# Foreword

*Following initial benchmarks like Jan Plaza's public announcement logic (Plaza, 1989), Johan van Benthem's dynamic modal setting of AGM theory revision (van Benthem, 1989), and Gerbrandy and Groeneveld's mix of dynamic update operators and epistemic operators (Gerbrandy* et al.*, 1997), logics mixing epistemic and dynamic logic became more and more popular. They have been studied under the denomination* dynamic epistemic logics *(DEL). One of the parameters of dynamic epistemic logics is the kind of epistemic operator that is considered, ranging from individual to common knowledge, and another parameter is the kind of change that can be modelled, ranging from public to private events.*

*In dynamic epistemic logics it was 'historically' problematic to revise beliefs—please excuse us for referring to developments older than a few years in that way. The intended notion is frequently knowledge, and an agent's knowledge has the advantage of being correct: there is no need ever to revise it. Even when weaker notions are modelled, such as introspective belief, one can only model the belief change that correponds to increasing certainty of belief. This does not take into account that the beliefs entertained by an agent might be erroneous, and that upon learning new information that contradicts current beliefs an agent must revise his beliefs. A complete account of action and belief requires therefore the inclusion of* belief revision *mechanisms. The need for such mechanisms is particularly obvious in Alexandru Baltag et al.'s influential generalisation of public announcement logic (Baltag* et al.*, 1998) and variants thereof, where events are no longer public, but may be perceived incompletely or erroneously by the different agents: erroneous perception of the (truthful) announcement of* $p$ *as the announcement of* $\neg p$ *will lead to erroneous beliefs.*

*Of course, such belief revision has always been the core of the area even known as 'belief revision'. In the classical version of belief revision as proposed by Carlos Alchourrón, Peter Gärdenfors and David Makinson in 1985 (Alchourrón* et al.*, 1985), a deductively closed theory* $T_a$ *is revised with a formula* $\varphi$*, resulting in a revised theory* $T_a * \varphi$*. Typically, the negation of* $\varphi$ *is in* $T_a$ *and has to be 'retracted'. The contents of* $T_a$ *is a set of propositional formulas that are viewed as the set of beliefs held (accepted) by a given agent* $a$*. Such a representation only accounts for* $a$*'s first-degree beliefs: we cannot reason about* $a$*'s beliefs about other agents' beliefs, as required in typical applications of epistemic logic. In his seminal paper* Two traditions in the logic of belief: bringing them together *(Segerberg, 1999) Krister Segerberg proposed to model belief revision within dynamic epistemic logic, and defined an integration of the logic of belief with propositional dynamic logic PDL. The combination is called* dynamic doxastic logic *(DDL). Segerberg was also motivated by Johan van Benthem's already mentioned dynamic (but not epistemic) modelling of AGM theory revision (van*

*Benthem, 1989). In Segerberg's setting a pointed Kripke model for belief in the theory $T$ satisfies in particular $\boldsymbol{B}_a\neg\varphi$ (agent $a$ believes that $\varphi$ is not the case), and a dynamic modal operator $[*\varphi]$, for 'belief revision with $\varphi$', is interpreted as an epistemic state transformer $R^{*\varphi}$. In the resulting epistemic state then holds $\boldsymbol{B}_a\varphi$. We now can write $\boldsymbol{B}_a\neg\varphi \wedge [*\varphi]\boldsymbol{B}_a\varphi$ to express that agent $a$ initially did not believe $\varphi$ but after revision with $\varphi$ now does believe that $\varphi$. Several other approaches have followed in recent years, also providing computational semantic ways to effect such belief revision. These dynamic epistemic approaches to belief revision provide in a natural fashion for multi-agent belief revision, for belief revision with epistemic beliefs, and provide refreshing insights on irrevocable belief revision and iterated belief revision. Belief revision with epistemic beliefs takes place when an agent reflects on his own beliefs, but also when an agent reflects on the beliefs of other agents. It is also known as higher-order belief revision.*

*The above described recent convergence of the theory revision tradition and the dynamic modal tradition in logics for changing knowledge and belief motivated us to bring together not only the logics, but also the researchers. In August 2005 we organized a workshop at the European Summer School on Logic, Language and Information (ESSLLI) in Edinburgh entitled* Belief revision and dynamic logic. *The workshop program committee consisted of, in alphabetical order: Alexandru Baltag, Johan van Benthem, Richard Booth, John Cantwell, Samir Chopra, Jim Delgrande, Robert Demolombe, Jelle Gerbrandy, Guido Governatori, Wiebe van der Hoek, Barteld Kooi, Willem Labuschagne, Jérôme Lang , Hector Levesque, Thomas Meyer, Abhaya Nayak, Maurice Pagnucco, Hans Rott, Krister Segerberg, Steven Shapiro, Keith Stenning, Rineke Verbrugge, and Renata Wassermann. Several papers were selected for presentation at the workshop after a first reviewing round. After the workshop, some of the presenters were invited to submit a new version of their paper to a special issue of the Journal of Applied Non-Classical Logics. After a second reviewing round we accepted eight papers. Unfortunately, due to restrictions in length of a JANCL issue we were not able to include all papers in one volume of the journal. Aucher's contribution was published in the regular issue JANCL 16:1, and we kindly acknowledge his willingness to help us out with this solution. The present issue JANCL 16:2, entitled* Belief revision and dynamic logic, *contains the remaining seven papers. The papers have been placed in alphabetical order. We now summarily present all contributions.*

*Guillaume Aucher's paper* Interpreting an action from what we perceive and what we expect *proposes a generalization of Baltag et al.'s account of event perception (Baltag* et al., *1998) to the probabilistic case. He shows that Baltag's construction of the beliefs after an update as an independent combination of the beliefs before the update and the perception of the event has to be augmented by the agent's expectation about that event. This construction takes the form of a product involving the three kinds of information.*

*In his paper* Dynamic Logic for belief revision, *Johan van Benthem proposes to add preferences between worlds in order to model plain and conditional belief, and also belief change that can be seen as updating preferences. He presents a wide scala*

*of ways to combine knowledge, belief, and dynamic operations for integrated knowledge and belief change, including axiomatic schemata relating conditions before and after belief change. A typical distinction is between processing 'soft' information that results in updating plausibilities only—such as when you learn $p$ but might want to keep your options open in case later updates might want you to change your mind—and 'hard' information that results in growth of knowledge—when you learn $p$ such that it is inconceivable to ever give it up afterwards.*

*Preferences being a fundamental tool for the definition of belief revision operations, in their paper* Dynamic Logic of Preference Upgrade*, Johan van Benthem and Fenrong Liu focus precisely on extensions of public announcement logic towards the modification of beliefs by way of preferences. Different from the previous paper, more general ways for preference change are modelled in this contribution, and they introduce the very appealing term of 'upgrade' in their paper, to distinguish preference change from 'update' constructions that eliminate or otherwise juggle worlds.*

*The paper* A model for updates in a multi-agent setting *by John Cantwell addresses a belief change operation that is different from belief revision, viz. belief update as introduced by Katsuno and Mendelzon (Katsuno* et al.*, 1991). The latter differs from the former by the fact that it corresponds to change in the world, as opposed to, in the case of revision, change in the agent's beliefs only. Cantwell's paper integrates the former kind of updates into Segerberg's dynamic doxastic logic (DDL) (Segerberg, 1999). Now where 'belief revision' and 'dynamic logic' meet, as in this special journal issue, terminology occasionally clashes: the present updates in terms of propositions expressing factual change have to be distinguished from updates in terms of informational events in dynamic epistemic logic.*

*The paper* Communication strategies in games *by Jelle Gerbrandy investigates the interplay between dynamic epistemic logic and game theory, focussing on the pragmatics of communication. In games of imperfect information, game moves may consist of partially revealing other players' knowledge. Informative actions in a dynamic epistemic logic enhanced with probabilities can thus be associated with the players' payoff in a (formal) game.*

*Patrick Girard's paper* From onions to broccoli: generalizing Lewis' counterfactual logic *weakens Segerberg's dynamic doxastic logic by relaxing the linear order underlying Grove's sphere construction for AGM belief revision into a partial order. He relates the resulting logic to Burgess' conditional logic, which is in terms of partial orders and thus stronger than Stalnaker's, but weaker than Lewis' sphere semantics.*

*In his paper* Expressivity and completeness for public update logics via reduction axioms *Barteld Kooi augments the logic of public announcements with public assignments, that express factual change. (There is a relation to Cantwell's paper that also investigated factual change, under the name of 'belief update'.) He studies the mathematical properties of the resulting family of logics. By means of reduction axioms he proves that in surprisingly many cases the extension has the same expressivity as the underlying version of public announcement logic.*

*The paper* Distributed knowledge *by Floris Roelofsen is about a well-known but not frequently investigated group notion of knowledge: a proposition is distributed knowledge among a group of agents if it follows from the knowledge of all agents put together. Roelofsen discusses the problematic discrepancy between the standard semantics for distributed knowledge, and what a group of agents can make known by communication. He also presents a notion of bisimulation involving accessibility relations corresponding to distributed knowledge, and some expressivity results.*

Hans VAN DITMARSCH
Otago University (New Zealand)

Andreas HERZIG
IRIT-CNRS (France)

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