Chapter 1
Introduction

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The modeling of knowledge and the modeling of context proceed, historically speaking, from two relatively independent enterprises. In an effort to bridge the gap between the two, the 13 essays collected in this book are all concerned with the notions of knowledge and context, the connections between them, and the ways in which they can be modeled, and in particular formalized. The question is of prime importance to such diverse disciplines as philosophy, linguistics, computer science and artificial intelligence, and cognitive science. The purpose of the book is to advance our understanding on that question by focusing on some of the most pressing issues that it raises in and across those disciplines:

- **Context and Epistemology.** In the last decades, mainstream epistemology has seen a major "linguistic turn", through the increased reliance on syntactic, semantic and pragmatic "evidence" about ordinary uses of linguistic constructions in terms of "know". An ever-increasing emphasis is put on the possibly crucial epistemological role of various notions of context (of inquiry, of utterance, of assessment, etc.) in knowledge and talk about knowledge, most notably as a result of the florishing discussions between "invariantists", "contextualists", "relativists", etc., of all sorts. But despite a (very small) number of attempts, the formal modeling of these positions, notions and distinctions has not yet been pursued.
- **Epistemology and Formalism.** In addition to its "linguistic turn", epistemology has also seen a very sensible "logical turn". This is witnessed by the

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recently revived and rising conviction, forcefully promoted by Hendricks and van Benthem among others, that traditional epistemological discussions (about skepticism and the definitions of various epistemic notions) may benefit from the use of the formal methods of epistemic modal logic, Formal Learning Theory, Belief Revision, and so on. However, one might feel that to this day formal epistemology has remained relatively little explicit about context and how exactly it enters the epistemic world. But there are exceptions, and the situation has recently been evolving.

- **Formalism and Context.** Well-known formal approaches to context can be found in natural language semantics – most notably in the treatment of indexicality – and in formal pragmatics – e.g. in the treatment of presupposition and implicature, or illocutionary logic. "Logics of context" can also be found in theoretical computer science, like those proposed by McCarthy and Buvač, or by Giunchiglia and Serafini. In both fields, however, the main formal approaches owe nothing to epistemology. Although here too the number of exceptions has recently been growing, one might have the impression that no general attempts have yet been made to pull together the formal modeling of context and the formal treatment of knowledge.

Bringing together original articles written by world-leading experts and emerging researchers in epistemology, logic, philosophy of language, linguistics, and theoretical computer science, the book presents a sample of the best research work currently carried out at those intersections.

In the opening chapter of this volume, Chap. 2, **Erich Rast** is concerned with issues that the notion of context raises in what might be thought to be its most natural setting, viz. the analysis of natural language meaning and the multifaceted problem of the semantics-pragmatics interface. After giving a valuable overview of the role of the notion of context in philosophical linguistics and beyond, Rast goes on to spell out a number of linguistic distinctions and adequacy requirements against which candidate models for a certain class of context-dependent expressions, "contextuals" like "ready", "tall", etc., are to be evaluated. With these criteria in mind the author sketches a proposal on how to represent those expressions in a formal truth-conditional setting. Rast addresses *en passant* several points of interest to the linguist as well as to the philosopher, like the relationships between context-dependence, contextuality, and indexicality, or the idea that "know" might be an indexical, an expression with contextually constant character but contextually variable content.

This latter idea is commonly associated with *epistemic contextualism*, a view famously championed by Stewart Cohen, Keith DeRose, and David Lewis. Contextualism stems from the necessity to account for an observation already made by Wittgenstein and Austin about our linguistic practice of attributing and denying knowledge to ourselves and to other people, viz. the observation that a knowledge claim may be perfectly acceptable as made in one context but totally inacceptable as made in another context. The most straightforward explanation for this contextually variable acceptability of knowledge claims is semantic: it is the *truth value* of such

claims that varies with the context in which they are made. What the contextualist adds is that this is so because the *truth-conditions* of those claims vary from one such context to another. The next three essays – by Baumann, Montminy, and Bouchard – are all concerned with defending some form or other of contextualism about knowledge(-*that*) ascriptions.

Some have objected to contextualism that it is incompatible with the fact that ordinary speakers often take themselves to disagree with other users of "know" located in contexts where different epistemic standards are in place. On the same grounds it has also been argued that we had better opt for *epistemic relativism*, the view that knowledge ascriptions depend for their truth not on the context in which they are made by a speaker, but on the context in which they are assessed for truth or falsity by a judge. In his essay, Chap. 3, **Martin Montminy** sets out to defend contextualism against this objection "from disagreement". He defends that ordinary speakers often make the mistake of thinking that they are disagreeing with speakers in contexts with different epistemic standards. Based on a careful analysis of this mistake and how it can be overcome, Montminy insists that when figuring out whether there is disagreement between speakers, the "perspectives" by which they stand towards a proposition play a crucial role which no version of relativism can accurately render. Montminy concludes that when it comes to accounting for the intuition of disagreement, relativism does not fare any better than contextualism after all.

In Chap. 4, **Peter Baumann** focuses on another important objection to contextualism due to Crispin Wright, the "Factivity Objection". The objection consists in deriving a contradiction from the truth of contextualism, the principle of factivity – i.e. that knowledge requires truth – and the principle of epistemic closure – i.e. that knowledge is closed under known entailment. Baumann acknowledges that this objection is a serious threat to contextualism in its most common form, the view that "know" behaves like an indexical. But he insists that the threat can be removed provided that we opt for an alternative, *relationalist* form of contextualism on which "know" denotes a ternary relation between a subject, a proposition, and an epistemic standard. The subsequent, unorthodox reformulation of epistemic closure makes it possible to account for cross-context knowledge attributions and enables us to explain away the factivity objection as equivocating on subtle contextual differences.

In his contribution, Chap. 5, **Yves Bouchard** too considers that the context-sensitivity of "know" is best understood in terms of a ternary relation between a subject, a proposition and an epistemic standard. His account is based on a "logic of context" originally developed by McCarthy and Buvač in Artificial Intelligence to represent ordinary knowledge and how it enters inferential processes operating on knowledge bases. Bouchard proposes to associate with each epistemic context c_ε a unique epistemic standard ε, identified with a subset of the axioms in the knowledge base associated with c_ε. These axioms specify the introduction rule for the knowledge operator in c_ε, and further axioms specify a number of "transposition rules" governing the relations of the standard of the context to other epistemic contexts. This, Bouchard contends, allows a precise formal modelling of

how "know" contributes context-sensitivity by having part of its content fixed by epistemic standards. It also provides a viable explanation of how exactly the alleged shifts in epistemic standards are regulated in a way that does not make epistemic standards shift with any fluctuation of conversational contexts whatsoever. Finally, Bouchard's proposal yields interesting solutions to well-known skeptical puzzles.

The next three chapters – by Aloni and Jacinto, by van Rooij, and by Hansson – are still concerned with contextualism, but focus on largely neglected, albeit highly important aspects, dimensions, and forms of the context-dependency of knowledge claims.

In Chap. 6, **Maria Aloni** and **Bruno Jacinto** shift attention from the context-sensitivity of "knowing-that" ascriptions to that of "knowing-*wh*" ascriptions – sentence-like constructions in terms of "know which" and "know who" to be precise. They insist on a particular form of context-sensitivity that the latter exhibit and that cannot be traced back to the context-sensitivity of "know" but to the *perspective sensitivity* of the embedded wh-questions. Wh-clauses are indeed interpreted relative to a *conceptual perspective*, that is, to one of the different ways to look at the domain of objects under consideration or "conceptual covers". Building on previous work by Aloni, they formalize this idea by means of a language of first-order predicate logic enriched with a question operator. The language is akin to the one used in Groenendijk and Stokhof's semantics of questions but augmented so as to make it possible to talk about conceptual covers and to capture the perspective-sensitive nature of questions. Aloni and Jacinto then engage in a tight discussion of which of contextualism, relativism, and two forms of invariantism can best account for that sensitivity. They are eventually led to endorse what they call an "explicit contextualist existential closure" view on the matter.

The context-sensitivity of knowledge-wh ascriptions is also thoroughly acknowledged by **Robert van Rooij** in his Chap. 7. He argues that just like the interpretation of standard answers to questions, whose conventional meaning is underspecified and whose exact meaning is determined by a contextually relevant decision problem, the context-dependence of knowledge constructions with embedded questions involves decision problems as well as conversational relevance. Van Rooij implements this idea in the formal game-theoretic framework of Optimal Assertions, originally developed in joint work with Benz to capture the notion of an optimal answer and here extended to the interpretation of embedded questions. He makes a further step and indicates how the framework of optimal assertions can be used to understand the context-dependence of knowledge-that ascriptions, and examines how the resulting analysis relates to standard contextualist accounts like David Lewis's. The paper thereby offers a good example of how formalism can help handling together knowledge-related problems and context-related issues in a philosophically rigorous manner.

In his essay Chap. 8, **Sven Ove Hansson** too examines knowledge claims in contexts of decision problems, but this time the relevant kind of knowledge is scientific knowledge. Hansson first discusses two models of science, one on which science aims exclusively at knowledge for its own sake, the other on which science is primarily a system of pure knowledge which gets secondarily adjusted when

exposed to contexts of practical applications with evidential requirements possibly differing from those of knowledge *per se*. Hansson argues for an alternative model according to which scientific knowledge continuously develops from the start under the combined, sometimes conflicting requirements of knowledge *per se* and knowledge *ad applicandum*. He draws the picture of a dynamic process alternating "epistemic" and "decisional" adjustments, in such a way that the influence of demands of practical applications on the acceptability of knowledge claims in science is never to the detriment of the reliability of scientific knowledge. Hansson also gives an indication of how the model he proposes can be formalized.

An aspect of knowledge strongly emphasized by Hansson and by van Rooij in their essays is that it is intimately related to action and choice. This tight connection is also the starting point of **Jan Broersen** and **John-Jules Meyer**'s contribution, "A STIT Logical Study into Choice, Failure and Free Will Action". The authors propose to formally investigate and develop a number of conceptual distinctions to do with the philosophical issue of freedom and cognate notions, like free will, free choice, and free action. They do so through means of a STIT-logical framework with epistemic operators, whose purpose is to logically represent action failure as having a mistaken belief about the choice one makes. This has interesting consequences for the definition of free will choice and Broersen and Meyer explore how they can be brought to bear on such questions as determinism, compatibilism, and moral responsibility.

What picture of belief can most appropriately capture its "practical dimension", its crucial links to action and intention in practical deliberative reasoning, is also the main purpose of **Richmond H. Thomason's** essay, Chap. 10. Thomason considers the Belief-Desire-Intention (BDI) framework a fruitful theoretical framework to engage deliberation about what goals to pursue, how to pursue them, and the relation of goals and plans to what to do on a given occasion. He describes and defends a *modular* approach to *practical belief*, which understands belief not as a single modality or belief attitude, but as an open-ended family of loosely related modalities or belief-like attitudes emerging from the need to act on particular practical occasions. *Ad hoc* attitudes of this sort that are appropriate for one particular occasion need not be consistent with other such attitudes appropriate for another, and the resulting conception of belief and related attitudes is more flexible and realistic for agents with human-like cognitive abilities and limitations. Doxastic attitudes come with contextual sensitivities of various kinds, including for instance sensitivity to time and social pressure, but also *stake-sensitivity*, the tendency of a belief to appear or disappear in response to such pragmatic factors as the sense of risk and the significance of what is at stake.

Although he acknowledges that belief depends on the subject's practical interests, **Gregory Wheeler** places a caveat on stake-relative views of belief in his essay Chap. 11, where he addresses the connections between qualitative and quantitative belief. While one might propose equating qualitative or "full belief" with "high level of confidence", this "Lockean" proposal has been criticized by orthodox probabilists like Jeffrey because it licenses ruling out perfectly good information. In the course of defending Lockeanism against this objection, Scott Sturgeon has advanced a

normative principle to the effect that the character of a belief should match the character of the evidence on which it is based. This principle of *character matching* is the target of Wheeler's essay, who sets out to turn it inside out by means of a counterexample. Interpreted in the light of a risk-reward theory of full belief inspired by Kyburg, the counterexample shows that although full belief depends on a subject's practical context, it does not depend on the total magnitude of the stake put at risk.

Belief is the topic of **Andreas Herzig** and **Emiliano Lorini**'s Chap. 12 too, but approached from the angle of its logical relationships with perception. They describe a number of variants of a "logic of perceptual belief" whose semantics is not based on possible worlds models, but on models consisting simply in valuations of atomic formulas having consistent data, where a datum is a special construction describing what an agent has perceived to be true (or false) and corresponding to Fred Dretske's "perceptual recognition" or "meaningful perception". The resulting framework makes it possible to represent and reason about the connections between an agent beliefs and the information she obtains by his senses. In the basic version of the logic, perception is construed as a private action: one's meaningful perception that ϕ directly determines one's belief that ϕ, even though one does not thereby learn that one perceives that ϕ. Herzig and Lorini consider extending the base logic by adding introspection principles, by turning from perceptual belief to perceptual knowledge, and by adding events in the style of dynamic epistemic logic.

Paul Egré's paper Chap. 13 also deals with an important logico-doxastic issue, namely the phenomenon of hyperintensionality of belief reports in natural language, and proposes to account for it in terms of context-dependence. His proposal, elaborating on the analysis of hyperintensionality by Cresswell and von Stechow, rests on the idea that belief sentences can be given a generalized *de re* logical form, even in situations where opacity would standardly be treated *de dicto* as in Hintikka's modal framework: a subject's opaque belief can be analyzed as a *de re* belief about the same thing but under different contextually determined counterpart relations. To capture this idea, Egré extends Gerbrandy's counterpart semantics for first-order epistemic logic to a second-order epistemic logic which enables handling cases of hyperintensionality involving expressions of distinct syntactic categories (coreferential proper names, cointensional predicates, and logically equivalent sentences), thereby allowing for a uniform treatment of these cases on a par with other classical cases of opacity. The merits and limits of his proposal are discussed in respect of issues like pragmatic enrichment, iterated belief reports, logical consequence, conjunction and identity.

In the closing chapter of the volume, Chap. 14, the founder of contemporary epistemic logic half a century ago, **Jaakko Hintikka**, takes up the ongoing epistemological debate over the proper analysis of knowledge. Hintikka proposes to depart from the definition, famously inherited from Plato, of knowledge as justified true belief. First disconnecting knowledge from belief in favor of the more flexible notion of "information", Hintikka adds a non-standard justification clause whose effect is that knowledge of propositions is no longer to be thought of as knowledge that these propositions can be verified, but *how* they can be verified, that is to say,

knowledge of corresponding Skolem functions whose very existence attests to the truth of those propositions. Elaborating on this idea, Hintikka shows how it finds a natural setting in the frameworks of game-theoretical semantics and independence-friendly logic, and points to subtle relationships of utmost philosophical significance between knowledge, justifiability, and truth. In this respect, Hintikka's contribution serves as the best illustration of a Wittgensteinian dictum that he himself pertinently reminds us of, that "one can distill a great deal of epistemology into a drop of logic".