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van Benthem, J.

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One Logician's Perspective on Argumentation

La perspectiva de un lógico sobre la argumentación

Johan van Benthem
Institute for Logic, Language and Computation, University of Amsterdam,
Amsterdam, The Netherlands
Department of Philosophy, Stanford University, Stanford, United States
johan@science.uva.nl

Abstract: Logic is often considered a technical subject, far removed from the concrete reasoning and discussion that we all practice in daily life. Understanding and improving that ordinary reasoning is then seen as the task of argumentation theory, which has operated independently from logic for a long time. But the discipline of logic has been undergoing a practical turn over the last decades, with my own work on logical dynamics of agency and intelligent interaction as an example. On the occasion of the death of Stephen Toulmin, a pioneer in modern argumentation theory and a prominent critic of mathematics-centered logic, I take a fresh look at what are usually considered major differences between daily practice and logical theory: the role of richer argument schemata and of procedural aspects of reasoning. I argue that these are in fact shared interests, making logic and argumentation theory allies rather than rivals.

Keywords: Logic, argumentation theory, dynamics, procedure, inference schema.

Resumen: La lógica a menudo es considerada como un tema técnico, lejos del razonamiento concreto y las discusiones que practicamos en nuestra vida cotidiana. Comprendiendo y mejorando esto, el razonamiento ordinario es entonces visto como la tarea de la teoría de la argumentación, la que ha operado independientemente de la lógica por un largo tiempo. Pero la disciplina de la lógica ha estado promoviendo un giro hacia lo práctico en las últimas décadas, siendo mi propio trabajo en lógica dinámica de agentes e interacción inteligente un ejemplo. Con ocasión de la muerte de Stephen Toulmin, un pionero en la teoría moderna de la argumentación y un prominente crítico de la primacía de la lógica matemática, aquí desarrollo una mirada al día de los que usualmente son considerados los mayores puntos de diferencia entre la práctica cotidiana y la teoría de la lógica: el rol de una más rica esquematización argumentativa y los aspectos procedimentales del razonamiento. Sostengo aquí que

estos puntos son en realidad de interés compartido, colocando a la lógica y la teoría de la argumentación como aliadas antes que como rivales.

Palabras clave: Lógica, teoría de la argumentación, dinámica, procedimiento, esquema de inferencia.

1. Introduction: Logic and argumentation theory

When I was a student around 1970, two courses on the subject of reasoning were taught in the same semester at the University of Amsterdam. One was on logic, attracting a small band of students in a marginal classroom; the other was on argumentation theory, packing a whole auditorium in the historic city centre with hundreds of students from many disciplines keen on improving their skills. Things have not changed much, I think, and the same difference would show if our students were offered a free choice today. Now this may be just the choice between Broad and Narrow Paths in life (Bunyan 1678). But there is more to the connection between logic and argumentation theory than relative popularity. Logic may be a normative mathematical study of valid inference patterns, but it is not disjoint from the realities of human reasoning – and logical theory has been influenced by ideas about common sense reasoning.[1] And practical reasoning and the practice of argumentation have an undeniable stability that gives logic in some form of grounding in reality, even though logic textbooks hardly reflect any of this.[2]

I have been interested for a long time in the connections or lack thereof, between logic, general argumentation theory (van Benthem 1996B) and legal reasoning (van Benthem 2001). And that interest came from reading 'forbidden books' in my days as a logic student, namely, Perelman & Olbrechts-Tyteca 1958 and Toulmin 1958. Both Perelman and Toulmin knew

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[1] Logic and artificial intelligence meet in the area of common sense reasoning: see Gabbay, Hogger & Robinson, eds., 1995. Logic and multi-agent systems in computer science are another thriving area: cf. Wooldridge 2002, Shoham & Leyton-Brown 2009. Finally, Hodges, Hodges & van Benthem 2007, van Benthem 2007A discuss current connections between logic and empirical cognitive science. And we will mention bridges between logic and argumentation theory later.

[2] The standard philosophical and mathematical textbook image of the field ignores the many links of logic with practice. A shining exception is Bennett 2004, who takes in psychology of reasoning.

modern logic well, and became disappointed with what it delivered in terms of understanding real argumentation. Both then abandoned it in favour of other approaches (traditional rhetoric, new styles of argument analysis) in a way that created alternative schools. Both authors also looked for a counter-weight to the mathematics-centered modern logic, turning to the Law as the major other paradigm of reasoning in human culture, at least as old as mathematics. Stephen Toulmin just died last year (http://www.nytimes. com /2009/12/11/education/11toulmin.html). This paper is a very brief commentary on his ideas in the light of modern developments in logic.

2. Rich formats of inference: the Toulmin Scheme

Inference formats Standard logic offers us only a simple binary scheme for the notion of inference:[3]

$$Premises \longrightarrow Conclusion$$

Toulmin's scheme for the structure of argument is more natural and evident, once you see it. Instead of a bare binary transition from premises to conclusions, it offers a format

For instance, I may claim that my trip will probably not end in Amsterdam today, given current snow conditions (the data) and some unfortunate

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[3] Incidentally, modern logic has several richer non-binary inference schemes with ideas not found in Toulmin. In particular, *situated inference* grounds discourse in reality (Barwise & Perry 1983, van Benthem & Martinez 2008), and most entailment then works *across situations,* with a much richer structure of information flow in argument (Barwise & Seligman 1995, Barwise & van Benthem 1999).

general features of the Dutch railway system (the reason). These features are based on many things, including the laws of physics and social contracts. But my claim is not absolute (claims seldom are), as there can be circumstances that defeat it, such as a sudden dramatic change in the weather. More generally, we make claims on the basis of data at our disposal, but there also needs to be a connection (the reason, or 'warrant') that itself may need further backing. Moreover, we usually make a claim with some force, stronger or weaker, marked by qualifiers like "certainly", "probably" that may come with an indication when the claim can be overridden ('rebuttals'). While not every concrete inference needs to have all these elements present, the scheme is a rich way of seeing many crucial aspects of ordinary reasoning. Finally, unit schemes can be linked to get broader maps of argument.

A practical turn: logic, common sense, and cognition My first point is simply that none of this is controversial today. While Toulmin's views may have been in sharp contrast with mathematical logic at the time, things have changed. The idea that inference comes in different forces, depending on the task at hand, has become widely accepted since the 1980s. One engine of change here has been the *semantics of natural language*, where ever more subtleties of ordinary speech and reasoning made their way into logical theories (cf. van Benthem & ter Meulen, eds., 1997). But a more powerful influence has been the study of *commonsense reasoning* in AI, that turns on just the above default character of most practical tasks (McCarthy 1980). The resulting systems for practical reasoning are often called *nonmonotonic logics,* since a conclusion based on some data may have to be withdrawn when more data come in. This has resulted in a broad stream of literature (cf. Gabbay, Hogger & Robinson, eds., 1995; Restall 2000), and even a philosophical doctrine of Logical Pluralism seeking the essence of logic in a broad arsenal of reasoning styles. Another take on this diversity, related but technically different in the end, shifts the focus a bit. Our actions are based on beliefs, rather than knowledge, since that is all we can go by. This may result in claims that may turn out to be wrong, but then a second major cognitive ability swings into action, namely, the ways in which we can *correct ourselves*, retract conclusions, and *revise beliefs*. Inference and revision go hand in hand in modern logical theories.

Toulmin's view seemed threatening at the time: standards of inference are task-relative, and logic with its universal claims must be rejected. But the opposite has happened. The diversity experience has enriched the discipline of logic, and given it much wider scope.[4] With a time lag of a few decades, logic has absorbed similar ideas to Toulmin's, largely through meetings with computer science and artificial intelligence. These richer views extend into cognitive science, witness the role of default logics in cognitive psychology and brain research (cf. the papers in Hodges, Hodges & van Benthem 2007).

Logic and argumentation theory today There is a lot to be compared, and merged, then between parallel research tracks in argumentation theory and modern logic. But I am not claiming any originality for this view. After all, this is precisely the point of the efforts of Walton & Krabbe 1995, Gabbay & Woods, eds., 2002, Prakken 1997, and many other authors bridging the divide between the two fields. Perhaps, to add something less irenic, some informal paradigms in current argumentation theory might acquire some more dynamics with a dose of logical insights from the last decades, while they would also benefit greatly from linking up with cognitive science, the way logic is trying to.[5]

Two historical analogies Going back to the Toulmin scheme, I end with two historical analogies. The first is with *Bernard Bolzano*, the great pioneer of modern logic (Bolzano 1837, cf. van Benthem 2003). Bolzano saw the task of logic as charting different natural styles of reasoning in different settings: deductive, probabilistic, or strict philosophical. Bolzano also predates Toulmin in not placing the central emphasis on logical forms with key words like "not", "and", "or", "all", "some". But he does not dismiss form altogether. He acknowledges the crucial role of function words versus content words in natural reasoning (this is just a simple evident fact) and indicates how this is not an alien mathematical abstraction, but a feature

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[4] Many specific features of the Toulmin schema are in fact topics in current logical research. The two-tier structure of Warrant and Backing is reflected in modern accounts of informational data bases, where inferences from data are often crucially determined by a hierarchically organized background theory, ranging from core laws to less entrenched assumptions. Likewise, the Qualifier and Rebuttal are central to non-monotonic logics and various explicit triggers for belief revision.

[5] As for the opposite direction from argumentation theory to logic, see below.

that arises naturally in our linguistic reality.[6] [7] Bolzano's logic was not well known in Toulmin's day - but my next example gets closer.

Another analogy that strikes me is with the *Hempel-Oppenheim* scheme of explanation (Hempel & Oppenheim 1948), predating the Toulmin schema by a decade. Philosophers of science had long noted that standard logical consequence will not do for the variety of reasoning found in science: explanation, prediction, confirmation, refutation, and so on. One famous scheme for explanation that was then proposed was this:

Known facts ———————————————————→ New evidence

Hypothesis   'Under normal circumstances'
Background theory   Auxiliary assumptions

A new piece of evidence is derived from known facts with the help of some hypothesis in a background theory. Moreover, the inference is only 'under normal circumstances', a crucial rider in common sense default reasoning as well as much of science.[8] Now this scheme has been criticized. Its applications tried to assimilate too much into a classical logic after all, making things complex (neopositivism died from internal complexity rather than external criticism) – where one would opt for nonmonotonic logics today. But my point remains. Right in Toulmin's 1950s, we see parallel observations on a practice that clearly goes beyond standard logic. But logic is *not abandoned, but enriched.*

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[6] Just Google for a list of most frequent words in English, and you will be amazed how dominant function words are in our actual natural language discourse, with logical ones high up. Here is one list out of many http://www.edict.com.hk/lexiconindex/frequency-lists/words2000.htm.

[7] Of course, the variety of reasoning is also still a central theme in the 19th century with C. S. Peirce, as in his famous triad of deduction, induction, and abduction (Peirce 1933).

[8] The inference can be made classically valid by filling in all relevant auxiliary assumptions, but these are seldom available. The more insightful formalization leads to studies of conditional reasoning, initiated by Goodman and brought to logic in the 1960s by Lewis and Stalnaker (see the survey in van Benthem 2006). Conditional logic and the above nonmonotonic logics have much in common, as both emphasize conclusions that hold, not in all models of the premises, but only in the 'closest' or 'maximal' ones in some relevant task-dependent ordering of all the possible situations.

Toulmin's decision to break away from logic was fateful, and in the light of the above, I wonder how justified it really was.

3. Logical dynamics: Toulmin's form versus formalities

Toulmin's opposition to the role of logical form as the engine of reasoning may have been somewhat extreme, but it did lead to one wonderful insight. In one passage, he speaks of replacing mathematical form by juridical *formalities*, i.e., the procedure by which we draw inferences, and the importance of procedure in argumentation generally.

Logical dynamics Now this, to me, is right on the mark – and it does point at a major theme that has been neglected in modern logic. Reasoning is an *activity*, functioning among many forms of information flow, and agents like us are constantly performing acts of observation, inference, belief revision, or evaluation that guide our behaviour. Moreover, crucially, we do not do this in isolation, but *interactively* with others: pure deduction on one's own is an extreme case. Now modern logic just studies some products of such acts, such as inference forms, or static instantaneous knowledge and beliefs of agents. It does not study those acts themselves, even though only the latter create the products, and make sense of them. Making the actions that drive rational agency first-class citizens is the program of Logical Dynamics that I have long pursued (van Benthem 1991, 1996A, and in the guise of 'dynamic epistemic logic': van Benthem 2010).

It would be tedious to make an extended plea for my own views here, and even more tedious to try and enlist Toulmin's 'formalities' for my own purposes. Suffice it to say that I think that logic should, and can, incorporate a wide variety of dynamic viewpoints, without giving up its classical methodological standards. In particular, current systems of dynamic epistemic logic describe both what agents know or believe or prefer at a given moment, and how these attitudes change as events happen that are part of the logical system: observations, questions, commands, or any acts of communication.[9]

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[9] Logical Dynamics is new to most logicians or philosophers. But I am confident that procedural views will prevail: they reflect a cognitive reality that cannot be denied.

History once more In fact, again in the 1950s, seminal dynamic ideas were around already. The analysis of reasoning in the famous *dialogue games* of Paul Lorenzen (cf. Lorenz & Lorenzen 1978) makes success in argumentation a matter of winning strategies for proponents of claims against opponents granting the premises. And casting reasoning in this way so did two things. First, it put the traditional logical constants in an entirely new light, as functional *control expressions* for moves in games, such as choosing options for continuing the debate, or switching roles between defense and attack. But also, it highlighted the crucial role of *procedure* (who speaks when, who can attack or defend what) in determining which inferences come out valid: classical, intuitionistic, or otherwise. Thus, years before Toulmin's book, logic had already started developing tools for some of the very things he was asking for: formalities, and task dependence.[10]

Logic, procedure, and games I conclude with a few points strengthening the connection between formalities and dynamics. First, on the Logical Dynamics stance, the Toulmin schema is a static 'product projection' of dynamic activities that can be studied explicitly. Take the role of the qualifier. This is a minimal code for actual *acts of revision* that agents undertake when forced by new information, either by observation of external facts or by internal pressures of discourse.[11] Thus, the scheme calls for a richer theory beyond classification, adding explicit accounts of the dynamics of changing claims over time, as new events happen.[12] Thus, I claim that one should go further than Toulmin's own scheme – and one very effective tool for doing that is using not less, but *more logic*!

This fits with a more general perspective on the controversy (if there is one left) between logic and argumentation theory. Historically, logic probably had its origins in dialectical and legal practice, but it was the *combination*

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[10] Significantly, modern informal argumentation paradigms like *pragma-dialectics* (van Eemeren & Grootendorst 2004) merge ideas from the Lorenzen and Toulmin traditions.

[11] I agree that logicians could still pay more attention to the study of explicit qualifier vocabulary, as well as related discourse particles like "but" and "even so". But there is no taboo on this subject, and some interesting formal studies of discourse dynamics can be found in the semantics of natural language.

[12] Another hook for dynamics is the slot for Warrant and Backing, but I skip that here.

of these origins with mathematical methodology that produced its great strength and staying power.[13] [14] To show this beneficial coexistence more concretely, Toulmin's opposition of 'form' and 'formalities' is untenable. Formalities have procedural structure, and that structure can be studied by bringing out the major operations creating it in a mathematical formalism. Put simply, *formalities have form*, there is no opposition. And as we saw with Lorenzen dialogues: one very powerful locus of procedural form are precisely those logical constants that Toulmin held in so little esteem, now in their game-theoretic interpretation.

4. Joint concerns: argumentation perspectives in logic

My final thoughts continue the juxtaposition of logic and argumentation.

Argumentation can enrich logical systems One key theme in logics of information flow and procedure is a multi-agent perspective. Information is usually obtained with others in conversation, experiment, or in education with students and teachers. Even our individual actions are typically driven by a mixture of what we know about physical facts and about what others know or do not know. Now, argumentation is a paradigmatic setting for this, as it is typically done with *others*, and it provides what logical theory needs: a concrete source of experiences and intuitions. Lorenzen dialogue games and others (cf. the survey in van Benthem 2007A) have provided some logical models for 'many-mind problems'. But more can be done, since the phenomenon is so rich. Agents can argue among themselves, or with a referee,[15] debates can have many purposes with different features, from common sense to specialized legal practices. Also, the nature of the assertions on the table can vary widely, and so can procedures of deliberation. There is room for logics of scenarios, and a systematic description of what

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[13] As I have put it elsewhere, Plato's *Dialogues* had to meet with Euclid's *Elements*.

[14] The same can be seen today. *Pace* Toulmin and Perelman, Logic and the Law are not competing cultural paradigms, but complementary ones with many fruitful interactions.

[15] Lorenzen games naturally invite further players: a *Judge*, or even a *Jury*.

information flows in them, following up on the seminal work that has been done (cf. Gabbay & Woods, eds., 2002).[16] [17]

This said, argumentation has not yet penetrated Logical Dynamics as it should. Consider the key topic of belief revision, a corrective mechanism to over-eager non-monotonic inference. Most logics so far have anonymous signals that trigger belief changes in single agents, rather than a setting of argument where being contradicted *by specific other agents* is one of the most powerful levers for change. It seems promising then to merge dynamic logics of information flow with concrete models of argumentation.[18] [19]

6. Conclusion

Looking back at Toulmin's seminal work, I feel a lot of resonance with the broad program of logical consequence (and in my case, dynamics) that many of us are pursuing today. He was right in many of his major observations, but I would say that he was wrong in his decision to leave the party. Working together, argumentation theory and logic can advance along Toulmin's lines extending both practical coverage and theoretical insight. And while

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[16] For illustrations in games, look at the analysis of game-theoretic conversation scenarios with disagreements in beliefs or assertions of rationality of players in van Benthem 2007B, Dégrémont & Roy 2009, Baltag, Smets & Zvesper 2009. These should dispel any lingering idea that logicians cannot analyze subtle conversational scenarios with surprising outcomes.

[17] This need not be monopolized by Lorenzen dialogues. Indeed, these have special features that may be less suitable, for instance, the fact that Opponent is doing nothing much except obstructing Proponent in his flights of fancy. Other logic games give equal weight to a proponent making a claim and an opponent claiming consistency by building a model verifying specified assertions. This is closer to existing practices like the roles of prosecutors and lawyers in court.

[18] Some attempts in this direction exist: cf. Rahman & Keiff 2005.

[19] *An obstacle: semantics versus syntax?* Things may not be entirely smooth. One barrier in merging logic and argumentation may be the different notions of *information* that play in multi-agent activities. There is semantic information in the style of Carnap and Hintikka as ranges of options, but also fine-grained syntactic information produced by inference (cf. van Benthem & Martinez 2008), and perhaps even a third kind of 'procedural information' (van Benthem 2010). It has been proposed to merge things in terms of *awareness*, where the point of an inference is to turn implicit knowledge induced by the premises into explicit knowledge (van Benthem & Velázquez-Quesada 2009). But this may not be the crux in argumentation, where the major notion seems to be neither awareness nor information, but *commitment* with respect to assertions on the table. There are no good dynamic epistemic logics with commitment dynamics yet.

logic has many interdisciplinary partners for romantic walks these days, including philosophy, mathematics, computer science, game theory, and cognitive science, I am not sure where argumentation theory is heading if it stays on its own.

Finally, I did hear Toulmin speak a few years ago in the historical Westindisch Huis in Amsterdam, and the above issues were already on my mind. But he was speaking on a very different subject, standing in a cocoon of fame, and shielded from the audience by throngs of cultural officials. I just went home without talking to him – and now wish I had not.

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