the other hand, are primarily descriptive, while using normative considerations for understanding the type of reasoning that subjects do when completing a task, including their potential interpretations. We thus need to distinguish descriptively informed normative work on the one hand and normatively informed descriptive work on the other hand. The former is a variant of epistemology / logic, while the latter is a specific way of doing psychology.³ We will now look at hybrid approaches from both directions.

The normative perspective

Normative work can benefit from descriptive psychological work to escape the objection of non-applicability to human cognition and real-world environments. There are mainly two types of (descriptive) questions that might be important for the work on a normative system.

1. Is the normative system applicable to a human reasoning task? Do humans subscribe to the basic assumptions of the system?
2. Do human intuitions about correct reasoning correspond to the standards of the system?

The first aspect has to do with relevance and it has a direct normative impact. A reasoning system that is based on assumptions (semantics, goals etc) humans implicitly accept gains normative force for human reasoning in comparison to a system with background assumptions that are less natural to humans. This is because the normativity of a logical or epistemological model unfolds inasmuch as its basic assumptions are accepted. Instrumental rationality is a special case of this: an instrumentally rational behaviour X is normative only inasmuch as it is a means to a desired end. The rationality of X depends on the acceptance of the end as desirable. However, there are more cases where rational evaluation is not ignorant to (psychological) facts. Interpretation is another case. As argued by Oaksford and Chater (1994) and more extensively by Stenning and Van Lambalgen (2012), the normatively correct answer in the Wason card selection task depends very much on how people interpret the task. A related issue is the role of semantic background. A formal framework with semantic stipulations that are far from the human language use might simply fail to be normative (for human reasoning) since humans do not use such kind of semantics. The conditional is an example: Since the material conditional of classical logic differs from the natural language semantics, some norms of classical logic are problematic if applied as norms of natural language conditionals (such as the violation of Aristotle's

³However, the distinction is not primarily about researcher's affiliation but the characterisation of a work as mainly normative or mainly descriptive. The Bayesian argumentation theory by Hahn and Oaksford (2007), for example, is mostly normative even though done by psychologists.

thesis). However, such foundations are implicit and hard to test. They are often inferred from behaviour.

This leads us to the second aspect: conformity of empirical data about human intuitions with the expectations of a normative system. This is easier to test, but provides no direct *normative* support for the system. However, coherence of empirical data with a normative model *can* be viewed as evidence that people are committed to the underlying assumptions of the normative model. In other words, people's reasoning of *X* can be explained as rational by a normative model that prescribes *X* and the hypothesis that they work on the same foundations as the normative model (and, more generally, the framework in which it was formulated). This is a kind of abductive inference, i.e. an inference to an explanation, with a specific role of rationality. People's belief of *X* is explained by them making background assumptions (e.g., semantics) that makes it rational to reason or believe *X*. For instance, people's strong intuitions about Aristotle's thesis is explained by their interpretation of conditionals as high conditional probability rather than as material conditional. If people interpret conditionals probabilistically, this has the above-noted consequences for the relevance of probabilistic normative models versus classical logic models.

Taken together, the two aspects seem to allow to infer that people's reasoning of *X* can be evidence for the normative correctness of *X*, which would be an outright is-to-ought fallacy. However, the steps are not straightforward and there are many caveats, especially with respect to the rational abduction. The normative-descriptive interplay in the first aspect, namely applicability, is the less troublesome component. The is-ought connection comes from the rather unproblematic idea that prescriptions for rational reasoning one may derive from a normative system are conditional on the appropriateness of underlying assumptions. If an agent does not subscribe to them, then these apparent prescriptions would not be prescriptive for *her*. Arguably, the more difficult step of the strategy is reasoning from a subject's conformity with a normative system to the hypothesis that the subject shares its underlying background assumptions (e.g., probabilistic semantics of conditionals) and behaves rational on the basis of these assumptions. To justify such an inference, one needs to consider alternative (normative) systems that could explain the same behaviour on the ground of different assumptions. In addition, non-rational explanations have to be considered as well. People's answers on a task may look like they follow a rational standard, when in fact people's behaviour is driven by very different factors (e.g., anticipation of answers the experimenter expects). Finally, rational abduction is intrinsically committed to the idea that a rational explanation of a behaviour is particularly attractive. According to this commitment, adequacy, correctness or even optimality play an explanatory role for understanding a behaviour. This brings us to the other side of the normative-descriptive interplay: the use of norms in descriptive research.

The descriptive perspective: rational explanation

In the computational-level-first tradition (Marr, 1982), normative considerations have been viewed as prerequisite for empirical testing.⁴ Normative considerations determine the search space and guide empirical research (Zednik & Jäkel, 2016). Moreover, the normative analysis plays the above-mentioned explanatory role in the understanding of human reasoning and judgement. For instance, the core of rational analysis—as employed in the Bayesian analysis of Wason's card task—is that a rational explanation is valuable: On the face of it, observing a behaviour *X* in reaction to some (reasoning) problem is not as surprising if *X* is a rational and adequate solution for the problem than if it is inadequate. In the latter case, we would be tempted to ask: 'Why was the behaviour chosen even though it is inadequate?' In the former case, we would rarely question the behaviour by asking: 'Why was the behaviour chosen (and maybe even repeated) though it is adequate?' A satisfying explanation of observed behaviour is intuitively not indifferent regarding normative aspects such as adequacy. At least, we view this as core commitment of hybrid approaches in as far as they develop descriptive theories that are partially based on normative considerations. The question whether normativity really plays an explanatory role is nevertheless highly controversial. Some authors (Danks, 2008) view a *causal* role of the norms as prerequisite of an explanation by normativity. Unfortunately it is difficult to demonstrate that people reason as they do *because* it is rational even in cases where the conformity of human judgement and a normative system is shown. However, a rational explanation might be valuable even if we know little about the role rationality played in its genesis as long as it is somewhat predictive of the future. That a type of behaviour is adequate (or in some sense optimal) makes it *prima facie* plausible that this kind of behaviour will persist and repeated in similar tasks. The same expectation is less plausible for inadequate or sub-optimal behaviour.⁵

Critics

Hybrid approaches, Bayesian ones in particular, came under attack in the last decade. Elqayam and Evans (2011) note the risk of committing is-ought fallacies. In particular, they claim that it is problematic to infer normative support for a framework such as Bayesianism from psychological evidence. We addressed this point above. Descriptive research has nothing to say about whether a formal system, framework or theory of correct reasoning works correctly on the basis of its own assumptions, which is indeed an analytical question. However, if it does, the system *unfolds* its normative force in a

⁴Elqayam and Evans (2011) doubt that computational modelling requires normative claims. In our understanding of normativity (evaluations of adequacy, rationality, optimality etc.) it is obvious that computational level explanation belongs into the realm of normative analysis.

⁵There is an extensive debate in evolutionary game theory (Weibull, 1995) about the sometimes ambiguous relationship between the optimality of behaviour and its stability or repetition.

real-world task as far as its background assumptions are met. Empirical research has a contribution in figuring out questions of applicability in specific tasks (such as the card selection problem) or a whole class of problems (reasoning with conditionals).

Critics of Bayesianism also argued that the focus on normative models leads to a neglect of mechanistic perspectives and is thus harmful (Jones & Love, 2011). Bowers and Davis (2012) judge Bayesian theories as trivial and unfalsifiable in their approach of explaining any kind of behaviour as a case of optimal Bayesian thinking. Most proponents of the Bayesian framework objected that the criticism is largely based on a misunderstanding and misrepresentation of Bayesian positions. However, their replies also touched on philosophical issues. For instance, Griffiths, Chater, Norris, and Pouget (2012) noted that frameworks (understood as languages in which models are formulated) cannot have truth-values and are thus generally not falsified or verified by empirical research. Hahn (2014) doubted that critic against some Bayesian models can be interpreted as a failing of the Bayesian framework. However, even though the notion of frameworks has played a role in this debate, there is no detailed framework analysis-based study of Bayesianism or similar approaches. In our final section, we now will provide a philosophical perspective on frameworks.

Frameworks, a Carnapian perspective

Frameworks are languages in which scientific problems can be addressed and solved, either empirically or analytically, depending on the kind of question. The concept of a framework is deeply connected to the philosophy of Rudolf Carnap. Regarding framework choice, Carnap postulates *tolerance* (Carnap, 1937). In Carnap (1950), he notes that we have to carefully distinguish between problems that are raised within a certain framework and questions outside a framework. According to Carnap, only the former makes sense, while the latter leads to fruitless metaphysical speculations. Following his own principle of tolerance, he argues against philosophically motivated framework critique: ‘To decree dogmatic prohibitions of certain linguistic forms instead of testing them by their success or failure in practical use, is worse than futile’ (Carnap, 1950, p. 221)

Let us reconsider the criticism by Bowers and Davis (2012), who claim that Bayesian cognitive scientists support the very implausible idea that human behaviour is optimal, from the Carnapian perspective. The question of interest is thus: ‘Is human performance (in a task T) optimal?’ Within a framework, the question can be addressed by analysing optimality in the normative model and collecting empirical data for comparison. The resulting models and thesis can be critically examined by other researchers, either on analytical grounds for the normative answer or empirical grounds for the descriptive claim.⁶ As noted by Hahn (2014), model cri-

tique should not be mistaken as criticism of the framework. Quite to the opposite, such kind of critic even presupposes that critics accept the language of the model (even if only to criticise). It can, in principle, not be used to evaluate or attack a framework as such. However, this is what critics of Bayesianism (or other hybrid frameworks) target. When Bowers and Davis (2012) question that people are *really* optimal, they aim to say something about human cognition *outside* of the Bayesian framework. This is problematic because only the framework provides the semantics to ask such questions and the methodology to answer them. Outside a framework, there is no real question to raise or to answer, at least according to the Carnapian distinction. Note that this analysis would not only affect critics, but also Bayesians themselves. Insofar as they make statements about the optimality or non-optimality of human cognition (independent of their Bayesian framework), they also would engage in a kind of bogus debate.

In addition to asking questions within frameworks (which makes sense) and asking questions outside of them (which makes no sense), one can also raise questions *about* frameworks, as Carnap himself frequently did. By his principle of tolerance (e.g., in Carnap, 1937, § 17), he claims that we should only judge by clarity and fruitfulness but leave philosophical concerns outside. This anti-metaphysical position has been widely criticised in the philosophy of the last century.⁷ For our application to the debate about Bayesianism, it is important to note that judgements of success and fruitfulness themselves depend on one’s position. While one side celebrates a rational explanation of an apparently puzzling behaviour as a success, critics view it as another case of insubstantial story-telling that fallaciously mixes normative and descriptive claims. This phrasing might be exaggerated, but the contrast is real. To evaluate the framework *just* by success rather than philosophical views is hardly possible because the evaluation of fruitfulness is to a certain extent philosophically motivated. Questions behind hybrid frameworks such as ‘Are normative aspects (adequacy, optimality) explanatory useful in understanding facts?’ or ‘Can normative systems be evaluated in terms of how well they apply to human reasoning?’ are not simply a quest for clarification, and they cannot be answered in terms of success because their answer defines what counts as such.

Stances and views

We have now reached the conclusion that the appreciation of hybrid approaches depends on one’s philosophical background. To a certain extent, philosophical commitments are hard to avoid. The question now becomes how serious these are? Is it necessary to justify the background position of a framework in order to work with it? Can (hybrid) frameworks themselves depend on or support a philosophical position?

⁶Diaz (1999) (descriptive).

⁷Leitgeb and Carus (2022) given an excellent overview of debates about Carnap’s views.

⁶For critical evaluation of Oaksford and Chater (1994), see Vindrola and Crupi (2021) (normative) or Oberauer, Wilhelm, and

Is there a deeper philosophical debate about how to evaluate hybrid approaches? Or does it suffice to just state such more general background assumptions as a matter of clarification while keeping somewhat tolerant or even ignorant in the evaluation of these philosophical matters? If this is the case, we could grant that clarifying a framework involves not only syntactical (or semantic) rules but also explanation of philosophical assumptions for reasons of transparency while keeping otherwise close to Carnap's principle of tolerance. Such strategy is reminiscent of the idea of a stance as known from Dennett (1987) and the *intentional stance* as well as van Fraassen (2002) and the *empirical stance*. By taking a stance, one adopts an epistemic attitude based on some philosophical principle, which is useful and guides our understanding, but implies no metaphysical commitment. The intentional stance helps us to understand the behaviour of our fellow humans on the basis of desires, beliefs etc. According to Dennett, this is *just* a stance. It does not mean that these desires and beliefs literally exist the way brains exist. For van Fraassen, the empirical stance is a way to justify his attitude that empirical study is the only source of (non-mathematical) knowledge, a principle that can never be known according to its own standards of knowledge. The stance motivates a certain epistemic policy (including a choice of a framework) without claiming an underlying fundamental philosophical truth. The stance is justified inasmuch as it is not outright irrational or impractical to follow. Taking a certain stance is more a matter of (practical) choice than metaphysical commitments.

To understand hybrid approaches as a particular stance works reasonably well when we look from the perspective of psychologically interested epistemology and logic. These work on the assumption that cognitive plausibility and relevance for human subjects are criteria for evaluating a normative system, as claimed by Pfeifer (2012). One may debate whether criteria of cognitive plausibility are better met by a Bayesian system, some type of logical system, or yet another framework. To debate the criterion of cognitive plausibility itself, however, is indeed futile. A researcher's interest in normative systems that fit human reasoning conditions is a matter of scientific choice and thus voluntaristic, which is typical for a stance-like attitude. There is also no deep philosophical disagreement with researchers who are working on normative systems with applications elsewhere (e.g., in pure mathematics).

Taken as a stance, the claim that cognitive plausibility is an external quality criterion of a normative reasoning system involves certain goals and methods (analytical as well as empirical), but no deeper belief about the true nature of logic (whatever that is). Looking back to anti-psychologism in logic, we can diagnose that logicians such as Frege were justified in developing the non-psychological stance of logic and operating on its basis. They were wrong inasmuch as they saw their stance as a truth about logic itself. Similarly, cognitive plausibility is better understood not as a general characteristic of a 'good' normative system as such but as an idea a researcher

subscribes to, as it is exemplified in the following quote by Johan van Benthem:

Now comes my simple declaration of faith. Logic is of course not experimental, or even theoretical, psychology, and it approaches human reasoning with purposes of its own. And a logical theory is not useless if people do not quite behave according to it. But the boundary is delicate. And I think the following should be obvious: if logical theory were *totally disjoint* from actual reasoning, it would be no use at all, for whatever purpose! (van Benthem, 2008)

The quote speaks of 'faith' and it appeals to practical reasons, why logicians should not delineate themselves too much from cognitive reality. It seems quite reasonable to understand this declaration as expression of a (perfectly reasonable) stance on logic.

From the perspective of descriptive cognitive science, subscribing to hybrid approaches seems to entail stronger philosophical commitments. There is something unsatisfying in the claim that normative aspects are explanatorily useful without knowing why and how they are explaining. Are they causally relevant and if so, in which sense? What is preferable in a rational explanation of a behaviour? How are they related to functional explanations in life sciences? This is not to deny that practical reasons play a major role: Normative models in descriptive context are often used to inspire empirical research and determine the search space. It might also well be that some scholars choose the normative over other approaches as a matter of taste. Nevertheless, the explanatory success of the scientific strategy has philosophical implications and it depends on philosophical notions, regarding issues of teleology and function (Neander, 1991) or the role of (rational) reasons as cause (Dretske, 1991, 2006). Following the terminology of Cuffaro and Hartmann (2021), we call this a *view* rather than a stance. Like stances, views are the background of scientific frameworks. However, they involve stronger commitments and justifications beyond mere practical reasons. As such they are influenced by philosophical positions and can also speak in favour of or against philosophical positions. This is not the place to discuss the view behind rational explanation in more detail, which would make a paper in its own right. For now it suffices to say that Bayesian cognitive science (as well as other normativist approaches in behavioural sciences) can be placed in a larger philosophical debate about function and rationality.

We conclude that psychologically informed logic and formal epistemology involves a stance, i.e., a particular way of approaching rational reasoning and belief. This is covered by voluntarism, and a debate about the true nature of logic or rational reasoning is futile. The application of normative aspects as explanatorily relevant in descriptive contexts, however, is based on a view of cognition (and behaviour more generally), according to which norms are relevant in the explanation of facts. Analysing and critically examining this view remains a topic for further debate.

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