Logic, Application, and Pluralism: A Survey of Views

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Abstract
The paper presents an analysis of a number of views on the nature and role of logical pluralism in relation to the application of logic in non-logical disciplines. The views in question are culled from a series of structured interviews on a range of issues concerning logic and application.

Keywords: Logic; Application; Pluralism

1 Introduction

Modern-day logic is applied in a wide range of non-logical domains. Being closely tied in its early days with questions in the foundations of mathematics, over the last century logic has become a tool that is being applied in computer science, in linguistics, in economics, in cognitive science, in artificial intelligence, and so on. And it is being applied there successfully. This remarkable situation, where a substantial part of the research in logic is somehow connected with its application in non-logical domains, raises a number of questions.

One way of addressing these questions is by viewing logic and its application

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The authors would like to thank the interviewees for their willingness to be interviewed, and for their feedback on the transcripts of their interviews as well as for their comments on a preliminary version of the report on which this paper is based. Of course, the responsibility for the analyses and the conclusions expressed in the report and in this paper rests solely with the authors.

as *practices*, i.e., as shared human activities conducted in a socio-cultural context.[1] Key features of practices are that they involve multiple actors; that they 'have a point', i.e., actors engage in them for a reason; that they are based on both natural and acquired behavioural patterns; and that they are shaped by explicit rules. What is important to note here is that a practice allows for a certain amount of *heterogeneity* of the realisation of these features in a practice. In a given practice these features allow for (limited) differences between (groups of) actors.

If we turn to the application of logic as a practice, these features give rise to various sets of interrelated questions. Who or what determines what a successful application is? What role do meta-logical properties of logical systems play? Is there a difference between logic being employed in empirical and in non-empirical domains? And what to think of logical pluralism? How does pluralism affect one's views on the relation between logic and its applications?

The present paper draws on the results of a survey of views of working logicians on these questions about logic and its applications. The survey was a follow-up of a small working group that was held in December 2024 at the Tsinghua University – University of Amsterdam Joint Research Center for Logic. In three sessions, the members of the working group discussed a number of theoretical questions concerning logic and its application in various disciplines, as well as their own practical experiences with application of logic.

The working group decided it would be fruitful to conduct a survey to take stock of and analyse a wider variety of views on these issues from working logicians. To that end, we conducted a series of structured interviews with a number of them, analysed the results, and formulated some general conclusions and recommendations. These results are presented in the report that the working group wrote, Du et al. [2025], which is available at `https://tsinghualogic.net/JRC/logic-and-application-a-survey-full-version/`.[2]

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1. This is not the place to dwell further on the analysis of the concept of practice. Suffice it to say that we draw inspiration from work done in practice theory (cf., e.g., Schatzki [1996, 2002]), and from work done in the philosophy and sociology of mathematics, where the view of mathematics as a social practice is explored (cf., e.g., Azzouni [2007], Mancosu [2008], Van Kerkhove [2009]).
2. The following logicians were interviewed: Johan van Benthem (Stanford U.); Patrick Blackburn (Roskilde U.); Thomas Bolander (Technical U. Denmark); Thomas Icard (Stanford U.); Fenrong Liu (Tsinghua U.); Qi Feng (Tsinghua U.); Ram Ramanujam (IMS Chennai); Giorgio Sbardolini (U. of Amsterdam); Jeremy Seligman (U. of Auckland); Chenwei Shi (Tsinghua U.); Dag Westerstahl (U. of Stockholm). In the paper, as in the report, the interviewees are not identified by name but with randomly assigned letters.
Geographically, two interviewees are placed in the USA, one in India, four in continental Europe, three in mainland China, and one in New Zealand. In terms of career stage, two are early career, three are mid career, and six are late career researchers. As for experience with application of logic in non-logical domains, there is expertise among the interviewees on a wide variety of domains: philosophy, mathematics, cognitive sciences, linguistics, computer sciences, artificial intelligence, social sciences. This heterogeneity is also reflected in the academic backgrounds

The report contains a detailed description of the design of the interviews; of the selection of interviewees; of the protocol that was followed; and of the questions that were posed. It also describes the practice-theoretical background of the project. The report contains detailed, quantitative and qualitative analyses of the answers to the questions posed during the interviews, as well as a number of recommendations for the set-up of logic curricula.

2 Pluralism

The advantage of conducting structured interviews lies in the ability to uncover unexpected perspectives on a range of issues. In the report we surveyed the positions held by interviewees on the topics that they were asked about, and we explored correlations between their answers and key features: career stage, academic background, and experience with application of logic in various areas. In almost every case the informativeness of the responses gained enormously from the ability to also have a look at the underlying motivation.

In this paper we focus on the issue of logical pluralism. Here we can discern a variety of positions, situated in a space that is construed by two dimensions: the nature of logic itself and the nature of application.

2.1 Pluralism as a philosophical issue

Let us start with the dimension of the nature of logic. Here we find two opposing views. On the one hand there is the classical view that sees logic as basically one thing that is fundamental with regard to anything that it is applied to. This view is that of the founders of modern logic, as witnessed for example by the following quote from the preface of Frege's *Begriffsschrift* [Frege, 1879]:

> The firmest proof is obviously the purely logical, which, prescinding from the particularity of things, is based solely on the laws on which all knowledge rests.

This view reflects the original motivation for the development of modern logic, viz., to serve as the secure foundation for core mathematics. That brings along both monism, – there is only one logic –, as well as independence of application, – when logic is applied it does not change with what it is applied to. This fundamental nature of logic is secured by assigning it a unique epistemological and ontological status. One of the most clear expressions of this vision can be found

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of the interviewees. Almost all of them have studied and worked not just in logic but also in other fields, such as engineering sciences, physics, mathematics, philosophy, linguistics, computer science.

For information about the interviewers and the exact structure of the interviews see the already mentioned report [Du et al., 2025].

in Wittgenstein's *Tractatus* [Wittgenstein, 1960, 5.473]: 'Logic must take care of itself'. It is beyond epistemological vindication and ontologically fundamental.

On the opposite side of the spectrum we find pluralism: logic is not one thing, it is a manifold of different systems. And these are all really different logics, not subsystems of one big overall system of logic. An early 'declaration' of pluralism can be found in Carnap's *The Logical Syntax of Language* [Carnap, 1937, p. xv]:

> Up to now, in constructing a language, the procedure has usually been, first to assign a meaning to the fundamental mathematico-logical symbols, and then to consider what sentences and inferences are seen to be logically correct in accordance with this meaning. Since the assignment of the meaning is expressed in words, and is, in consequence, inexact, no conclusion arrived at in this way can very well be otherwise than inexact and ambiguous. The connection will only become clear when approached from the opposite direction: let any postulates and any rules of inference be chosen arbitrarily; then this choice, whatever it may be, will determine what meaning is to be assigned to the fundamental logical symbols.

Now one might think that the subsequent development of a wide variety of logical systems, –such as modal logics, tense logics, epistemic logics, deontic logics, and so on– has reinforced the 'Principle of Tolerance' that Carnap espoused.

But that is not the case. The debate around logical pluralism has not subsided, it is still a central topic in the philosophical-logical arena, and in the current literature one may find a range of positions and views debated and defended. Influential is the work of Beale and Restall, [Beale and Restall, 2000, 2006], who defend a Carnap-inspired pluralism. And on the opposite side of the spectrum we find defences of monism, such as those of Stei [Stei, 2020]. However, it is relevant to note that these discussions usually proceed in terms of philosophical and logical criteria. They are metaphysical and/or epistemological debates about the nature of logic as such, without (much) reference to what we can call 'the demands of reality', i.e., the demands and constraints that actual applications of logic to empirical and conceptual problems and phenomena in non-logical domains pose. It is from this perspective of application that we have asked our interviewees to reflect on the issue of pluralism.

2.2 Pluralism in practice: application

From the perspective of application a range of considerations becomes relevant. There are ontological motivations, that link different logics to different ontological domains. Example: non-classical quantum logic for describing quantum phenomena and classical logic for the dealing with phenomena at the macroscopic level. In a similar fashion one can motivate using different logics for dealing with different

epistemological realms. Example: many-valued logics for dealing with matters of future (in)determinism and two-valued logics for the analysis of statements about the past and present; or static epistemic logic for the analysis of knowledge and belief structures versus dynamic epistemic logics for describing information exchange.

The sheer variety of logics and the diversity of their motivations then leads to the view that the term 'logic' describes a toolbox, with a variety of tools all geared to specific uses, that can be expanded as needs arise. From that perspective application is a main driver of development.[3] These two dimensions together create a space of possible positions, and one of the goals of the project is to see which positions in that space are actually occupied and, if so, for what reasons do logicians occupy them. Our primary interest is in the considerations surrounding the application of logic. This includes views on the nature of logic, but also on issues that are inherent to application as such.

From the present perspective, in which application is central, it is not so much these theoretical viewpoints as well as the actual, day-to-day experiences with application of logic that is of interest. Commitment to pluralism in some form or other seems standard among present-day logicians. Few of them seem to maintain that there is in fact only one logic. But that raises question when it comes to application.

For instance, does pluralism 'transfer'? I.e., given that there are a number of logics that can be applied to a problem, does that mean that the problem as such has a number of solutions in terms of the application area? Or does a given problem in a particular application always require a unique answer? If so, uniqueness up to what level? And whose view, those of the logician or those of the non-logician in whose domain logic is being applied, carries the day here? Those are the questions that we asked our interviewees and it is their answers that we analyse in what follows.

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3. The toolbox metaphor also appears in Wittgenstein's description of the variety of language in *Philosophical Investigations* [Wittgenstein, 2009, § 11]:

> Think of the tools in a toolbox: there is a hammer, pliers, a saw, a screwdriver, a rule, a glue-pot, glue, nails and screws. — The functions of words are as diverse as the functions of these objects. (And in both cases there are similarities.)

This pluralism has to be accepted for what it is, Wittgenstein continues [*ibid.*, § 14]:

> Suppose someone said, 'All tools serve to modify something. So, a hammer modifies the position of a nail, a saw the shape of a board, and so on.' — And what is modified by a rule, a glue-pot and nails? — 'Our knowledge of a thing's length, the temperature of the glue, and the solidity of a box.' — Would anything be gained by this assimilation of expressions?

3 Logic, application, practice

In what follows we explore how their views on the nature of logic and on various aspects of its application in a non-logical domain help shape the interviewees' positions with regard to pluralism.

Pluralism was addressed at two points in the interviews: as a question, viz. 'Does the application fix a unique logic?' and in the form of a thesis, viz., 'Pluralism of logics can only be motivated by pluralism of application domains, i.e., fixing the application domain entails fixing *the* logic of that domain.' As we shall see, analysis of the answers to the question and of the positions on the thesis bring to light a rich variety of meta-level reflections on the application of logic. In what follows we will attempt to systematise them.

We begin by identifying three key dimensions that emerged as central to the views of the interviewees as expressed in their responses. Those dimensions define a rich space of possible positions, and we will locate the eleven interviewees within that space. In this way we will chart, not only possible positions but also the intricate relations between them.

The positions discussed in this chapter are reconstructed from the interviews. In some cases, they have not been explicitly articulated by the interviewees themselves, but are reconstructed on the basis of the transcripts. Thus, the positions that we identify cannot be strictly linked with individual interviewees. Therefore, we refrain from associating individual interviewees with them. This choice reflects our aim to highlight how the dimensions we identify shape the interviewees' broader conceptions of the application of logic in relation to pluralism, rather than to focus on the views of particular individuals.

As noted previously, 'logical pluralism' can mean quite different things, to different people. We distinguished between variety in expressiveness (e.g., propositional logics versus quantificational logics) and variety in what is expressed (e.g., classical logic versus intuitionistic logic). Arguably both play a role in sculpting a space of positions on pluralism. But there are also concerns that relate to considerations about 'getting things done' from a practical perspective.

This leads us to distinguish between three dimensions: views on the nature of logic, views on the demands of the application area in which logic is applied, and views on the demands made by the practice of applying logic. We discuss them separately in the following sections, and then use the results to construe a space of possible positions.

3.1 The ontological status of logic

When the question of pluralism is approached from an ontological perspective we find that there are two opposing views. At one end there is the view that there is only one logic. On the opposite end there is the view that multiple logics co-exist.

The first view conceives of logic as being constrained by reality to the extent that logic is just this one thing. Per contrast, the second view holds that reality does not impose any constraints and permits multiple logics that co-exist without conflict.

Figure 1: Ontological status of logic

In between the two extremes we can find intermediate positions. For example, one could acknowledge both intuitionistic logic and classical logic as bona fide logics because they both have ontological groundings, but in different ontological domains, while at the same time rule out para-consistent logics as 'not real logic' because they lack such grounding.

3.2 The demands of application

Besides views on the ontological status of logic itself, considerations concerning the nature of the application area that logic is intended to capture may also play a role in determining one's stance on the issue of pluralism. Again we have two extremes. On the one end there is the position that no matter what the application area is, everything can be done in one logic. On the other extreme we find the view that each application area calls for its own, possibly different logic.

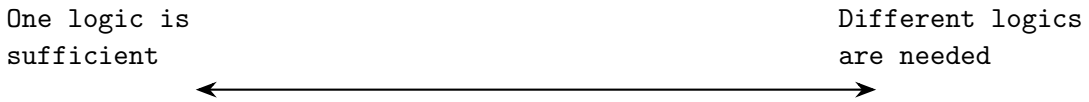

Figure 2: Demands of application

Again, there will be intermediate positions, that acknowledge differences between application areas, but that don't go to the extreme that different logics are needed to adequately capture an application.

Various kinds of considerations may determine one's position on this spectrum. They may concern the ontology of the application area, for example, quantum phenomena in contrast macroscopic phenomena, which may be considered to call for different logics. But one may also have epistemological considerations, that concern variations in the ways reasoning or knowledge is structured and represented. Here one can think of statements about the future, which one could argue call for a many-valued logic to handle questions of (in)determinism, versus statements about the past and present for which two-valued logics would be the suitable instrument.

Note that how one views the demands of a particular application area may also vary. Consider modelling belief structures. One may hold that there exists, in principle, one single logic that is capable of capturing the unique structure underlying beliefs. At the opposite extreme, however, it may be argued that belief structures as such necessitate the employment of distinct logics in order to represent different facets. For instance, agents may reason monotonically in some contexts while engaging in non-monotonic reasoning in others, thereby motivating the application of a plurality of logics within one application area.

3.3 The demands of practice

Several interviewees observed that, beyond the above two conceptual dimensions, other considerations are operative when logic is being applied in a non-logical domain. Being engaged in that as a concrete practice comes with its own demands, and as far as pluralism is concerned those demands determine a position on the following scale:

Figure 3: Demands of practice

To the left we find the position that everything can be done satisfactorily using one logic. The right endpoint is then motivated by the consideration that, even if, in principle, one could do the job using a single system, in practice the results of doing so may become excessively complex, thereby impeding understanding. Consequently, for practical reasons different logics are needed to provide complementary perspectives on the same domain. In this sense, logic functions as a 'toolbox': one picks a particular instrument that is suited to do a particular job.

3.4 Relationships

The three dimensions defined above create a space of possible motivations for taking up a position with regard to pluralism. As it happens pluralism is almost universally accepted by our interviewees, but we note hat their motivations differ, often quite substantially.[4] The three-dimensional space aims to capture both resemblances and differences between positions by locating them in this space. But before turning to that there is one more thing to discuss, viz., the relative (in)dependence of the dimensions.

Note that the first two dimensions concern positions on the nature of logic and on the nature of application, respectively. These are more theoretical issues

4. See Du et al. [2025, section 2.3] for details.

and the positions on these dimensions are therefore motivated from a largely theoretical perspective. The third dimension, however, captures positions that depend on practical considerations.

By and large the practical considerations seem to cross-cut the theoretical ones. For instance, the view that we need a 'practical pluralism' because simpler formalisations are generally easier to understand and manipulate, seems to be compatible with a monistic stance on the nature of logic itself as well as with the view that all application can be done in one logic. The only real tension appears to be between the 'practical' position that everything can be done in one logic and the view that different logics are needed, one of the extreme of the demands of application dimension.

What about connections between the theoretical dimensions? Here, too, positions on each of them appear to be by and large compatible. For example, the position on the ontological dimension that multiple logics co-exist appears compatible with both extremes on the demands of application dimension. Whether one logic suffices or different logics are needed from that perspective does not make a difference.

But what about the position on the ontological dimension that there is only one logic? Can that be compatible with the position on the demands of application dimension that different logics are needed to capture an application? This really depends on what one takes the latter to imply. If it is read in a 'as a matter of fact' manner, there seems to be no conflict. One may hold that a given application determines a single underlying logic, yet also hold that achieving a comprehensive understanding of that application may nonetheless require drawing on multiple logical systems. Unification is possible, yes, but it may not be achievable in practice. It may be a stage that the research never reaches, but that's fine.

4 Positions

In this section, we locate the interviewees within the conceptual space defined by the three dimensions introduced above. It is worth emphasising again that our aim is not to provide a detailed interpretation of each interviewee's stance on the three dimensions, but rather to explore how they jointly shape possible perspectives on the application of logic in the context of logical pluralism. We briefly touched on relationships between the three dimensions, but only in terms of their extremes. As we shall see, greater nuance emerges once we consider also intermediate positions.

4.1 The sculpted space of positions

The three dimensions we introduced above sculpt the space of positions as shown in figure 4. The space total consists of eight different regions, which we will use to

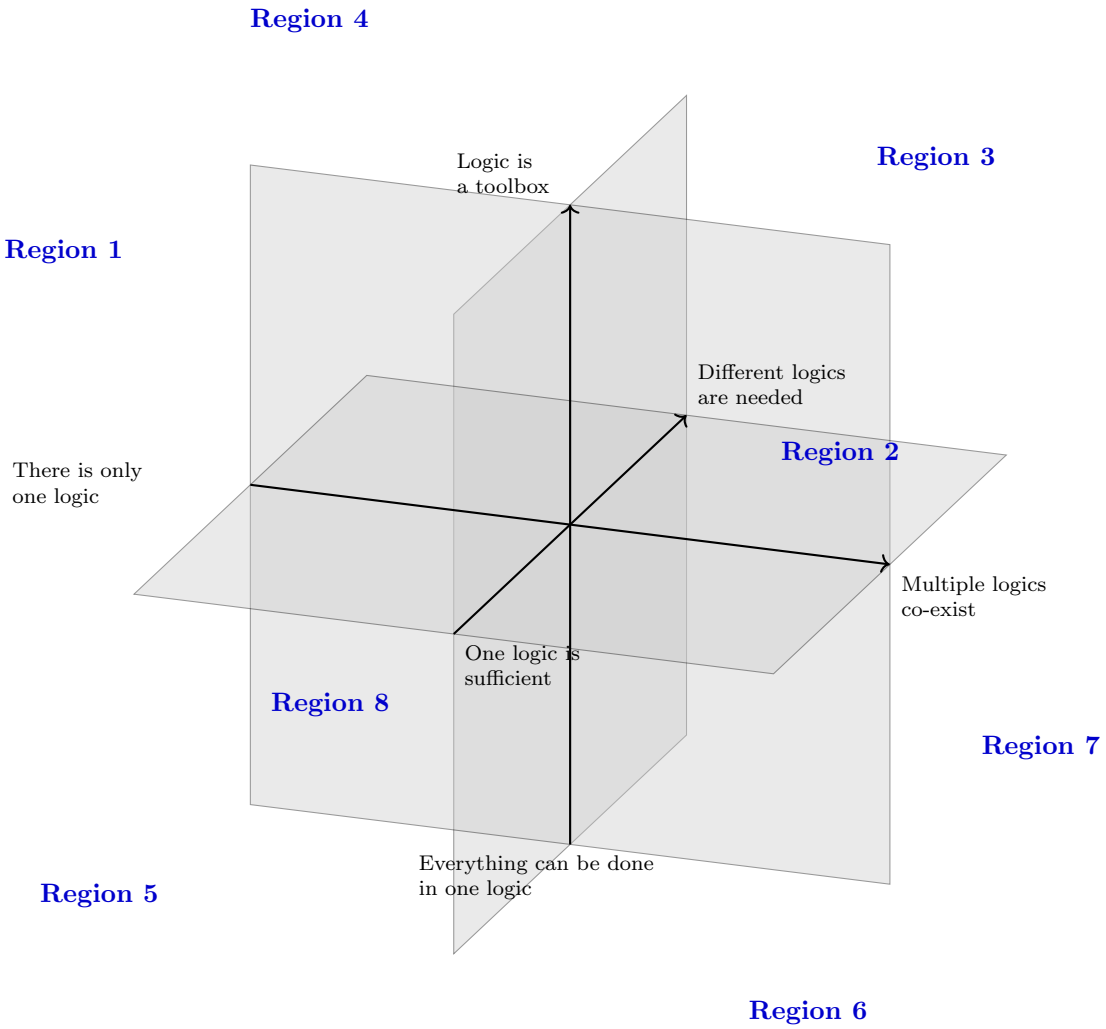

Figure 4: The sculpted space of positions

locate the specific positions occupied by the interviewees.

As a start we should note that there are regions that are not occupied by any of our interviewees. And for one of them this is no accident: there is one region that seems conceptually impossible. This is Region 7, which encompasses a positive degree of commitment to the position that there coexist multiple logics, to the position that different logics are needed for capturing the application, and to the position that everything could be done in one logic. That is not a conceptually coherent space.

Apart from Region 7 all others appear to be potentially 'inhabitable'. As a matter of fact, though, no interviewee occupies Region 2 or Region 6. That is, regardless of the third dimension, that of demands of practice, no-one maintains

a positive degree of commitment to the position that there coexist multiple logics and the position that one logic is sufficient for capturing the application.

A tentative interpretation of this finding may be the following. If reality permits multiple logics, then different logics must at least capture some distinct aspects of the application that no single logic can fully represent. Conversely, if one logic is sufficient for capturing the application, then, in principle, reality itself may determine a single correct logic. However, we should note that the small sample size, and its selective nature, might also explain why Region 2 and 6 are not inhabited by one of the interviewees.

In the following, we first discuss the remaining five regions, accompanied by figures highlighting the positions being taken. At the end, we present a comprehensive figure that displays all regions together with all marked positions (figure 10).

4.2 Region 8

We start with Region 8, which is depicted in figure 5. It is inhabited by only one interviewee, [J]. This region seems to present an awkward position. It combines the position that there is only one logic (dimension 1) with the position that different applications require different logics (dimension 2), while at the same time also maintaining the position that everything could be done in one logic (dimension 3). The one interviewee that inhabits Region 8 is located at the extreme end of each dimension.

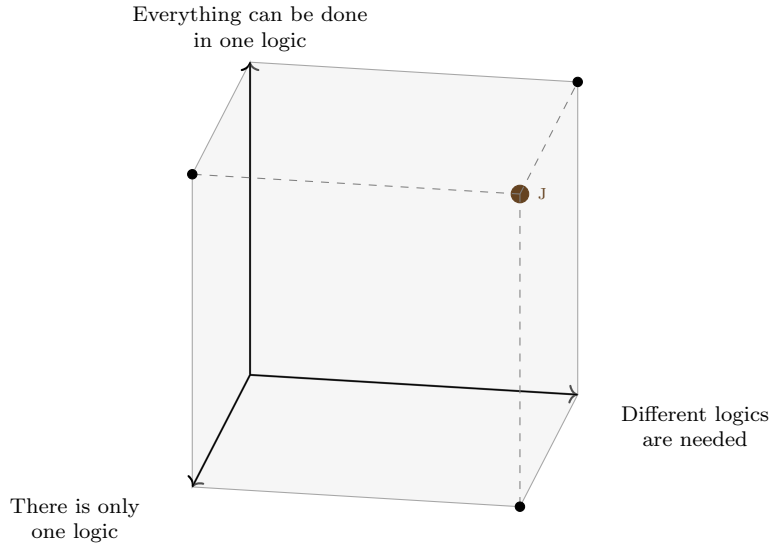

Figure 5: Region 8

To understand this interviewee's position their view on the nature of logic is especially important. They do not see logic as a pre-existing, abstract mathemat-

ical theory that is subsequently applied to other domains. Instead, they think of logic as something that is to be 'discovered' in the study of human reasoning and communication. In the short introduction this interviewee gave before the interview, they mentioned that they see logic as 'a theory of human reasoning'. Thus, they regard not just the formal systems of mathematical logic, but also everyday reasoning and argumentation as belonging to field of logic. This is based on their conviction that there is a genuine logical structure behind these as well.

In the nature of logic dimension, we locate the interviewee at the extreme left end, since they believe that the basis of logic is the human mind and its inherent capacities of reasoning and communication. This foundational belief may resolve the awkwardness of their position. From this perspective, there is indeed only one logic because logic is ultimately rooted in human cognition, with its complex, but unified architecture. It is logic as the single, natural phenomenon that this interviewee seeks to understand. However, this cognitive architecture manifests itself in the real world in a variety of ways. And because of that a plurality of formal systems is required to adequately model and explain them. Indeed, 'different logics are needed'. Thus, the position that everything can be done in one logic does not refer to a single, simple formal system, such as classical first order logic, but rather to 'the logic of the mind', which, due to its richness, can only be partially approximated by various formal logical frameworks. This interviewee's position is not that any logic can be arbitrarily applied, but that the nature of the application domain, viz., rational human behaviour, justifies a well-delineated pluralism .

Thus rather than holding an awkward, perhaps untenable position, we see that the interviewee's stance exemplifies a nuanced understanding of pluralism, where the unity of logic is found in its cognitive origins, while its diversity is necessitated by the diverse ways in which human reasoning and communication manifest themselves.

4.3 Region 5

Next we turn to Region 5. It is represented in figure 6. This region is inhabited by two interviewees, [G] and [E].

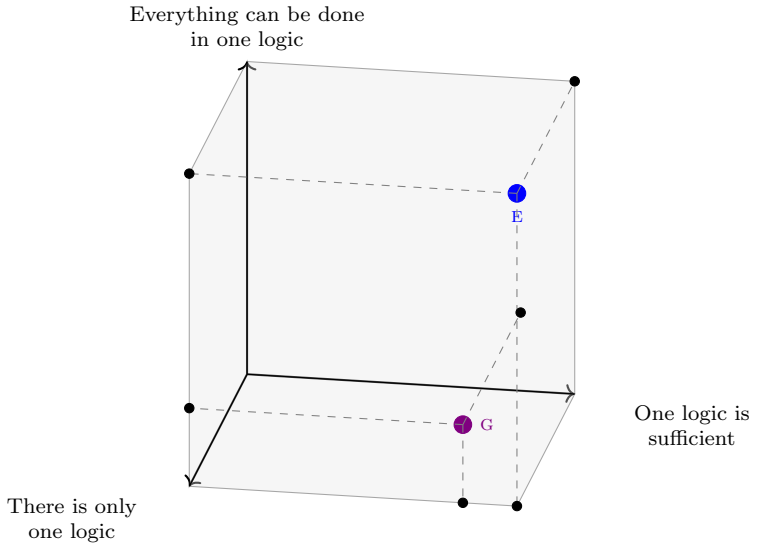

Figure 6: Region 5

The position of interviewee [E] represents a stance that takes all three dimensions at their extreme values—that is, a monist position with respect to each issue. It should be noted, however, that this is not a Fregean kind of monism that insists there is only one true logic capable of capturing all valid reasoning. Instead, the interviewee holding this position, [E], advocates a softer, more pragmatic form of unity. They see logic primarily as a a collection of instruments for reasoning and remain largely silent on its ontological nature. When asked about the use of logic across different domains, this interviewee did not explicitly deny the need for multiple systems, yet they did express doubt about the real usefulness of such distinctions in practice: from the standpoint of set theory all these systems can be understood as different manifestations of the same underlying logical structure.

At the same time, interviewee [E] cautions against the idea of enforcing any single logic: thought should remain free and no-one should impose their framework on others. Faced with pluralism, we should keep an open mind and allow different perspectives to co-exist and interact. And perhaps one day we may realise that all these logics are simply different ways of viewing the same underlying reality. This suggests that, in principle, there *is* one logic that grounds all others – a single conceptual framework within which different logics operate as specialised tools.

The second interviewee that inhabits Region 5, [G], does not commit to strong monism but to a more moderate version. In their answer to the question about pluralism, they emphasised that they oppose relativistic forms of pluralism , according to which an inference may be correct according to one logic and incorrect according to another one, without there being any way to decide which is right

and which is wrong. This interviewee believes that once one has established what the main primitives in one's logic mean, then there is no room for pluralism. This suggests a commitment to the position that there is only one logic.

However, the interviewee also acknowledged that in practice different logics might be needed to capture different aspects of an application. That indicates a more pluralistic stance on the demands of application and the demands of practice dimensions. Whereas interviewee [E] grounds pluralism in the idea of logic as a collection of instruments and sees all systems as expressions of a single logical framework, interviewee [G] distinguishes more sharply between theoretical unity and practical diversity. For them, pluralism in use does not undermine the underlying unity of logic. Rather, it reflects the complexity of the domains to which logic is applied. In this way, both positions converge on a vision of 'soft monism', – one that preserves the ideal of a unified logical foundation while recognising the legitimacy and necessity of using multiple logics in practice.

4.4 Regions 1 and 4

We group Region 1 and Region 4 together because the three interviewees that inhabit these two regions share similar positions on pluralism. Each of them notes that, in practice, the logical systems used in their application areas are largely fragments of classical predicate logic – either first-order or second-order. Hence, along the nature of logic dimension, they are all located at the position that there is only one logic, a view grounded in their working experience with classical logic.

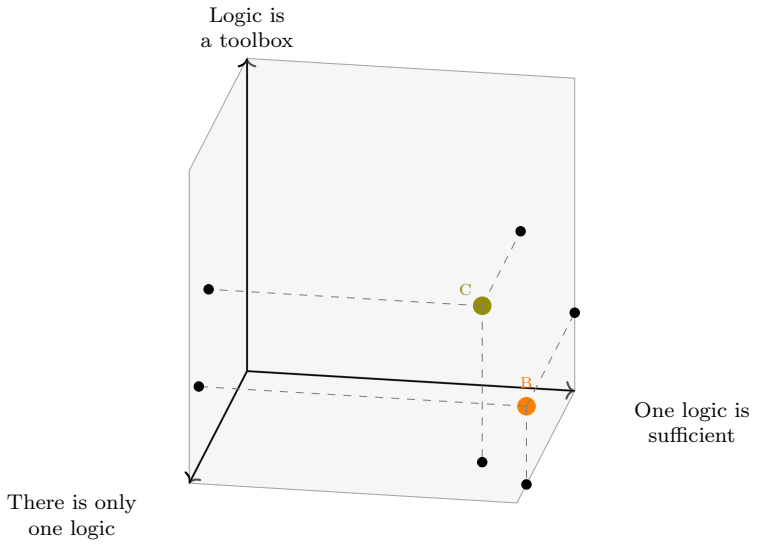

Figure 7: Region 1

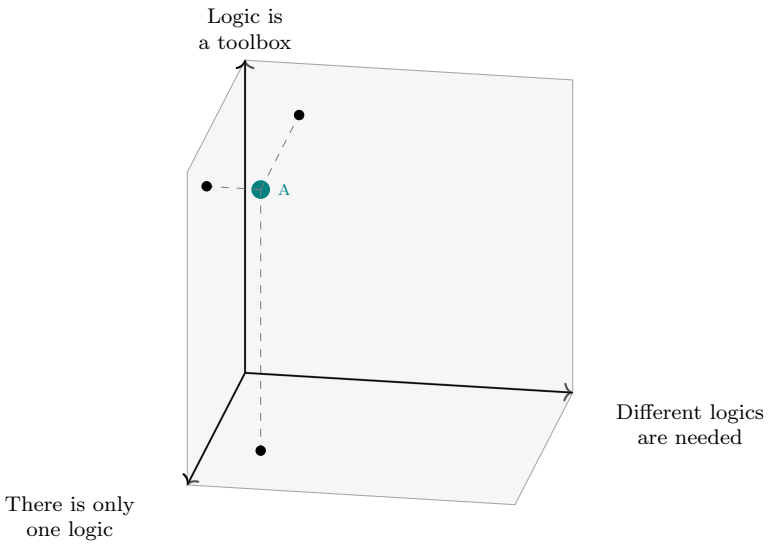

Figure 8: Region 4

However, there are also differences. The two interviewees in Region 1, [C] and [B], emphasised that the logics they work with can, in most cases, be faithfully translated into classical first-order logic or into fragments of second-order logic. This is why we placed them quite close toward the position that one logic is sufficient for capturing the application in the demands of application dimension. The interviewee who inhabits Region 4, [A], did not make such explicit claims and is therefore positioned further away from that position.

At the same time, all three interviewees agreed that logic is a toolbox and explicitly rejected the view that everything can be done in one logic. This suggests that there is a tension in their thinking between monism and pluralism. On the one hand, they see logic as unified in principle –a single framework of reasoning that grounds all others. On the other hand, they recognise that, in practice, no single system can handle every kind of problem with equal clarity. Different domains may call for different formal tools, even if these tools ultimately rest on the same foundation. Their position, therefore, presuppose that theoretical monism can be combined with practical pluralism.

4.5 Region 3

Region 3 represents the most pluralistic area within the conceptual space, characterised as it is by a strong endorsement of pluralism across all three dimensions. It is also the most densely populated one: the majority of interviewees –five in total– are located in this region. Rather than using the singular term 'logic' the interviewees in this area prefer the plural 'logics' to describe their research. In application

areas such as mathematics, computer science and philosophy, they do not think applications fix their logic. Instead, they believe that different logics are needed to capture different aspects of the same application area.

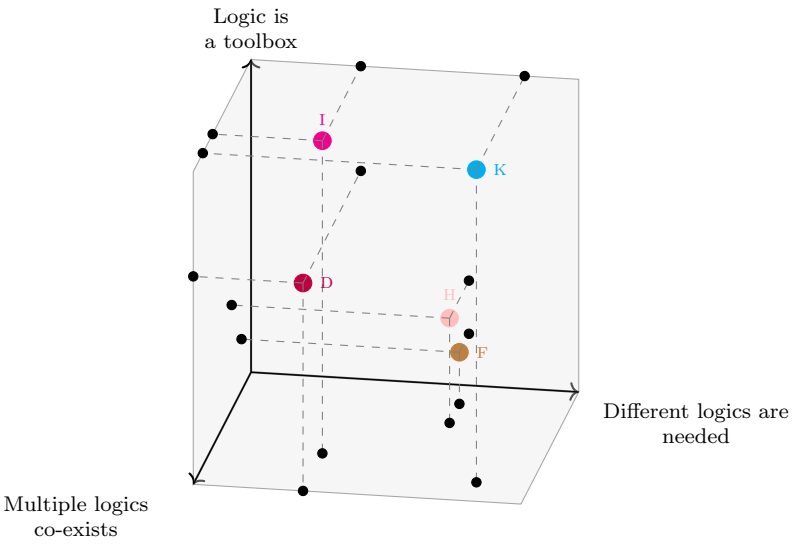

Figure 9: Region 3

The examples cited by the interviewees in support of their positions provide ample illustration of their pluralistic attitudes. For example, interviewee [D] notes that mathematics as such does not force one to use a specific logic and that different logics can be used to study different parts of mathematics. Another example comes from temporal logic. Various interviewees, e.g., [I] and [B], observed that there are many different formal systems that can be used to understand temporal aspects of reasoning, though these systems may describe them in quite different ways. Or consider quantum phenomena: often cited as requiring a non-classical logic, interviewee [D] claims that classical logic with dedicated modal operators may do the job as well. Even though these systems can often be translated into one another, they still offer different perspectives on the same phenomena and can be extended to new contexts. Even when two logics have the same expressive power, one may prove more convenient or illuminating for a particular purpose.

This pluralistic stance is not merely about using different symbols or formal systems. By allowing multiple frameworks to co-exist, researchers can approach the same questions from complementary angles. Pluralism here is seen as a way to increase understanding rather than to fragment it. Different logics highlight different structural features of reasoning and reveal connections that might otherwise remain hidden.

Note that the interviewees in Region 5 hold that once an application is

fixed, one logic is sufficient to capture it. For them, diversity arises only when moving *between* domains. The interviewees in Region 3, however, maintain that even *within* a domain, multiple logics may be equally valid and jointly useful. This contrast shows a shift from monism in principle to pluralism in practice: diversity is not a symptom of confusion but a deliberate methodological choice.[5]

5 Conclusions

We end this qualitative analysis of positions with regard to pluralism with some general observations about the distribution of interviewees in the conceptual space we have constructed. Figure 10 then presents the 'sculpted space inhabited'.

Firstly, regardless of their individual positions, most interviewees accept a simple form of pluralism: there are many logics in the world. At the same time, most logics used in applications are fragments or variants of more complex systems, and their semantics can often be treated as objects within set theory or model theory. Where interviewees differ is in how they interpret the meaning of this plurality. For some, the existence of multiple logics is merely a descriptive fact: different systems serve different technical purposes but do not challenge the idea of a single underlying logical core. For others, the diversity of logics reflects genuine conceptual differences, suggesting that the very notion of logic itself may vary depending on context, goals, kind of reasoning involved. This interplay between unity and diversity sculpts the conceptual space and determines how the interviewees position themselves between theoretical monism and practical pluralism.

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5. That being said, there are notable differences between these interviewees, reflected in the different positions they occupy in Region 3. We can discern three clusters. The first consists of interviewees [F] and [H]: they hold a position that bears a similarity to that of A in Region 4, the difference being that these interviewees hold that an application may permit multiple coexisting logics.
The second cluster covers interviewees [D] and [I]: they stand out because of their commitment to the position that multiple logics co-exist. On this view applications do not determine a specific logic but rather inspire call for application of a range of different ones. These interviewees do differ among themselves in their views whether multiple logics are in fact required to fully capture a single application. Uncertainty at this point is correlated with uncertainty on the demands of practice dimension: different logics might serve particular practical purposes, yet it remains unclear whether such diversity necessarily contributes to a deeper understanding of the application itself.
The third cluster is formed by [I] and [K]: they fully adopt the view that logic is a toolbox on the demands of practice dimension. For them, the choice of logic depends primarily on the specific goal of a project, with meta-properties of logics –such as decidability, traceability, or computational efficiency– playing a central role. Their views diverge slightly regarding how such practical considerations influence inquiry into the application. Whereas [I] does not emphasise these pragmatic factors, [K] maintains that different logics motivated by such considerations may each offer distinct contributions to our understanding of the application.

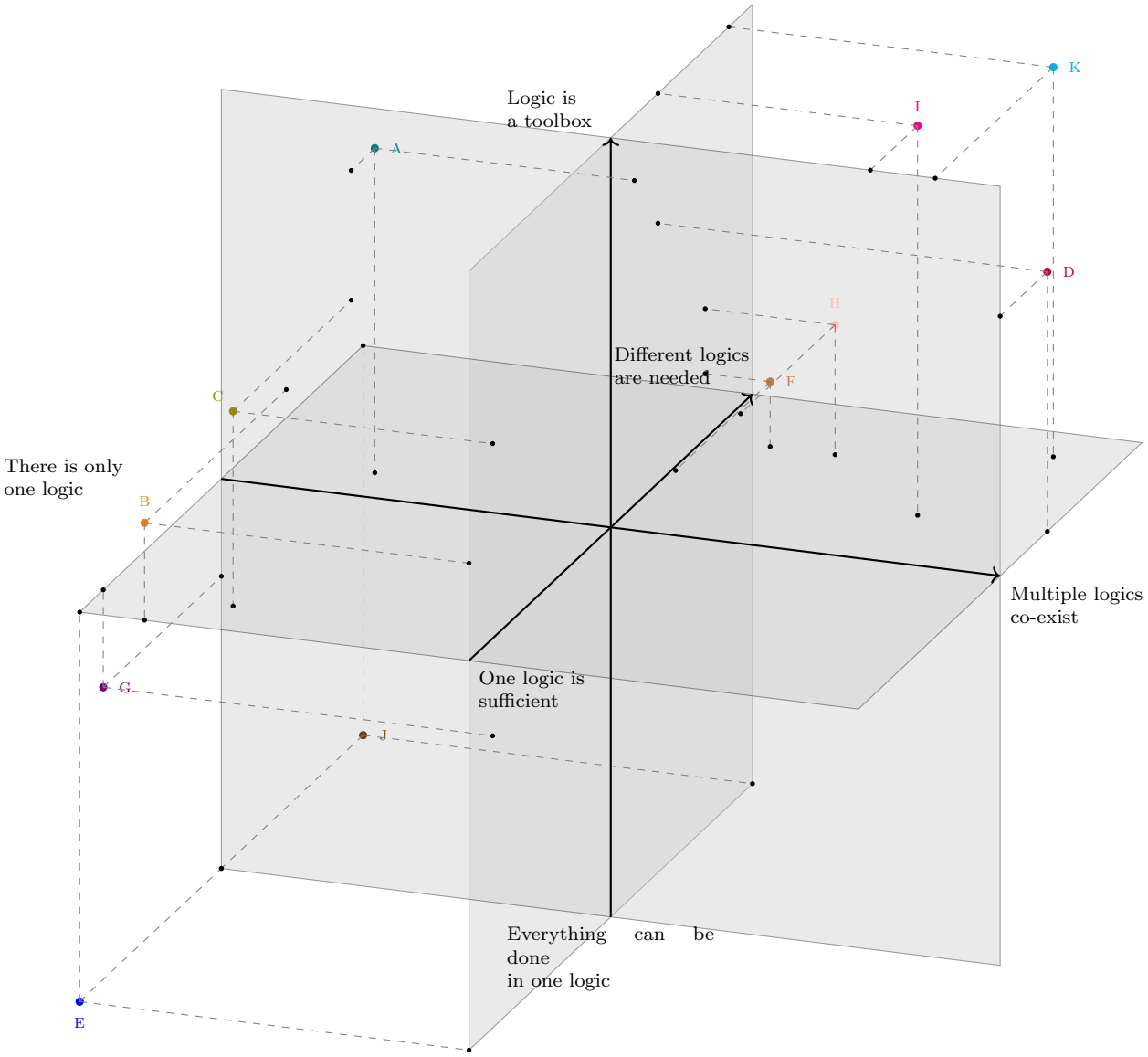

Figure 10: The sculpted space inhabited

Secondly, several interviewees adopt what may be called a 'two-level view' of pluralism. They combine a monist attitude toward the nature of logic with a pluralist attitude toward its application. In principle, logic is seen as unified, grounded in a single framework; in practice, however, multiple logics may be needed to analyse different aspects of reasoning, language, or communication.

Thirdly, the overall pattern shows that most interviewees lean toward pluralism not as a rejection of uniqueness but as a practical way of dealing with complexity. Even when two logics describe the same phenomena and share the

same expressive power, they may emphasise different features of those phenomena and therefore prove useful in different ways. Pluralism, for most of them, is thus less a statement about the nature of logic than a recognition that multiple perspectives can co-exist within one coherent view of what constitutes logical inquiry and application of logic in non-logical domains.

Finally, it is worth noting that several interviewees who endorsed pluralism referred to research in AI as an example when discussing the practical advantages of using multiple logics. In that area, they observed, different frameworks –temporal, epistemic, probabilistic, and so on– are used to model different aspects of reasoning and information processing. To them this demonstrates the value of pluralism in practice. Other interviewees, however, who have a more monist orientation observed that the success of AI lies precisely in its ability to integrate diverse reasoning systems within a single computational framework. This contrast suggests that AI offers an interesting test case for logic application. It illustrates both the practical power of logical diversity and the possibility that such diversity might still rest on a unified foundation.

As we hope the analysis in the foregoing has shown, and as the overall picture also illustrates, pluralism and monism are not radical opposites, they do not present a 'yes-or-no' kind of choice. Rather, the complementary pulls of unity and diversity call for nuanced views that strike a balance between these two opposites. The multiplicity of positions that we have identified in the interviewees' responses reflect a multiplicity of ways to understand what logic is and how it can be applied in non-logical domains. That the positions of contemporary logicians display such a richness of views and arguments is, we are convinced, the opposite of a weakness: it is a strength to foster and take advantage of.

References

J. Azzouni. How and why mathematics is unique as a social practice. In B. Van Kerkhove and J.-P. van Bendegem, editors, *Perspectives on Mathematical Practices. Bringing Together Philosophy of Mathematics, Sociology of Mathematics, and Mathematics Education*. Springer, New York, 2007.

J. Beale and G. Restall. Logical pluralism. *Australasian Journal of Philosophy*, 78(4):475–493, 2000.

J. Beale and G. Restall. *Logical Pluralism*. Oxford University Press, Oxford, 2006.

R. Carnap. *The Logical Syntax of Language*. Routledge & Kegan Paul, London, 1937.

P. Du, Q. He, Y. Ji, W. Ouyang, W. Zheng, and M. Stokhof. Logic and application. A Survey. Technical report, Tsinghua University and University of Amsterdam Joint Research Center for Logic, Tsinghua University, Beijing, December 2025.

G. Frege. *Begriffsschrift. Eine der arithmetischen nachgebildete Formelsprache des reinen Denkens*. Louis Nebert, Halle a.S., 1879. English translation in van Heijenoort 1970.

P. Mancosu, editor. *The Philosophy of Mathematical Practice*. Oxford University Press, Oxford, 2008.

T. R. Schatzki. *Social Practices. A Wittgensteinian Approach to Human Activity and the Social*. Cambridge University Press, Cambridge, 1996.

T. R. Schatzki. *The Site of the Social*. Pennsylvania State University Press, Pittsburgh, 2002.

E. Stei. Rivalry, normativity, and the collapse of logical pluralism. *Inquiry*, 63 (3-4):411–432, 2020.

B. Van Kerkhove, editor. *New Perspectives on Mathematical Practices. Essays in the Philosophy and History of Mathematics*. World Scientific Publishers, Singapore, 2009.

L. Wittgenstein. *Tractatus Logico-Philosophicus*. Suhrkamp, Frankfurt a/M, 1960.

L. Wittgenstein. *Philosophical Investigations*. Wiley-Blackwell, Oxford, 2009. Translated by G. E. M. Anscombe, P. M. S. Hacker and J. Schulte. Revised fourth edition by P. M. S. Hacker and J. Schulte.