To appear in: Hansson, Sven Ove; Gertrude Hirsch Hadorn (eds). *The Argumentative Turn in Policy Analysis. Reasoning About Uncertainty.* Dordrecht: Springer.

Analysing practical argumentation

Georg Brun, Gregor Betz
Georg.Brun@philo.unibe.ch, gregor.betz@kit.edu

Abstract Argument analysis is a powerful tool for structuring policy deliberation and decision-making, especially when complexity and uncertainty loom large. Argument analysis seeks to determine which claims are justified or criticized by a given argumentation, how strong an argument is, on which implicit assumptions it rests, how it relates to other arguments in a controversy, and which standpoints one can reasonably adopt in view of a given state of debate. This chapter first gives an overview of the activities involved in argument analysis and discusses the various aims that guide argument analysis. It then introduces methods for reconstructing and evaluating individual arguments as well as complex argumentation and debates. In their application to decisions under great uncertainty, these methods help to identify coherent positions, to discern important points of (dis)agreement, as well as to avoid spurious consensus and oversimplification.

Keywords practical reasoning, argument analysis, reconstruction, argument mapping, uncertainty, argumentation schemes

1. Introduction

When experts derive policy recommendations in a scientific report, they set forth arguments for or against normative claims; they engage in practical reasoning – and so do decision-makers who defend the choices they have made, NGOs who argue against proposed policy measures and citizens who question policy goals in a public consultation. Practical reasoning is an essential cognitive task that underlies policy making and drives public deliberation and debate.

Unfortunately, we are not very good at getting practical arguments right. Intuitive practical reasoning risks to suffer from various shortcomings and fallacies as soon as a decision problem becomes a bit more complex – for example in terms of predictive uncertainties, the variety of outcomes to consider, the temporal structure of the decision problem, or the variety of values that bear on the decision (see Hansson and Hirsch Hadorn 2016). Hence we need to analyse policy arguments and to make explicit which scientific findings and normative assumptions they presume, how the various arguments are related to each other and which standpoints the opponents in a debate may reasonably hold.

Although argumentation does not provide an easy route to good decisions in the face of great uncertainty, the *argumentative turn* builds on the insight that substantial progress can be made with the help of argument analysis.[1] Consider, for example, the following text which is listed as an argument against "nuclear energy" in *Pros and Cons. A Debater's Handbook:*

> In the 1950s we were promised that nuclear energy would be so cheap that it would be uneconomic to meter electricity. Today, nuclear energy is still subsidised by the taxpayer. Old power stations require decommissioning that will take 100 years and cost billions. (Sather 1999:257)

It is unclear which claim(s) this professed argument is supposed to attack or support, and maybe even more so, in which way it is supposed to do so. Analysis is needed to make the reasoning more specific and to reveal its hidden assumptions. In general, we expect that argument analysis can help us understand which aspects of a decision challenge are crucial, and in what respects and why we disagree. Does a disagreement concern the truth or the relevance of some premises? Or rather which conclusion they support or about how strong the argument is? Clarity in such matters is important, not least because there is always a danger that policy debates lead to a spurious consensus on an ill-defined position all parties interpret in favour of their own views.[2]

If argument analysis should be of help in answering the questions mentioned and provide the desired clarity, it must provide reconstructions. It must start with the arguments that are put forward in a debate and try to represent them as clearly as possible in a form which allows for an effective evaluation. This is a task which differs not only from scientific research into the subject matter of the debate, but also from discourse analysis; that is, from empirical research which aims at describing and structuring the views and arguments different people put forward or subscribe to in a debate. As a reconstructive enterprise, argument analysis has both a descriptive goal, inasmuch as it deals with the arguments people actually use, and a normative perspective. This means that reconstructions of arguments are guided by the goal of making the given argumentation as clear as possible and by standards for evaluating arguments: premises can be right/true or wrong, arguments can be valid or invalid, strong or weak.

As a reconstructive enterprise, argument analysis is also not opposed to traditional decision theoretic reasoning. Quite the contrary, what has been said about argument analysis is true of applied decision theory as well: it is essentially a method for reconstructing and evaluating practical reasoning. But traditional decision theory is confined to problems which exhibit only a very limited range of uncertainty, namely unknown or not precisely known probabilities of outcomes (cf. Hansson and Hirsch Hadorn 2016). And it is restricted to a specific though important type of reasoning, so-called consequentialist arguments. Relying on traditional decision theory therefore also means *systematically* ignoring other kinds of practical arguments that may be set forth in order to justify policy conclusions.

---

[1] An "argumentative turn" in policy analysis and planning had first been proclaimed by Fisher and Forester (1993), who called for putting more emphasis on deliberative and communicative elements in decision making (see also Fischer and Gottweis 2013). We conceive of our chapter, and this book in general, as a genuinely normative, argumentation-theoretic contribution to – and extension of – the programme of an argumentative turn, which was so far mainly shaped by the perspectives of political science and empirical discourse analysis.

[2] For examples, see Singer (1988:157–9).

For this reason we suggest to conceive of argument analysis as the more general, more unbiased and hence more appropriate method for decision analysis, which incorporates the insights of traditional decision theory just as far as consequentialist arguments are concerned and the preconditions for its application are met.

In Sect. 2, we start with a brief survey of the various tasks involved in argument analysis, the aims guiding argument analysis and the uses to which argument analysis may be put. Section 3 then introduces the basic techniques for analysing individual arguments and discusses the most common problems. On this basis, we sketch an approach to analysing complex argumentation and debates in Section 4, while Section 5 addresses strategies for dealing with the specific challenges of analysing reasoning involving practical decisions under uncertainty.

Argument analysis is a lively field of research and the argumentative turn is no systematic, monolithic theory, but includes a plurality of approaches and methods. We therefore add the caveat that this chapter is neither a presentation of textbook-methods nor an overview of the available approaches, it is rather an opinionated introduction to analysing practical reasoning.[3]

2. Tasks, aims and uses of argument analysis

This section sets the stage for further discussion by giving a overview of argument analysis. We identify a range of tasks involved in argument analysis, give an account of the aims guiding argument analysis, and then briefly comment on the various uses which may be made of argument analysis. On the basis of this general overview, the subsequent sections discuss the individual tasks in more detail and with reference to examples.

2.1. Tasks of argument analysis

Argument analysis, understood in a wide sense, involves two basic activities: reconstruction and evaluation of argumentation and debates.

Reconstruction of argumentation and debates comprises a range of tasks which take argumentative texts as inputs and return various representations as outputs. Roughly, one can distinguish the following activities of reconstruction:

- Text analysis: extract debates and arguments from texts.
- Debate Analysis: determine how the argumentation of different proponents relate to each other.[4] For example, does A's argument support or attack B's argument or position?
- Argument analysis in a narrow sense: break down complex argumentation into individual arguments and their relations. For example, identify attack and support relations between arguments, or distinguish "hierarchical" argumentation, in which one argument supports a premise

[3] We freely draw on our earlier work, specifically Brun (2014), Brun and Hirsch Hadorn (2014), Betz (2013), Betz (2010).

[4] We use "debate" in a sense which does not necessarily involve more than one person. One can "internalize" proponents of various positions and explore how they can argue against each other.

of another argument, from "multiple" argumentation, in which several arguments support the same conclusion.[5]

- Analyse individual arguments and recast them in standardized form as inferences:[6] determine which premises and which conclusion are given; reformulate unclear, incomplete and nonuniform sentences; supply missing elements.

In this chapter, we discuss these tasks in reverse order and we take the analysis of debates and complex argumentation together since on a basic level debates and complex argumentation are analysed in the same way.

Each of these tasks not only involves the identification of some argumentative structure but also its representation in a form which supports the goals of the reconstruction, especially the aim of enhancing clarity. For both, analysis and representation, a broad range of tools are available, ranging from informal guidelines to formal languages and software support (see the resources listed at the end of this chapter).

It is important to note that the above list of reconstructive tasks is not to be read as implying that the activity of reconstructing has a simple sequential structure. Although the list can be used as a rough guide to reconstructing, the various tasks constitute neither a linear and nor a uniquely determined sequence of steps. They are rather (partly) interdependent, and backtracking and looping strategies will frequently be called for. One reason is that, in general, several competing reconstructions may be on offer in each and every step of analysis. This constantly requires taking decisions which need to be made with a perspective to the other reconstructive tasks. Another reason is that each subsequent step of reconstruction will identify additional structure, which may prompt us to revise or refine an "earlier" step. If, for example, the analysis of individual arguments uncovers ambiguities, this will often motivate exploring alternative reconstructions of the overarching complex argumentation. As we will shortly see, the reconstruction of an argumentation is also intertwined with its evaluation. The practical upshot is that reconstructing requires a strategy of trial and error, going back and forth between reconstruction and evaluation as well as between reconstructing individual arguments and more complex structures (cf. Fig. 1). Since all this requires creativity rather than following a predefined procedure, new ideas are always possible and consequently, the analysis of a realistically complex argumentation is an open-ended undertaking.

---

[5] Sometimes "serial" or "subordinate" are used in place of "hierarchical", and "convergent" in place of "multiple". See Snoeck Henkemans (2001) a survey on terminology and basic structures of complex argumentation.

[6] We use "inference" as a technical term for completely explicit and well-ordered arguments.

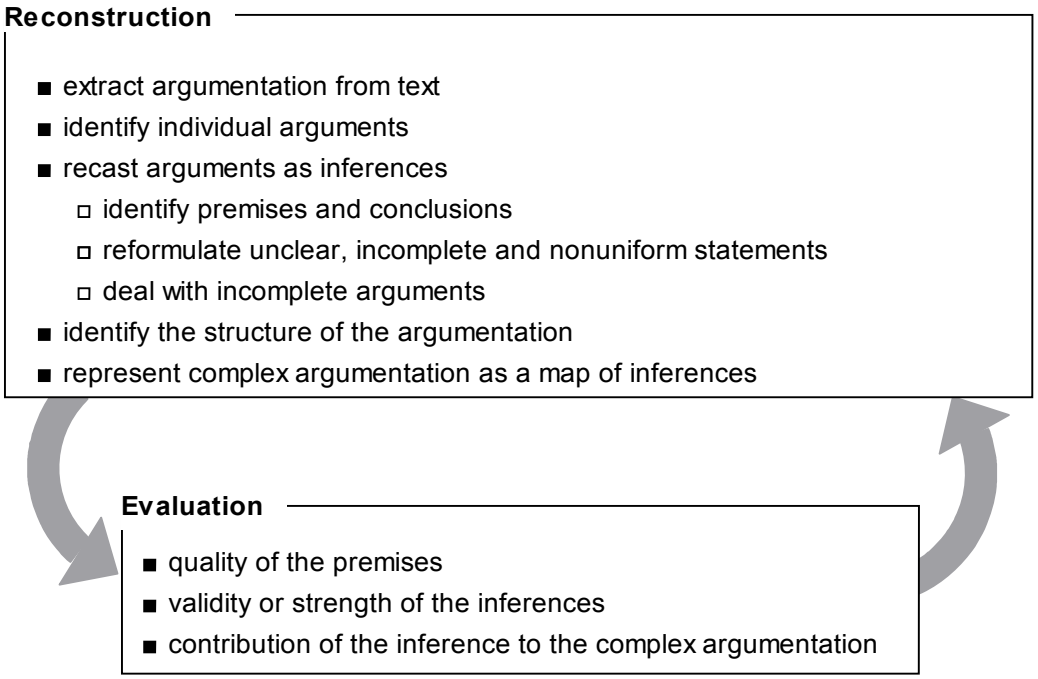

Figure 1 Interplay of reconstruction and evaluation in argument analysis (adapted from Brun and Hirsch Hadorn 2014:209)

Speaking of "reconstruction" should also help to avoid, right from the beginning, the misunderstanding that argument analysis is just a matter of uncovering a given but maybe hidden structure. As the discussions below will make clear, argument reconstruction is an activity based on and relative to some theoretical background, it involves creative and normative moves, and it aims at coming up with representations of arguments that meet certain standards the original texts typically fail to comply with, for example, full explicitness. This fits well with the term "reconstruction", which refers to a construction guided by a pre-existing object or situation, in our case an argumentation.

Let us now turn from reconstruction to evaluation. A comprehensive evaluation of arguments and complex argumentation involves assessing a whole range of qualities. The following may be distinguished:

- Truth and acceptability of the premises of individual arguments.
- Validity or strength of individual arguments: does the truth of the premises guarantee or at least provide good reasons for the truth of the conclusion? Valid arguments with true premises are called "sound".
- Overall evaluation of a complex argumentation: is the argumentation valid or strong in view of the validity or strength of its component-arguments? Does the argumentation contain "gaps"?
- Contribution of arguments to a complex argumentation, debate, discussion or inquiry ("dialectical relevance").
- Coherence of a position (as characterized by an argumentation).
- Contribution of argumentation and debates to solve a problem, for example, a decision task.

Not all of these aspects can be addressed by argument analysis alone. Most importantly, assessing the truth of the claims involved is subject to other kinds of research in, for example, empirical sciences or ethics.

For some of these evaluations, extensive theoretical treatments are available. Logical theories, for example, make it possible to prove validity, the theory of dialectical structures can be used to effectively assess which position can be consistently adopted in a debate, and argumentation theory provides extensive treatments of fallacies; that is, of common patterns of invalid, weak, irrelevant, misleading or otherwise problematic arguments. Using some of these resources requires taking additional, non-trivial steps of reconstruction, such as formalizing inferences in order to prove their validity with the help of some logical theory.

2.2. Aims and guiding perspectives

Argument analysis may be done in the service of all kinds of practical or theoretical goals, but it always operates between two pulls. On the one hand, argument analysis is an interpretational undertaking dealing with some given argumentation, which it is therefore committed to take serious. On the other hand, argument analysis aims to represent the argumentation at hand as clearly as possible, evaluate it, and identify problems and potential for improvement. These two orientations open up a spectrum from exegetical to exploitative argument analysis (Rescher 2001:60), from argument analysis which aims at understanding as accurately as possible an author's argumentation to argument analysis which seeks to find the best argumentation that can be constructed following more or less closely the line of reasoning in some given argumentative text.

The exegetical aspect implies that reconstructions must answer to hermeneutic principles, especially accuracy (sometimes called "loyalty"[7]) and charity. "Accuracy" means that a reconstruction must be defensible with respect to the argumentative text, in particular its actual wording and the available information about its context. Charity calls for reconstructing an argumentation under the defeasible presumption that it performs well with respect to validity, soundness and the other evaluative dimensions mentioned above. In particular, charity is a "tie-breaker" if there are alternative, equally accurate interpretations. It requires, other things being equal, to select the most favourable interpretation. This makes sure that an unfavourable evaluation of an argument is not merely the result of interpretative mistakes of even malevolence. Charity is also a basic reason why reconstruction and evaluation are intertwined in argument analysis.

However, reconstruction is also guided by the fundamental aim of clarification. This ideal comprises three core aspects: explicit, precise and transparent representation. Explicitness not only requires that the relation between individual arguments in a complex argumentation be represented explicitly, but also that the individual arguments are framed as inferences, which implies that all premises and the conclusion are made explicit and formulated as self-contained statements. "Precision" is not used in its numerical sense, but means that argument reconstruction needs to address ambiguity, context-dependence and vagueness in a way which makes sure that they do not lead to misevaluation of the arguments at hand. Transparency, finally, calls for representing debates, complex

[7] cf. Walton (1996:211–6); for a more comprehensive discussion of hermeneutical principles in the context of argument analysis see Reinmuth (2014).

argumentations and individual arguments in a way that makes it easy to grasp their structure and get an overview.[8]

In short, reconstruction means representing argumentation in a form which ensures that its structure is represented explicitly, precisely and transparently. Since these aspects of clarity as well as the hermeneutic principles of accuracy and charity may be partly antagonistic, trade-offs are often inevitable. And in such cases, deciding whether a proposed reconstruction is adequate requires judgement rather than applying a purely formal procedure. And in many cases more than one resolution of conflict, favouring different reconstructions, may be plausible.

2.3. Uses of argument analysis

The core function of arguing is to provide reasons for a claim, but arguments – even the same argument – may be put to very different uses. One may strive to identify supporting reasons as a means to, for example, support some statement, attack a position, resolve whether to accept a controversial claim, reach consensus on some issue, shake an opponent's convictions or explore the consequences of adopting a certain position. Argument analysis by itself does not directly realize such aims, neither does it necessarily lead to better arguments. However, it may prove effective as a means to

- reflect on one's own reasoning and that of others; for example, by becoming more clearly aware of all the premises involved, of the exact relations between the constituents of a complex argumentation, or of the strengths and weaknesses of an argumentation;
- identify promising revisions of a position; for example, eliminate problematic premises or strengthen an argument by resorting to a weaker conclusion or by adding supporting premises;
- identify promising moves in a debate; for example, identify premises that could be used to support a position, finding arguments that may force an opponent to modify her position or identify arguments that can help to find a consensus.

3. Analysing individual arguments

In this section, we illustrate many aspects of argument analysis with the help of an argument from Singer's *Animal Liberation* and a passage from Harsanyi, in which he criticizes John Rawls's appeal to the maximin principle in *A Theory of Justice* (Rawls 1999). For the sake of exposition, we give comparatively meticulous reconstructions for these two untypically transparent examples (square brackets are used for cross-references and to indicate important changes to the original text):

> **[Singer]** So the researcher's central dilemma exists in an especially acute form in psychology: either the animal is not like us, in which case there is no reason for performing the experiment; or else the animal is like us, in which case we ought not to perform on the animal an experiment that would be considered outrageous if performed on one of us. (Singer 2002:52)

[8] On various aspects of clarification see also Morscher (2009:1–58), Hansson (2000).

(1.1) Either the animal is not like us or else the animal is like us.

(1.2) If the animal is not like us, there is no reason for performing the experiment.

(1.3) If the animal is like us, we ought not to perform on the animal an experiment that would be considered outrageous if performed on one of us.

(1.4) [There is no reason for performing the experiment or we ought not to perform on the animal an experiment that would be considered outrageous if performed on one of us.]

[Harsanyi] Suppose you live in New York City and are offered two jobs at the same time. One is a tedious and badly paid job in New York City itself, while the other is a very interesting and well paid job in Chicago. But the catch is that, if you wanted the Chicago job, you would have to take a plane from New York to Chicago […]. Therefore there would be a very small but positive probability that you might be killed in a plane accident. […]

[3.2] The maximin principle says that you must evaluate every policy available to you in terms of the *worst possibility* that can occur to you if you follow that particular policy. […] [2.1] If you choose the New York job then the worst (and, indeed, the only) possible outcome will be that you will have a poor job but you will stay alive. […] In contrast, [2.2] if you choose the Chicago job then the worst possible outcome will be that you may die in a plane accident. Thus, [2.4/3.1] the worst possible outcome in the first case would be much better than the worst possible outcome in the second case. Consequently, [3.3] if you want to follow the maximin principle then you must choose the New York job. […]

Clearly, this is a highly irrational conclusion. Surely, if you assign a low enough probability to a plane accident, and if you have a strong enough preference for the Chicago job, then by all means you should take your chances and choose the Chicago job. (Harsanyi 1975:595)

(2.1) The worst possible outcome of the option *New York* is having a poor job.

(2.2) The worst possible outcome of the option *Chicago* is a dying in a plane accident.

(2.3) [Having a poor job is much better than dying in a plane accident.]

(2.4) The worst possible outcome of [the option *New York*] is much better than the worst possible outcome of [the option *Chicago*].

(3.1) The worst possible outcome of the option *New York* is much better than the worst possible outcome of the option *Chicago*. [=2.4]

(3.2) [Given two options, the maximin principle says that you must choose the one the worst possible outcome of which is better than the worst possible outcome of the other.]

(3.3) [The maximin principle says that] you must choose the option *New York.*

3.1. Basics of reconstruction

A reconstruction of an individual argument takes an argumentative text as its input and aims at delivering an inference as its output. The guiding principles are the hermeneutic maxims of accuracy and charity as well as the ideal of clarity with its aspects of explicitness, precision, and transparency. In principle, the reconstruction proceeds by employing four basic types of operations: elements which do not contribute to the argument, for example, digressions and purely rhetoric embellishments, are

deleted, unclear statements are reformulated, premises and conclusion are rearranged into a standard form, and missing elements, such as (parts of) a premise or the conclusion are added.

The first task is to find argumentative elements in a text. In argumentative passages, one or more statements are treated as providing a reason for a further statement (and this in turn may be done in the service of any of the many uses to which arguments can be put; cf. Sect. 2). Hence, the criterion which decides whether some element of a text is part of an argument is functional. Being a premise or a conclusion is not a matter of the form or the content of a sentence, but a role a statement can play, just like being an answer. Identifying arguments in a text therefore presupposes at least a rough understanding of the structure of the text. A well-tested strategy is to start by sketching the main argument(s) in a passage in one's own words and as succinctly as possible. For [Harsanyi] that could be (of course, many other formulations are equally plausible at this stage of analysis):

(4) The worst possible outcome of the option *Chicago* (dying in a plane accident) is much worse than the worst possible outcome of the option *New York* (a poor job). Therefore, according to the maximin principle you must choose the option *New York*.

One can then turn to the analysis of individual arguments, and tackle the problem of identifying the premises and the conclusion. In practice, this is not just a matter of applying formal techniques. "Indicator words" such as "therefore", "thus", "because" and many more are certainly worth paying attention to, but they cannot be used as simple and reliable guides to an argument's structure. It is usually best to try to identify a conclusion (which may not be stated explicitly) and then actively search for premises, also with the help of hypotheses about what would make for a good argument. A functional perspective provides the guide for this search: what would fit what we already have found out or assumed about the argument at hand? What makes sense in light of the complex argumentation or the debate the argument is part of? (Betz 2010:§ 99; Sect. 4 below). In [Harsanyi], we know (from the context) that Harsanyi wants to attack Rawls's use of the maximin principle and specifically the claim that one should take the New York job. Hence the conclusion of (4) is a good starting point.

Once some premises or a conclusion are identified, they must typically be reformulated for the sake of clarity. Explicitness requires that all premises and the conclusion must be specified as a complete, independently comprehensible sentence. This is of special importance if more than one element of an argument are given in one sentence. In extracting individual premises or a conclusion from such sentences, the result must be spelled out as a full sentence, which usually means that some anaphoric expressions (expressions used in such a way that their interpretation depends on the interpretation of other expressions, e.g. relative pronouns, or "first case" and "second case" in 2.4) must be replaced by expressions which can be independently interpreted.

A second aspect of clarity is precision. Eliminating ambiguity, context-dependence and vagueness altogether is neither realistic, nor necessary for the purposes of argument analysis. But certain problems call for reformulation. Concerning ambiguity and context-dependence, premises and conclusions must firstly be represented in a way which avoids equivocation; that is, the use of corresponding instances of the same expression with different meanings. In [Singer], for example, an equivocation would result if "is like us" did not refer to the same aspects of likeness in its two occurrences; reconstruction (1) assumes that this is not the case. Some of these problems can be tackled by employing, or if necessary introducing, a standardized terminology (e.g. restricting "risk"

to known probabilities; cf. Hansson and Hirsch Hadorn 2016). Secondly, syntactical ambiguity needs to be resolved, for example, different readings of scope ("Transportation and industry contribute 20% to the US greenhouse gas emissions."). Thirdly, context-dependent, for example, indexical ("I", "this", "here", "now", …) and anaphoric ("Harsanyi quotes Rawls before *he* criticizes *him*."), expressions, must be replaced if there is a danger that their interpretation might not be clear in the resulting representation of the argument. In practice, the necessary reformulation of premises and conclusion is often greatly facilitated by introducing notational aids such as brackets or subscripts (e.g. "$risk_1$" for known probabilities of outcomes, "$risk_2$" for unwanted outcomes).

Argument analysis will also sometimes uncover vagueness; that is, expressions for which there are "borderline-cases" cases in which it is unclear whether the expression applies although the meaning of the expression is clear. Vagueness is a pervasive and to a large extent unproblematic feature of natural language expressions, but it can have the undesired effect that the truth of a sentence featuring a vague expression cannot be assessed. However, if reducing vagueness is necessary, this task cannot be handled with the resources of argumentation theory alone. Deciding in which way statements should be made more exact is rather a matter of considerations relating to the subject matter of the argument at hand.

The goal of transparency, the third aspect of clarity, means that it should be easy to recognize the meaning of every sentence in an inference as well as its logical structure and, more generally, any structure relevant to argument evaluation with respect to, for example, the strength of individual arguments or the coherence of a position. Key factors of transparency are abbreviation, simplicity and uniformity of expression, easily graspable symbols and a direct correlation between features of the representation and features of the argument which are relevant to its evaluation. In practice, all this boils down to representing debates, argumentations, inferences and individual sentences in standardized forms which are easily grasped.

Transparency is therefore to a considerable degree a matter of selecting appropriate tools for representing inferences. Examples range from the format *premises – inference bar – conclusion* (as in 1–3) and visualizations (e.g. Fig. 2) to logical languages (e.g. $\neg p \vee p;\ \neg p \rightarrow q;\ p \rightarrow r \Rightarrow q \vee r$ for (1)[9]). While the former are readily graspable, logical formulas become cognitively efficient only after some initial training.

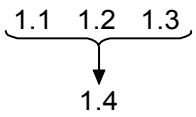

Figure 2 Alternative representation of inference (1) reconstructed from [Singer]

On an informal level, streamlining formulations is nearly always of pivotal importance. This includes eliminating superfluous elements (e.g. purely illustrative examples), simplifying needlessly complex phrasing, introducing informal abbreviations, introduce standard expressions for marking out logical structure (e.g. "and" instead of "but", "not acceptable" instead of "inacceptable") and

[9] With *p* corresponding to "the animal is like us", *q* to "there is no reason for performing the experiment" and *r* to "we ought not to perform on the animal an experiment that would be considered outrageous if performed on one of us."

especially eliminating stylistic variations, for example, by replacing expressions which are synonymous in the context at hand by one and the same. In the examples (1)–(3), the most extensive reformulation is (3.2), which replaces Harsanyi's casual formulation of the maximin principle by a more precise one.

3.2. Dealing with incomplete arguments

A certain type of incomplete arguments, so called enthymemes, are responsible for notorious problems of argument reconstruction. Enthymemes are arguments which are weak in the form in which they have been put forward, but merely because a premise or the conclusion has been "left implicit". Such arguments are extremely common because efficient transmission of information with the help of relatively few explicit expressions is a basic trait of natural language communication. This favours leaving unexpressed what can be assumed as easily understood anyway. Enthymemes are arguments which exploit this feature of natural language communication by not explicitly stating a premise or the conclusion.[10] Accordingly, not all incomplete or otherwise weak arguments count as enthymemes, but only those which can more or less readily be completed in a way which can be assumed to go without saying in the context at hand.

In what follows, we introduce the traditional approach to deal with incomplete arguments by supplying premises or a conclusion.[11] This approach is motivated by the goal of explicitness and guided by the hermeneutic principles of accuracy and charity, which, however, are antagonistic in this context. Charity speaks in favour of reconstructing an inference that can be positively evaluated and accuracy in favour of respecting the actual wording of an argument. Adding a premise or a conclusion will therefore have a price in accuracy even if it is charitable.[12] Importantly, charity and accuracy come in degrees, can be traded off against each other, and often more than one candidate for completing an argument will remain plausible. Exercising judgement rather than applying a formal procedure is needed for assessing the alternative suggestions and deciding which one to select.

Both, the notion of an enthymeme and the appeal to charity are linked to the evaluation of arguments. Hence reconstruction and evaluation are intertwined in dealing with enthymemes.

[10] Of course, reconstructing enthymemes does not rest on the highly dubious idea that *all* implicit information should be made explicit. Even complete arguments virtually always involve a great deal of presuppositions. That the premise "The 2 degree goal can no longer be achieved", as well as its negation, imply "Reaching the 2 degree goal is not impossible at every point in time" does not mean that the latter sentence should be reconstructed as an additional premise.

[11] In fact, missing conclusions are often neglected in the literature.

One alternative to the traditional approach relies on argument schemes and adds the elements needed to turn the argument at hand into an instance of such a scheme (Paglieri and Woods 2011). Another idea is to interpret arguments against the background of a belief-state ascribed to its author and deal with "incomplete" arguments by revising the ascribed belief state (Brun and Rott 2013).

[12] This presupposes that charity is interpreted as a presumptive principle, not merely a tie-breaker.

As Jacquette (1996) has pointed out, adding a premise is in some cases less charitable than strengthening a premise or weakening the conclusion.

Considerations of deductive validity or non-deductive strength (to be discussed below) go into judging whether an argument counts as an enthymeme and in which ways it may be completed.

When reconstructing enthymemes by adding a conclusion, the leading consideration is whether a sentence can be found which turns the given enthymeme into a strong argument and which suits the conclusion's role in its dialectical context. Specifically, the argument resulting from adding a conclusion should fit into the complex argumentation, which it is part of according to the analysis in progress. If, for example, an argument is thought to constitute an attack on another argument, its conclusion may be expected to be incompatible with one of the latter's premises; if it is thought to be part of a hierarchical complex argumentation, its conclusion is expected to be effective as a premise of another argument (e.g. 2.4 and 3.1). In the example [Singer], the context in *Animal Liberation* strongly suggests a conclusion which speaks against experimenting on animals. In practice, the search for prospective conclusions can be facilitated by checking out whether the given premises fit an argumentation scheme; that is, a commonly used pattern of arguing (cf. Walton et al. 2008). For example, the reconstruction (1) and specifically the added conclusion (1.4) are guided by the idea (suggested by Singer) that this argument can be reconstructed as instantiating one of the standard schemes of dilemmas. For practical arguments, the decision principles discussed in Sect. 5 can be used as a heuristic guide.

For adding premises, the leading consideration is that one or more sentences need to be found which yield a strong argument and which can be defended as acceptable and more or less obvious *relative to their dialectical context*. The question is not whether the author of the argument or of the reconstruction actually finds the prospective premise acceptable or obvious, but whether it can be assumed to have these qualities in the context in which the argument at hand is supposed to provide a reason for its conclusion. This may well be a position an author is attacking or discussing, rather than endorsing herself. For example, since Harsanyi refers to Rawls's position, the added premises (2.3) needs to be acceptable to Rawls in the described fictional situation, not to Harsanyi. As a practical strategy (cf. van Eemeren and Grootendorst 2004:3, 117), one may start with the "logical minimum" as a candidate for the additional premise. For deductive arguments, this is a sentence of the form "If [the given premises], then [the given conclusion]". For non-deductive arguments, two strategies are available. One can either try to find a weakest[13] premise which yields a non-deductively strong argument, or one can convert the argument at hand into an equivalent deductive one with a weakened premise and investigate which additional premises are needed for such a conversion. For both strategies, argumentation schemes may be used as a heuristic tool.

Once a candidate for a reconstruction has been found, one has to decide whether the supplementary premises can plausibly be ascribed to a proponent of the relevant position. This may not be the case for two reasons. If the premise is inacceptable to the proponent because it is too strong, the argument cannot be dealt with as an enthymeme, but must be evaluated as weak. However, a premise can also be implausible because it is too weak. Typically this is due to problematic implicatures; that is, claims not implied but suggested by the prospective premise in virtue of communicative principles (van Eemeren and Grootendorst 1992:ch. 6). In such cases, a stronger premise may yield a more adequate

[13] Sentence S is logically stronger than sentence T (and T is logically weaker than S) just in case S implies T but not vice versa.

reconstruction. The logical minimum for (3) in [Harsanyi], for example, would be (3.2*), which is much less plausible than (3.2) as a premise expressing the maximin principle:

(3.2*) If the worst possible outcome of the option *New York* is much better than the worst possible outcome of the option *Chicago*, then the maximin principle says that you must choose the option *New York*.

Two important general points need be noted. The hypothesis that an argument is an enthymeme is, of course, defeasible. Hence, reconstructing incomplete arguments can take different routes. Either a complete inference can be reconstructed which can be defended in light of the hermeneutic principles and the specific considerations discussed, or else one may conclude that the argument presented is just weak, or even resolve that it is unclear what it is supposed to be an argument for. Secondly, there may be several ways in which an enthymeme can be reconstructed as a complete inference, each fitting into a different reconstruction of the complex argumentation at hand. Selecting a best reconstruction is than a matter of an overall judgement.

3.3. Evaluation of arguments

Arguments can be evaluated in (at least) three respects: the quality of their premises, the strength of the relation between premises and conclusion, and the argument's contribution to the complex argumentation which it is part of. In this section, we focus on the first two perspectives; the third is discussed in Sect. 4. All these evaluations address inferences, and therefore presuppose that at least a tentative reconstruction of the argument at hand has been carried out.

With respect to the quality of the premises, the question whether they are true is obviously of central interest. In general, it cannot be answered by argument analysis but calls for investigation by, for example, perception, science or ethics. The main exceptions are inconsistencies that can be detected by logical or semantical analysis which shows that the logical form or the meaning of a set of premises guarantees that they cannot all be true.[14] Inferences involving an inconsistent set of premises are negatively evaluated since they cannot perform the core functions of arguments; they provide no reason in favour of the conclusion. However, arguments with an inconsistent set of premises are relatively seldom found. Much more common are inconsistencies arising in the broader context of a complex argumentation, when a proponent endorses an inconsistent set of sentences (see Sect. 4). Plainly, truth and consistency must be distinguished from acceptability since we do not live in a world in which people accept all and only true sentences (in such a world, there would be little need for arguments). Premises must therefore also be evaluated with respect to whether they are acceptable in their dialectical context. If, for example, an argument is supposed to convert an opponent or to undercut[15] its position (as in Harsanyi's argumentation against Rawls), its premises must be acceptable to the opponent, irrespective of whether they are acceptable to the proponent or the author of the

[14] Other inconsistencies, e.g. inconsistency of a premise with known facts of science, are just a reason for assessing the premise in question as false.

[15] In an undercut argument, the proponent (who puts forward the argument) uses premises which the opponent accepts to infer a conclusion which the opponent denies. See Betz (2013) for a typology of dialectical moves.

argument. Again, this is a matter that needs to be assessed in the course of analysing the broader argumentative context.

The second perspective from which arguments are evaluated focuses on the relation between the premises and the conclusion. The leading perspective is that a good argument should lead from true premises to a true conclusion: does the truth of the premises guarantee the truth of the conclusion or does it at least provide strong support? Two standards are commonly distinguished, deductive validity and non-deductive strength. If an inference is evaluated for deductive validity, the question is whether the conclusion *must* be true if the premises all are. If evaluated for non-deductive strength, the question is whether the premises provide a strong reason, if not an absolute guarantee, for the truth of the conclusion.[16]

Deductive validity is conceived as a maximally strong link between premises and conclusion in the following sense: it guarantees (in a logical sense to be explained below) that the conclusion is true *if* the premises are. This leaves room for deductively valid inferences with premises or conclusions that are false; it only excludes the possibility that we could be confronted with true premises and a false conclusion. Hence a deductively valid inference can be put to two basic uses: showing that the conclusion is true, given that the premises are true; or showing that at least one premise is false, given that the conclusion is false (this is Harsanyi's overall strategy of argumentation). Another important consequence is that for showing an inference to be deductively invalid, it suffices to point out one situation in which the premises are true but the conclusion false. Showing that an inference is deductively valid is more ambitious insofar as referring to just one case will not do. We rather need a general argument which shows that there cannot be a case in which the premises are true and the conclusion false.

Such arguments can be given in basically two ways, which correspond to two varieties of deductive validity. The first is called "formal" validity[17] and covers arguments which are valid in virtue of one of their logical forms. Logical forms are constituted by features of inferences which are relevant to their validity and "topic neutral" such as the way inferences can be analysed into constituents of logically relevant categories (e.g. sentences, predicates and singular terms) and logical expressions such as "and", "all" and "if … then". The core idea of formal validity is that some inferences are valid solely in virtue of such structural features and regardless of the meaning of the non-logical expressions they involve. The notion of logical form is relative to a logical theory (of, e.g. zero- or first order logic), and such a theory is also needed to actually show that an inference is formally valid. The basic structure of a proof of formal validity involves two steps. First, the inference at hand must be formalized. One of its logical forms must be represented by means of a formula; that is, a schematic expressions of the formal language which is part of the logical theory. Secondly, the logical theory can be used to prove that every inference which has a logical form represented by the scheme in question

---

[16] The distinction between deductive and non-deductive primarily applies to standards of evaluation and only derivatively to arguments. An arguments can then be called "deductive" either because it is meant or taken to be evaluated by deductive standards, or because it performs well with respect to deductive standards. (Skyrms 2000:ch. II.4).

[17] In this chapter, we use "validity" simpliciter as an abbreviation for "deductive validity"; in the literature it often also abbreviates "formal validity".

is valid. Well-known techniques for such proofs include truth tables and natural deduction. In this way, the validity of the example [Singer] can be shown by proving $\neg p \vee p;\ \neg p \rightarrow q;\ p \rightarrow r \Rightarrow q \vee r$.

The second form of deductively valid inferences are "materially" valid inferences (also called "semantically" or "analytically" valid), the validity of which is due to a logical form and the meaning of (some of) the non-logical expressions they contain (e.g. "Option *New York* is better than option *Chicago.* Therefore *Chicago* is worse than *New York*."). One way of dealing with materially valid inferences employs a strategy of treating such inferences as enthymematic counterparts of formally valid inferences. If a premise expressing the conceptual relationship responsible for the materially valid inference is added to the original, a formally valid inference results. The inference at hand is then materially valid just in case the resulting inference is formally valid and the added premise expresses a conceptual truth. In reconstruction (2) of [Harsanyi], for example, one could add (2.5) as a premise and then get (2.6) as a conclusion (in line with 4):

(2.5) x is much better than y just in case y is much worse than x.

(2.6) The worst possible outcome of the option *Chicago* is much worse than the worst possible outcome of the option *New York*.

Non-deductive strength is an attribute of inferences which are deductively invalid, but the premises of which nonetheless provide good reason for their conclusions. Three characteristics distinguish non-deductive strength from logical validity: non-deductive strength is compatible with the conclusion being false even if all the premises are true, it comes in degrees, and it is nonmonotonic; that is, adding premises can yield a stronger or weaker argument. An immediate consequence is that even if a strong non-deductive argument supports some conclusion, there can still be a counter-argument which shows that this conclusion is false. Evaluating the non-deductive strength of arguments is a much more heterogenous business than assessing deductive validity. In the literature, a range of different types of non-deductive inferences are analysed. Examples include inferences based on probability ("inductive" inferences), analogies, inferences to the best explanation and inferences involving causal reasoning or appeal to the testimony of experts. It is debated how the various types of non-deductive inferences can best be analysed, whether they can be reduced to a few basic theoretical principles and whether they admit of a uniform and maybe even formal treatment. Some also defend a deductivist strategy of systematically correlating (some types of) non-deductively strong arguments to deductively valid ones with additional premises and a weaker conclusion. Again, argumentation schemes can be used as a heuristic tool for identifying candidates for additional premises.[18] One particular idea is to include premises which express that there are no valid or strong counter-arguments. We critically elaborate on this approach in Sect. 5, which also includes a range of examples.

Invalid and non-deductively weak inferences pose a particular challenge to the analyst. If she fails to show that an inference is valid or strong, this may be her fault rather than a deficit of the inference. For invalidity, there is the simple case mentioned above, in which we find that an inference has true premises and a false conclusion in some possible situation. But unless we can refer to such a direct counter-example, showing formal invalidity amounts to showing that the inference has *no* valid logical form, and there is, strictly speaking, no general way of conclusively showing that we have investigated

[18] Lumer (2011) explains how argumentation schemes can be exploited for deductivist reconstructions.

all the inference's logical forms (cf. Cheyne 2012). All we can do, is making plausible that an inference has no valid form, and for this, we need to rely on the assumption that we have considered all formal features of the inference which may be relevant to its validity. So any verdict of invalidity is at most as plausible as this assumption. And similar considerations apply in case of material invalidity and non-deductive weakness. Still, verdicts of invalidity or non-deductive weakness can often be argued convincingly, for example, by pointing out a confusion about necessary and sufficient conditions.

Many more defects of arguments are systematically studied under the label "fallacies". In general, fallacies are arguments that are irrelevant or misleading, especially because they are presented as being valid or strong although they are in fact invalid or weak, or as performing a dialectical function they in fact do not perform. The first type, traditionally called *non sequitur*, has just been discussed. The second type is exemplified in problems of dialectical irrelevance such as arguments which do not support the thesis they are presented as supporting (*ignoratio elenchi*) or arguments which attack a position the opponent does not in fact defend ("straw-man").[19] In this way, Harsanyi's undercut seems to miss the point because he includes assumptions about probabilities although Rawls intends maximin as a principle only for some situations which involve "choice under great uncertainty" (Rawls 1999:72); that is, choice situations, "in which a knowledge of likelihoods is impossible, or at best extremely insecure" (Rawls 1999:134).[20]

3.4. Practical arguments

So far, our discussion has not been specifically tailored to practical arguments. The basic characteristic of practical argumentation is that it leads to a "normative" conclusion. In this chapter, we focus on normative sentences which qualify an action with some deontic modality; that is a phrase such as "it is forbidden to …", " … must not do …" or "… ought to …".[21] On the one hand, there are many more such expressions which are commonly used. On the other hand, not all normative premises and conclusions are normative sentences, because they can have a normative meaning in the context at hand even if they do not contain an explicitly normative expression (e.g. "Boys don't cry."). A first task of reconstruction is therefore formulating the normative premises and the normative conclusion explicitly as normative sentences. One possibility is to qualify directly acts (e.g. "Agent A ought to do X" etc.), another is to is to rely on standard qualifiers for sentences ("It is obligatory that Agent A does X"), which are studied in deontic logic (cf. McNamara 2010):

---

[19] There is a rich literature on fallacies; cf. section *Resources.* For specific fallacies in argumentation about risk, see Hansson (2016).

[20] Harsanyi offers further considerations which may dispel the straw-man worry in the text that follows what we quoted as [Harsanyi].

[21] This is a restricted perspective since there are other types of non-descriptive sentences as well, for example those which include evaluative terms ("good", "better"). For a more precise and sophisticated discussion (using a different terminology), see Morscher (2013).

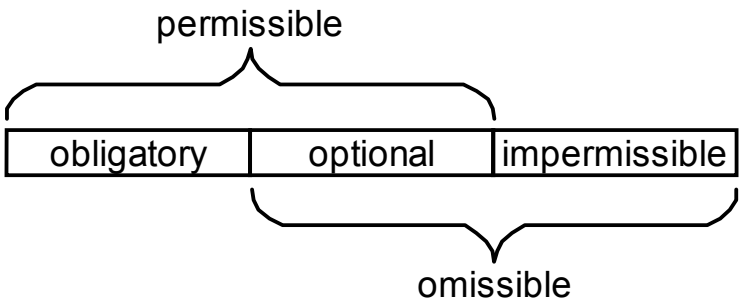

Figure 3 Deontic modalities and their logical relations (e.g. everything optional is permissible)

As an example, we get the following standard formulation for the conclusion of inference 3:

(3.3*) The maximin principle says that it is impermissible that you choose the option *New York*.

Importantly, the relations depicted in Figure 3 only hold if the various modalities relate to the same normative perspective. What is obligatory from a legal point of view is not merely optional from this point of view even if it is morally optional. Reconstructions therefore must make the normative perspective explicit unless all explicit normative phrases in an argumentation relate to the same normative perspective.

A second challenge for reconstructing practical arguments arises in connection with the fact that there are no valid practical inferences without any normative premises.[22] Practical arguments are frequently enthymematic in this respect, and normative premises must then be supplied in reconstruction. For the purpose of a systematic study of practical arguments, it will be convenient to rely on inferences with a certain standard form that can be expressed with the help of a decision principle. This is a sentence which claims that a certain option for acting has a certain deontic status under some descriptive and normative conditions. Such principles can then be used as a premise which joins further premises stating the mentioned conditions with a conclusion expressing the normative status of the relevant option. In Section 5, we will discuss a selection of examples of decision principles.

Another cluster of problems which regularly arises in the analysis of practical arguments is the following. If an option or a decision problem can be assessed with reference to more than one action-guiding principle, one faces the question of how these principles relate to each other. Are they lexicographically ordered (e.g. moral considerations trump prudential ones)? Or can the principles be weighted against each other in some other way? And how can such information be accounted for in argument analysis? Furthermore, premises of practical arguments will often include so-called *prima facie* (or *pro tanto,* or defeasible) reasons or obligations (cf. Hansson 2013:99). These are normative claims which are stated without any restrictions, but may be overridden in specific cases of application nonetheless (e.g. “Lying is impermissible” may not apply to cases in which an insignificant lie can

[22] Strictly speaking, this is only true for practical arguments in which every premise and the conclusion either is *entirely* in the scope of a deontic modality or does not contain any deontic modality. The situation is much more complex if for practical arguments which include “mixed” sentences; that is, sentences only part of which are in the scope of a deontic modality. See Morscher (2013) for an accessible discussion.

save the life of many). We suggest to deal with these challenges as problems of acquiring coherent positions in a complex argumentation (see Sect. 4.2).

4. Analysing complex argumentation

4.1. Reconstructing complex argumentation as argument maps

We have so far studied methods for analysing individual arguments. Virtually every policy debate and practical deliberation contains however multiple, typically conflicting arguments (see, e.g. Schefczyk 2016 on the monetary policy debate). If the *argumentative turn* aspires to represent an alternative to traditional risk analysis, it has to solve the problem of aggregating and compounding opposing arguments; at least, it has to *suggest* methods for balancing conflicting reasons.

Balancing reasons is a fundamental reasoning task we all perform regularly in a more or less systematic way. The basic tool we use to structure this task is a pro/con list. Still, such a pro/con list is insufficient for aggregating conflicting arguments. It may at best serve as a starting point for a more thorough analysis and should be seen as a mere heuristic one may use when nothing important is at stake (e.g. in many everyday decisions). The problem is that policy deliberation and analysis does frequently not go beyond giving a pro/con list. (And *if* it does, it uses highly questionable methods, e.g. cost benefit analysis.) There is a striking mismatch between the efforts our societies put into (a) getting the factual statements our policy analysis relies on right and (b) drawing the right conclusions from these factual statements in view of our complex normative beliefs. Put bluntly: where we find that a back-of-the-envelope-calculation is not good enough to establish the facts, we should not draw policy conclusions merely relying on pro/con lists, either.

But why precisely is a pro/con list not enough? There are three major issues with such lists:

1. *Macro structure*. It is unclear how exactly the different arguments relate to each other. Even worse, such lists wrongly suggest that all *pro* arguments (respectively *con* arguments) are related to the central thesis in a similar way.
2. *Micro structure*. The internal structure of the individual arguments remains unclear.
3. *Aggregation*. The plain juxtaposition of *pros* and *cons* suggests improper aggregation methods, such as simply counting (weighted) *pros* and *cons*.

Let us illustrate these points with an example. Consider the thesis:

[T] The global use of nuclear power should be extended.

The following list of arguments is drawn from the 18th edition of *Pros and Cons: A Debater's Handbook* (Sather 1999:255-7); the items have only been shortened (as indicated) and re-labelled. The fact that many of the descriptive claims made are false (as of today) does not prevent the example from being instructive.

Pro	*Con*
[Pro1.1] The world faces an energy crisis. Oil will be exhausted within fifty years, and coal will last less than half that time. It is hard to see how 'alternative' sources of energy will fulfil growing power needs. [Pro1.2] It is estimated, for example, that it would take a wind farm the size of Texas to provide for the power needs of Texas. […]	[Con1.1] The costs of nuclear power stations are enormous, especially considering the stringent safety regulations that must be installed to prevent disaster. [Con1.2] Alternative energy, however, is only prohibitively expensive because there is no economic imperative to develop it when oil and gas are so cheap. […]
[Pro2.1] The Chernobyl disaster, widely cited as the reason not to build nuclear power plants, happened in the Soviet Union where safety standards were notoriously lax, and often sacrificed for the sake of greater productivity. […]	[Con2.1] It is simply not worth the risk. Nuclear power stations are lethal time-bombs, polluting our atmosphere today and leaving a radioactive legacy that will outlive us for generations. [Con2.2] Chernobyl showed the potential for catastrophe […]. […]
[Pro3.1] The problems of the nuclear energy programme have been a result of bureaucracy and obsessive secrecy resulting from nuclear energy's roots in military research. These are problems of the past. […]	[Con3.1] In the 1950s, we were promised that nuclear energy would be so cheap that it would be uneconomic to meter electricity. Today, nuclear energy is still subsidised by the taxpayer. […]

Now consider:

1. *Macro structure*. For example, does argument [Con3.1] back up [Con1.1], does it question [Pro1.1], or does it criticize the central claim [T]? – Maybe it even does all three things at the same time. That is just not transparent.
2. *Micro structure*. None of the arguments is fully transparent in terms of assumptions and validity. It is for example unclear which implicit premises the argument [Pro1.1] appeals to in order to justify the central thesis [T].
3. *Aggregation*. It is tempting to count how many *pros* and *cons* one accepts in order to balance the conflicting arguments. We will see that this would be irrational.

So, how can we improve on this? As a first step, we have to get a better understanding of the *structure* of complex argumentation in general.

Arguments exhibit an internal premise-conclusion structure. The logico-semantic relations between the statements arguments are composed of determine the "dialectic" relations between arguments, the relations of support and attack.[23]

[23] Pollock (1987:485) distinguishes two further dialectic relations. An argument *rebuts* another argument if the arguments possess contradictory (or at least contrary) conclusions; an argument *undercuts* another argument if it questions the validity or applicability of an inference scheme applied in the latter. (Note that this is another use of "undercut" than in footnote 15.) The undercut

- An argument *supports* another argument if the conclusion of the supporting argument is identical with (or at least entails) a premise of the supported argument.
- An argument *attacks* another argument if the conclusion of the attacking argument negates (or at least contradicts) a premise of the attacked argument.

We can now state more precisely the shortcomings of pro/con lists. They suggest that all *pro (con)* arguments possess the same conclusion, which is identical with the central thesis (respectively its negation). Typically some *pro* arguments do however support other *pro* arguments, rather than the central thesis directly; or they attack *con* arguments. These exact dialectic relations remain obscure in mere pro/con lists.

Attack- and support-relations between arguments can be visualized as a network, a so-called argument or debate map. (Note that "argument map" sometimes refers to the visualization of the internal structure of a single argument, too.) Argument maps visualize the dialectical structure of a complex argumentation. It is convenient to display central theses besides arguments in such a map. This allows one for example to visually express so-called rebuttals without introducing an extra relation in the argument map; argument A rebuts argument B in case A supports a thesis that B attacks.

Conceptually, the micro-structure of arguments determines the macro-structure of a debate. Methodologically, i.e. in terms of reconstruction procedure, the reverse order of analysis has turned out to be practical. Accordingly, we suggest to *sketch* the dialectical structure first before reconstructing individual arguments in detail, which may (and typically does) lead to a revision of the original sketch. Sketching the dialectical structure essentially means to lay out the explicitly intended and intuitively hypothesized support- and attack-relations between arguments. The starting point of such a sketch may be a pro/con list.

Figure 4 shows a sketch of the debate about nuclear power, based on the pro/con list given above (solid arrows represent support, dashed arrows attack relations between the arguments, and theses). The map is basically a hypothesis about the debate's dialectical structure, which has to be probed through detailed reconstructions of the individual arguments. At the same time, this hypothesis may guide the further reconstruction process, namely through suggesting constraints for (i) adding premises and (ii) modifying premises and conclusions in arguments.

---

relation is, however, not directly relevant in the framework we propose here. Validity of the individual arguments is guaranteed qua charitable reconstruction. Rather than using controversial inference schemes for the reconstruction, we suggest to add corresponding general premises that can be criticized. Pollock's undercut-relation hence effectively reduces to the attack relation.

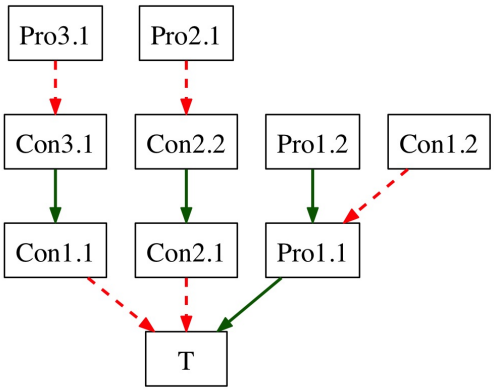

Figure 4 Argument map visualizing support (solid arrows) and attack (dotted arrows) relations between arguments and theses (boxes) in the illustrative debate about nuclear power

We next present detailed reconstructions of two arguments mentioned in the illustrative pro/con list and the argument map above, the argument [Pro1.1] in favour of the global expansion of nuclear energy and the argument [Con2.1] against it.

[Pro1.1]

(1) If the global use of nuclear energy is not extended and the growing power need will be met nonetheless, then fossil fuels will fulfil growing power needs or 'alternative' sources of energy will do.

(2) It is impossible that fossil fuels will fulfil growing power needs (because of limited resources).

(3) It is impossible that 'alternative' sources of energy will fulfil growing power needs.

(4) **Thus** (1-3): The global use of nuclear energy is extended or growing power needs will not be met.

(5) The global energy crisis must be resolved, i.e. growing power needs must be met.

(6) *Practical-Syllogism*-Principle [cf. below].

(7) **Thus** (from 4-6): The global use of nuclear power should be extended. [T]

[Con2.1]

(1) The probability of accidents in nuclear power stations with catastrophic environmental and health impacts is non-negligible.

(2) Nuclear power stations pollute our atmosphere and leave a radioactive legacy that will outlive us for generations.

(3) If a technology exhibits a non-negligible likelihood of catastrophic accidents, pollutes the atmosphere and generates long-lasting, highly toxic waste, then its continued use – and a fortiori its expansion – poses severe environmental and health risks for current and future generations.

(4) **Thus** (1-3): The continued use of nuclear energy – and a fortiori its expansion – poses severe environmental and health risks for current and future generations.

(5) Any measure that poses severe environmental and health risks for current and future generations should not be implemented.

(6) **Thus** (4,5): The global use of nuclear power should not be extended. [N.B. entails non-T!]

These two reconstructions corroborate the dialectic relations as presumed in the preliminary argument map (cf. their conclusions).

4.2. Argument maps as reasoning tools

Let us now suppose that all arguments have been reconstructed like [Pro1.1] and [Con2.1] above, and that the dialectic relations as visualized in Figure 4 do really obtain, i.e. the debate's macro-structure dovetails with the micro-structure of the arguments. In addition, we assume that all individual arguments have been reconstructed as deductively valid (and non-redundant).[24] How can we evaluate such a debate?

It is important to understand that the reconstruction itself is not prescriptive. It neither decides on who is right or wrong nor on who has the final say in a debate. Hence argument analysts do not teach scientists or policy-makers what they should believe or do, and for what reasons. Essentially the reconstruction itself entails only if-then claims: if certain statements are true, then certain other statements that occur in the debate must also be true. The argument map does not reveal which statements are true; it is thus neutral and open to different evaluations (depending on which statements one considers to be true, false or open). In other words, the argument map identifies the questions to be answered when adopting a position in the debate, and merely points out the implications of different answers to these questions. Because of this, a thesis that is supported by many arguments is not necessarily true. And, by the same token, a thesis that is attacked by many arguments is by no means bound to be false. This applies equally to arguments. An attack on an argument does not imply that the very argument is definitely refuted. (It may be, for example, that the attacking argument itself draws – from an evaluative perspective – on premises that can easily be criticized by adding further arguments.)

But then, again: how *can* we reason with argument maps? How do they help us to make up our mind?

We suggest that argument maps are first and foremost a tool for determining positions proponents (including oneself) may adopt, and for checking whether these positions satisfy minimal standards of rationality, i.e. are "dialectically coherent." While arguments constrain the set of positions proponents

[24] The proper analysis and evaluation of non-deductive reasoning poses serious theoretical problems and goes beyond the scope of this chapter. For a comprehensive state-of-the-art presentation compare Spohn (2012).

can reasonably adopt, there will in practice always be a plurality of different, opposing positions which remain permissible.[25]

Such positions can be conceptualized and articulated on different levels of detail.

- On the macro level, a complete (partial) position specifies for all (some) arguments in the debate whether it is accepted or refuted. To accept an argument means to consider all its premises as true. To refute an argument implies that at least one of its premises is denied (whereas such a coarse-grained position does not specify which premise).
- On the micro level, a complete (partial) position consists in a truth-value assignment to all (some) statements (i.e. premises and conclusions) that occur in the debate's arguments.

There is no one-to-one mapping between coarse- and fine-grained positions. Different fine-grained formulations may yield one and the same coarse-grained articulation of a proponent's position. Fine-grained positions are more informative than coarse-grained ones.

These two types of articulating a position come along with coherency standards, i.e. minimal requirements a reasonably adoptable position must satisfy. The basic rationality criterion for a complete macro position is:

> [No accepted attack] If an argument or thesis A is accepted, then no argument or thesis which attacks A is accepted.

A partial macro position is dialectically coherent if it can be extended to a complete position which satisfies the above criterion.

Consider for illustrative purposes the two macro positions (articulated on the background of the nuclear energy debate) which are shown in Figure 5. The left-hand position is complete in the sense that it assigns a status to every argument in the map. Moreover, that position satisfies the basic rationality criterion. There is no attack relation such that both the attacking and the attacked item are accepted. The right-hand figure displays a partial macro position, which leaves some arguments without status assignment. That position violates constraint [No accepted attack] twice, as indicated through a flash of lightning.

---

[25] A prominent rival approach to the one presented in this chapter are Dung-style evaluation methods for complex argumentation, which have been developed in Artificial Intelligence over the last two decades (cf. Bench-Capon and Dunne 2007, Dung 1995). Dung-style evaluation methods impose far-reaching rationality constraints; e.g. non-attacked arguments *must* be accepted, and undefended arguments *must not* be accepted. According to the approach championed in this chapter, in contrast, any argument can be reasonably accepted, as long as the proponent is willing to give up sufficiently many beliefs (and other arguments).

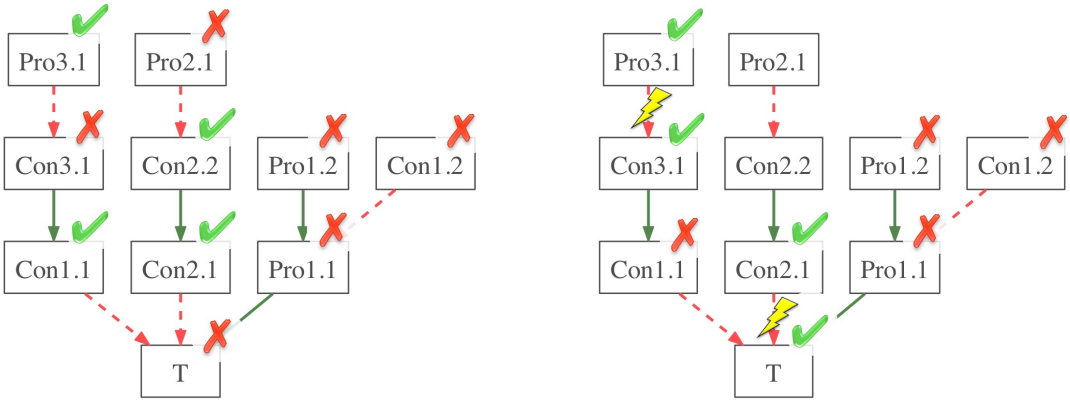

Figure 5 Two macro positions, visualized against the background of the nuclear energy debate's argument map. "Checked" arguments are accepted, "crossed" arguments are refuted, "flashes" indicate local violations of rationality criteria (see also text)

Complete micro positions must live up to a rationality criterion which is articulated in view of the inferential relations between statements (rather than the dialectic relations between arguments).

[No contradictions] Contradictory statements are assigned complementary truth-values.

[Deductive constraints] There is no argument such that, according to the position, its premises are considered true while its conclusion is considered false.

A partial micro position is dialectically coherent if it can be extended to a complete position which satisfies the above criteria.

Consider for illustrative purposes the two arguments [Pro1.1] and [Con2.1] we have reconstructed formerly. A position which takes all premises of [Pro1.1] to be true but denies its conclusion, or which assents to the conclusions of both [Pro1.1] and [Con2.1] is obviously not dialectically coherent; it directly violates one of the above constraints. A partial position according to which all premises of [Pro1.1] and [Con2.1] are true is not dialectically coherent, either, because truth-values of the remaining statements (i.e. conclusions) cannot be fixed without violating one of the above constraints.

A micro or macro position which is not dialectically coherent violates basic logical / inferential constraints that have been discovered and articulated in the debate. (Note that this standard of coherence is even weaker than the notion of logical consistency.) If a proponent's position is not dialectically coherent, the proponent has not fully taken into account all the considerations that have been put forward so far. Either she has ignored some arguments, or she has not correctly adapted her position in regard of some arguments. As new arguments are introduced into a debate, previously coherent positions may become incoherent and in need of revision.

Argument maps and the articulation of positions in view of such maps may hence help proponents to arrive at well-considered, reflective positions that do justice to all the considerations set forth in a deliberation. Suppose, for example, a stakeholder newly realizes that her position is attacked by an argument she considers *prima facie* plausible. That discovery may – indeed: should – lead her to modify her stance. But there are different, equally reasonable ways to revise her position: she may decide to refute the previously ignored argument despite its *prima facie* plausibility, or she concedes the criticism and gives up the argument that is attacked.

Coherency checking is hence a proper way for balancing and aggregating conflicting normative arguments. Let us suppose that all *descriptive* premises in the arguments pro and con expanding nuclear energy were established and agreed upon. Whether a proponent assents to the central thesis [T] thus hinges only on her evaluation of the various *normative* premises, e.g. premise (5) in [Pro1.1] and [Con2.1], respectively. Typically, there will exist no dialectically coherent position according to which all ethical proscriptions, all decision principles, all evaluative statements and all claims to moral rights are simultaneously accepted. Only a subset of all normative statements that figure in a debate can be coherently adopted. And there are various such subsets. Coherency checking hence makes explicit the precise normative trade-offs involved when aggregating conflicting practical arguments.[26]

Over and above coherency checking, argument maps can be valuable tools for managing plurality and coping with conflicting positions. In terms of argument mapping, actual dissent between opponents can stem from two causes: (i) the proponents have overlooked arguments put forward by their respective opponent; (ii) some arguments and theses are evaluated differently. Re (i): If dissent arises, among other things, because one opponent has missed certain arguments, the opponents should first of all agree, and possibly expand, the argument map, whereupon the positions held by the opponents will be re-evaluated. At best, dissent is dissolved right after that. Re (ii): If there is dissent in spite of agreement on the set of relevant arguments, one may proceed as follows. One firstly identifies the theses and arguments mutually agreed on by the opponents. Based on this common ground, one then tries to determine or develop consensual policies. For policy deliberations, this translates as follows: the argument maps can be used for developing robust policy proposals, i.e. policy measures that are compatible with many different positions and sets of basic moral assumptions.

Plurality management may also allow one to identify promising argumentation strategies for reducing disagreement. The reconstruction may for instance reveal that there is a central argument which is simply not agreed upon because its empirical assumptions are still controversial. Consensus on the central normative thesis might then be reached by arguing about and clarifying the empirical assumption (which is sometimes easier than agreeing on basic normative evaluations). In addition, formal models of debate dynamics suggest, quite generally, that one should argue in an opponent-sensitive way (i.e. on the basis of one's opponents' assumptions) in order to reduce mutual

---

[26] Sometimes one and the same („prima facie") normative principle, when applied to a complex decision situation, gives rise to conflicting implications. This is paradigmatically the case in dilemmatic situations, where one violates a given norm no matter what one does. In argument-mapping terms: given all descriptive premises are accepted, there is no coherent position according to which the „prima facie" principle is true. In regard of such cases, we suggest to systematize the aggregation and balancing process through *specifying* the normative principle in question such that the differences between alternative choices are made explicit. E.g. rather than arguing with the principle "You must not lie" in a situation where one inevitably either lies to a stranger or to one's grandma, one should attempt to analyze the reasoning by means of the two principles "You must not lie to relatives" and "You must not lie to strangers", which can then be balanced against each other.

disagreement (cf. Betz 2013:12). The detailed analysis of a debate is certainly helpful in identifying such argumentative moves.

The very basic point of plurality management is illustrated by Figure 6. It shows two macro positions that disagree on most of the relevant issues (arguments in the debate) but agree on some core points: the central thesis should be refuted; it is attacked by an argument that should be accepted; and the sole justification of the central thesis should be rejected. This core agreement may suffice to agree on policy questions, further dissent concerning other arguments is then irrelevant (regarding *policy* consensus formation).

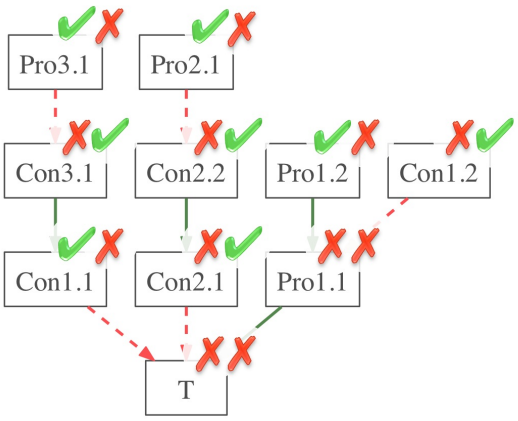

Figure 6 Two macro positions, visualized against the background of the illustrative argument map

Let us briefly return to our third criticism of pro/con lists: improper aggregation methods. It should be clear by now that numbers do not count. We should not simply add up accepted *pros* and *cons*. A single *pro* argument may override a dozen *con* arguments. The left-hand macro position in Figure 6, which is dialectically coherent, accepts 3 out of 4 *pro* arguments and only 1 out of 5 *con* arguments, but denies the central thesis nonetheless.

The process of specifying a dialectically coherent (macro or micro) position in view of an argument map can be modelled by means of a decision tree. To illustrate this process we shall consider a simplified dialectical structure that consists of three arguments A,B,C and a thesis T. We assume that A attacks T, B supports T, and C attacks B (Fig. 7).

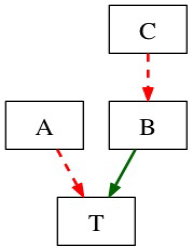

Figure 7 A simple, abstract argument map

Each argument has but one premise whose truth-value is not fixed through background knowledge, labelled a,b,c respectively. In order to find a dialectically coherent micro position on this map and to

determine whether one should accept the central thesis, one may execute the decision tree shown in Figure 8.[27]

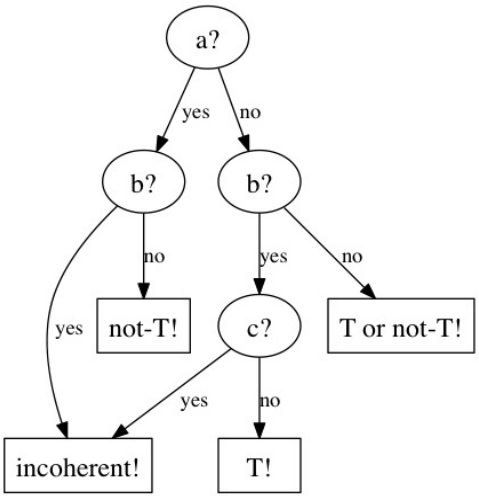

Figure 8 Decision tree for determining whether to accept the central thesis in the argument map depicted in Figure 7

We have started this section with the issue of aggregating conflicting reasons. Argument maps per se do not resolve this problem, they do not provide an algorithm for weighing conflicting reasons. They provide a detailed conceptual framework in which this task can be carried out. The resolution of normative conflicts will essentially depend on the acceptance/refutation of key premises in the arguments. These premises will also include conflicting decision principles. The map does not tell you how to do it, it only shows between which (sets of) normative statements one has to choose.

4.3. An illustrative case study

This section illustrates the above methods by reporting how argument maps have been used as reasoning tools in climate policy advice.[28] Climate engineering (CE) refers to large-scale technical interventions into the earth system that seek to offset the effects of anthropogenic GHG emissions. CE includes methods which shield the earth from incoming solar radiation (solar radiation management) and methods which take carbon out of the atmosphere (carbon dioxide removal).[29]

In 2010, the German Ministry of Education and Research (BMBF) commissioned six individual scoping studies on different aspects of CE. Eventually, these individual studies were to be integrated into a single, interdisciplinary assessment. Betz and Cacean compiled a report on ethical aspects (eventually translated and published as Betz and Cacean 2012).

The overall aim in writing the study was to provide neutral policy advice on ethical issues of CE. To achieve this goal, Betz and Cacean (2012) decided to carry out an analysis of the various (ethical)

[27] "Yes" stands for statement accepted; "no" for statement not accepted. For the sake of simplicity, we do not distinguish between denying a statement and suspending judgement.

[28] This section is adapted from http://www.argunet.org/2013/05/13/mapping-the-climate-engineering-controversy-a-case-of-argument-analysis-driven-policy-advice/ [last accessed 16.03.2015].

[29] On the ethics of climate engineering and the benefits of argumentative analysis in this field compare Elliott (2016).

arguments pro and con climate engineering methods. Splitting up the analysis into consecutive sub-tasks and including feedback rounds, they

- compiled a comprehensive commented bibliography of the CE discourse with a focus on ethical arguments (including scientific articles, policy statements, media reports, popular science books, etc.),
- sketched the overall dialectical structure and the individual arguments, which provided a first argument map,
- presented the preliminary argument map at project workshops to get feedback,
- and, finally, revised their interpretation of the debate and reconstructed the arguments in detail (as premise-conclusion structures).

The immediate result of this procedure was a comprehensive argument map, which was then used in the BMBF project in order

1. to compile the report "Ethical Aspects";
2. to assist policy makers in acquiring a coherent position (by evaluating alternative core positions proponents and policy makers may adopt);
3. to merge the various disciplinary studies in a final assessment report.

Re (1): The scoping study on ethical aspects of climate engineering contains a macro map of the debate that structures the entire report. Each chapter is devoted to a sub-debate of the controversy. The chapters in turn feature micro maps that display the internal structure of the sub-debates and visualize the individual arguments plus their dialectic relations. The arguments are then discussed in detail in the chapter texts. Central arguments are reconstructed as premise-conclusion structures.

Re (2): Betz and Cacean also used the argument map to assist stakeholders in acquiring a coherent position.

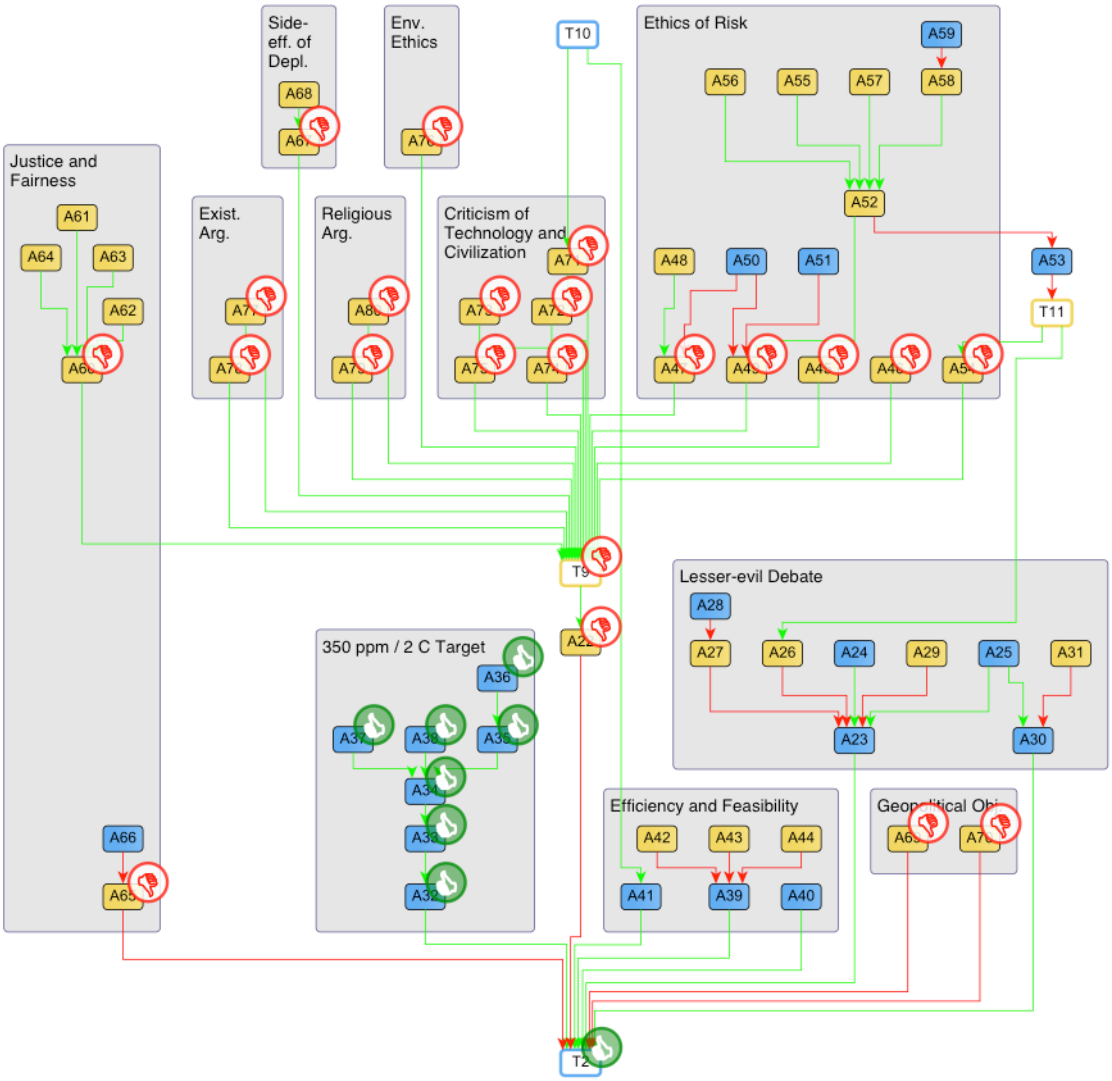

Figure 9 Illustrative core position (here: thumbs up) and its logico-argumentative implications (here: thumbs down) in a detailed reconstruction of the moral controversy about so-called climate engineering (Source: Betz and Cacean 2012:87)

Thus, they have identified alternative core positions the ministry, or another stakeholder, may adopt. Such a core position might, for example, consist in saying that CE should be researched into so as to have these methods ready for deployment in time. They have then visualized the core position in the argument map and calculated the logico-argumentative implications of the corresponding stance (cf. Fig. 9). The enhanced map shows, accordingly, which arguments one is required to refute and which theses one is compelled to accept if one adopts the corresponding core position. For example, proponents who think that ambitious climate targets will make some sort of climate engineering inescapable are required to deny religious objections against CE deployment. By spelling out such implications, Betz and Cacean tried to enable stakeholders to take all arguments into account and to develop a well-considered position.

Re (3): The argument map also proved helpful in integrating the various discipline-specific studies into a single, interdisciplinary assessment report (Rickels et al. 2011). So, the assessment report, too, starts with a macro map, which depicts the overall structure of the discourse, and lists the pivotal arguments. Most interestingly, though, all the empirical chapters of the assessment report (on physical

and technical aspects, on sociological aspects, on governance aspects, etc.) consistently refer to the argument map and make explicit to which arguments the empirical discussion unfolded in the chapter is related. This allows one to trace back sophisticated empirical considerations to the general debate and hence to the key questions of the controversy.

In sum, this case shows that argument mapping techniques can be very helpful in compiling assessment reports and providing scientific policy advice: they structure relevant empirical information and normative assumptions in such a way that decision makers are empowered to balance conflicting reasons in a well-informed and transparent way.

5. Arguing under uncertainty

5.1. General requirements of rational deliberation and sound decision-making

There are two basic requirements of sound decision-making that apply in particular to practical reasoning. First of all, a specific course of action should be assessed relative to all conceived-of alternatives. Secondly, all (normatively relevant) consequences of each option should be taken into account; in particular, uncertainty about such consequences must not simply be ignored (e.g. by falsely pretending that the consequences are certain or by ignoring some consequences altogether).[30]

There are two different ways in which these requirements can be applied to the *argumentative turn*, the argumentation-theoretic paradigm of practical reasoning. We have seen that every practical argument relies on a (frequently implicit) premise which states a more or less general decision principle (cf. Sect. 3.4). A decision principle licenses the inference from descriptive and normative statements to a normative conclusion. Now, the strong interpretation of the requirements demands that every individual decision principle (i.e. every individual practical argument) reasons for or against an action *in view of* all alternatives and all plausible outcomes. Arguments that fail to do so can accordingly be dismissed as defect. The alternative, weak interpretation of the requirements merely demands that all alternative options and all their plausible outcomes be considered in the entire debate, but not necessarily in each individual argument.

This choice boils down to the following question: should we allow for decision principles which individually do not satisfy standards of good decision-making? – Yes, we think so. The following simplified example is a case in point:

Argument A

(1) The 2-degree-target will only be reached if some CE technology is deployed.

(2) The 2-degree-target should be reached.

(3) *Practical-Syllogism*-Principle (see below).

(4) **Thus**: Some CE technology should be deployed.

Argument B

(1) CE technologies are risk technologies without a safe exit option.

---

[30] Steele (2006) interprets the precautionary principle as a meta-principle for good decision-making which articulates essentially these two requirements.

(2) Risk technologies without a safe exit option must not be deployed.

(3) **Thus**: No CE technology may be deployed [contrary to A.3 above].

None of these arguments considers explicitly all options and all potential outcomes. (This is because the antecedent conditions of their decision principles, A.3 and B.2, do not do so.) In combination, however, these two arguments allow for a nuanced trade-off between conflicting normative considerations. Risk-averse proponents may stick to argument B and hence give up the two-degree-target (premise A.1) in order to reach a dialectically coherent position; others may prioritize the two-degree-target and accept potential negative side-effects, in particular through denying that these side-effects are a sufficient reason for refraining from CE (i.e. they deny premise B.2). In sum, practical reasoning and, in particular, coherency checking is performed against the entire argument map; as long as all normatively relevant aspects are adequately represented somewhere in the map, practical reasoning seems to satisfy the general requirement of sound-decision making. There is thus no need for explicitly considering all options and all potential outcomes in each and every single argument.

5.2. Decision principles for reasoning under great uncertainty

In the remainder of this chapter, we will present some argument schemes (in the form of decision principles that can be added as a premise to an argument reconstruction) which may allow argument analysts to reconstruct very different types of normative arguments. Such argument schemes can facilitate the reconstruction process and are mainly of *heuristic value*. There are certainly good reconstructions which do not correspond to any of these schemes. And schemes might have to be adapted in order to take the original text or plausibility etc. into account. That is, schemes are rather prototypes that will frequently provide a first version of an argument reconstruction, which will be further improved in the reconstruction process.

It is characteristic for practical arguments under uncertainty that their descriptive premises make explicit the uncertainty one faces. One way to arrive at (more or less) plausible decision principles for reasoning under uncertainty is hence to weaken their descriptive premises by introducing modal qualifications. The first six decision principles offer alternative qualifications of the descriptive premises (corresponding to apodictic, probabilistic and possibilistic versions). In general, the more far-reaching the qualification and the weaker the descriptive premises, the stronger and hence more questionable the corresponding decision principle.

Just to be clear: we are not advocating any of these decision principles. Following the idea that argument maps are tools which support agents in balancing conflicting normative reasons, the principles stated below will figure as premises in different arguments and will have to be weighed against each other on a case-specific basis.

The first principle states that any measure which is required to reach a goal should be taken – provided the goal should be attained.

[Practical Syllogism Principle]

If

(1) It ought to be the case that S.

(2) S [**will not/is unlikely to/might not**] be the case unless agent A does X.

then

(3) Agent A ought to do X.

While the apodictic version of this principle is analytic, the possibilistic version is arguably *very* weak, we have merely mentioned it for reasons of systematic completeness. This observation implies the following for the aggregation of conflicting arguments: when coherency checking reveals that we face a choice, we are rather prepared to give up the possibilistic principle than the probabilistic or the apodictic version. Similar remarks apply to the principles below.

Practical arguments frequently justify options not because they are necessary for attaining some goal but because they are optimal. Such arguments could be reconstructed with the following principle:

[Optimal Choice Principle]

If

(1) It *prima facie* [i.e. without considering negative side-effects that are inevitable when bringing about S] ought to be the case that S.

(2) S [**will/is likely to/might**] be the case if agent A does X.

(3) There is no alternative to X for agent A that [**will/is likely to/might**] bring about S and is more suitable than X.

(4) The certain, likely and possible side-effects of agent A doing X are collectively negligible as compared to the [**certain/likely/possible**] realisation of S.

then

(5) **Thus**: Agent A ought to do X

The underlying idea is that conditions (1) and (4) collectively guarantee that S ought to be the case *all things considered* and that (2) and (3) imply that X is [likely/possibly] the optimal means to reach S.

Deontological reasons may be analysed along the following lines.

[Prohibition Principle]

If

(1) Acts of type T are categorically impermissible.

(2) Agent A doing X is [**certainly/likely/possibly**] an act of type T.

then

(3) Agent A must not do X.

The apodictic version of this principle is, as in the case of the Practical Syllogism, analytic. As an alternative to modal qualifications, uncertainties may be made explicit in the characterization T of an act; e.g.: “an attempted murder”, that is an act (of a certain kind) that leads with some probability to some consequence. In such a case, premise (2) need not be qualified.

Rights-based considerations pose no principle problems for argument analysis, either.

[Principle of Absolute Rights Violation]

If

(1) Persons P possess the absolute right to be in state R.

(2) Agent A doing X [**certainly/likely/possibly**] prevents persons P from being in or achieving state R.

then

(3) Agent A must not do X.

The following principle speaks against some action based on the fact that the act violates *prima facie* rights that are not overridden (compare for example argument B in Betz (2016)).

[Principle of Prima Facie Rights Violation]

If

(1) Persons P possess the *prima facie* right to be in state R.

(2) Agent A doing X [**certainly/likely/possibly**] prevents persons P from being in or achieving state R.

(3) There exist no collectively weightier rights (than someone being in state R) whose realisation is [**certainly/likely/possibly**] jeopardized when not doing X.

then

(4) Agent A must not do X.

Standard approaches in formal decision theory can be re-interpreted as decision principles, which in turn correspond to specific types of arguments (see also Betz (2016), Sect. 3). We illustrate this fact by means of two prominent examples. The following decision principle represents the criterion of expected utility maximization (e.g. Savage 1954).

[Principle of Expected Utility Maximization]

If

(1) The option o^+ has an expected utility of EU^+, according to probabilistic forecasts P and utility function U.

(2) There is no alternative option to o^+ which has an expected utility equal to or greater than EU^+, according to probabilistic forecasts P and utility function U.

(3) The probabilistic forecasts P are reliable.

(4) Utility function U adequately combines all normative dimensions that are relevant for the assessment of o^+ (and its alternatives).

then

(5) Option o^+ ought to be carried out.

Finally, consider a principle that grasps maximin reasoning under great uncertainty (cf. Gardiner 2006).

[Worst Case Principle]

If

(1) Some available options may have catastrophic consequences.

(2) There are no options whose potential gains would outweigh, if realized, the worst possible consequences that may come up. [Counterfactual comparison of potential best and worst case]

(3) There are no reliable probabilistic forecasts of the available options' consequences, especially not of their worst possible consequences.

(4) There is no other available option whose worst possible consequence is (weakly) preferable to the worst possible consequence of option o^+.

then

(5) Option o^+ ought to be carried out.

For various examples of worst case arguments compare Betz (2016:Section 3.1).

6. Outlook

In this chapter we surveyed methods of argumentation analysis, with a special focus on justifying and criticising decisions under great uncertainty. Our approach starts with a systematic account of the aims of argument analysis, including the various dimensions in which an argumentation may be evaluated and the various standards that guide the reconstruction of arguments. On this basis, we introduced and exemplified the basic procedures for identifying, reconstructing and evaluating individual arguments as well as complex argumentation and debates. We then explained how such reconstructions of complex controversies may serve as reasoning tools. Finally, we discussed a range of decision principles that figure prominently in practical arguments under great uncertainty.

These methods have been developed as tools for clarifying and evaluating existing arguments and debates. The argumentative approach, however, has far greater potential. Concepts and techniques of argumentation analysis may be used to effectively *improve* practical reasoning in a variety of contexts. An argumentative approach enables experts and policy advisors to design scientific assessments and to provide decision-relevant scientific insights without being policy-prescriptive; it helps citizens and stakeholders to articulate their standpoints and to meaningfully contribute to intricate debates; it assists moderators in steering a controversy and managing a plurality of opinions; and it supports decision makers in balancing conflicting reasons in a transparent and well-informed way. We are convinced that a focus on argumentation will improve the deliberative quality of policy debates. Argumentation and argument analysis ultimately serve an emancipatory agenda. All too often, citizens and stakeholders are intellectual captives of unchallenged assumptions. Argumentation analysis frees

people who are lost in the communicative labyrinth of reasons – it empowers them to speak up, to argue their views, and to scrutinize positions, held by themselves or others.

Resources supporting argument analysis

Bowell, Tracy, and Gary Kemp. 2015. *Critical Thinking. A Concise Guide. 4th ed.* London: Routledge.

Chapter 5 gives a very accessible yet reliable introduction to techniques of argument reconstruction focusing on the analysis of individual arguments and complex argumentation.

Two online tutorials focusing on analysing complex argumentation are:

- Course "Argument Diagramming" at Carnegie Mellon University: http://oli.cmu.edu/courses/free-open/argument-diagramming-course-details/.
- *Critical Thinking Web:* http://philosophy.hku.hk/think/.

A more extensive treatment of fallacies can be found in the *Internet Encyclopedia of Philosophy:* http://www.iep.utm.edu/fallacy/.

Argunet is an argument mapping software designed to support the reconstruction of complex argumentation and debates: http://www.argunet.org/.

Links were correct on 22.07.2015.

References

Bench-Capon, Trevor J. M., and Paul E. Dunne. 2007. Argumentation in Artificial Intelligence. *Artificial Intelligence* 171: 619–641.

Betz, Gregor. 2010. *Theorie dialektischer Strukturen.* Frankfurt a.M.: Klostermann.

Betz, Gregor. 2013. *Debate Dynamics. How Controversy Improves Our Beliefs.* Dordrecht: Springer.

Betz, Gregor. 2016. Accounting for possibilities in decision making. In *The argumentative turn in policy analysis. Reasoning about uncertainty*, eds. Sven Ove Hansson, and Gertrude Hirsch Hadorn xx-xx. Dordrecht: Springer.

Betz, Gregor, and Sebastian Cacean. 2012. Ethical Aspects of Climate Engineering. Karlsruhe: KIT Scientific Publishing. DOI 10.5445/KSP/1000028245.

Brun, Georg. 2014. Reconstructing Arguments. Formalization and Reflective Equilibrium. *Logical Analysis and History of Philosophy* 17: 94–129.

Brun, Georg, and Gertrude Hirsch Hadorn. 2014. *Textanalyse in den Wissenschaften. Inhalte und Argumente analysieren und verstehen. 2nd ed.* Zürich: vdf.

Brun, Georg, and Hans Rott. 2013. Interpreting Enthymematic Arguments Using Belief Revision. *Synthese* 190: 4041–4063.

Cheyne, Colin. 2012. The Asymmetry of Formal Logic. In *The Logica Yearbook 2011,* eds. Michal Peliš, and Vit Punčochář, 49–62. London: College Publications.

Dung, Phan Minh. 1995. On the Acceptability of Arguments and Its Fundamental Role in Nonmonotonic Reasoning. Logic Programming and n-Person Games. *Artificial Intelligence* 77: 321–357.

van Eemeren, Frans H., and Rob Grootendorst. 1992. *Argumentation, Communication, and Fallacies. A Pragma-Dialectical Perspective.* Hillsdale: Lawrence Erlbaum.

van Eemeren, Frans H., and Rob Grootendorst. 2004. *A Systematic Theory of Argumentation. The Pragma-Dialectical Approach.* Cambridge: Cambridge University Press.

Elliott, Kevin C. 2016. Climate Geoengineering. In *The argumentative turn in policy analysis. Reasoning about uncertainty*, eds. Sven Ove Hansson, and Gertrude Hirsch Hadorn xx-xx. Dordrecht: Springer.

Fischer, Frank, and John Forester. 1993. *The Argumentative Turn in Policy Analysis and Planning*. Durham: Duke University Press.

Fischer, Frank, and Herbert Gottweis. 2012. *The Argumentative Turn Revisited. Public Policy as Communicative Practice*. Durham: Duke University Press.

Gardiner, Stephen M. 2006. A Core Precautionary Principle. *The Journal of Political Philosophy* 14: 33–60.

Hansson, Sven Ove. 2000. Formalization in Philosophy. *The Bulletin of Symbolic Logic* 6: 162–175.

Hansson, Sven Ove. 2013. *The Ethics of Risk: Ethical Analysis in an Uncertain World.* New York: Palgrave Macmillan.

Hansson, Sven Ove 2016. Evaluating the uncertainties. In *The argumentative turn in policy analysis. Reasoning about uncertainty*, eds. Sven Ove Hansson, and Gertrude Hirsch Hadorn xx-xx. Dordrecht: Springer.

Hansson, Sven Ove, and Gertrude Hirsch Hadorn. 2016. Introducing the argumentative turn in policy analysis. In *The argumentative turn in policy analysis. Reasoning about uncertainty*, eds. Sven Ove Hansson, and Gertrude Hirsch Hadorn xx-xx. Dordrecht: Springer.

Harsanyi, John C. 1975. Can the Maximin Principle Serve as a Basis for Morality? A Critique of John Rawls' Theory. *American Political Science Review* 69: 594–606.

Jacquette, Dale. 1996. Charity and the Reiteration Problem for Enthymemes. *Informal Logic* 18: 1–15.

Lumer, Christoph. 2011. Argument Schemes. An Epistemological Approach. In Argumentation. Cognition and Community. Proceedings of the 9th International Conference of the Ontario Society for the Study of Argumentation (OSSA), May 18–22, 2011, ed. Frank Zenker. Windsor: University of Windsor. http://scholar.uwindsor.ca/ossaarchive/OSSA9/papersandcommentaries/17/. Accessed 22.07.2015.

McNamara, Paul. 2010. Deontic Logic. Stanford Encyclopedia of Philosophy. http://plato.stanford.edu/archives/fall2010/entries/logic-deontic/.

Morscher, Edgar. 2009. *Kann denn Logik Sünde sein? Die Bedeutung der modernen Logik für Theorie und Praxis des Rechts.* Wien/Berlin: Lit.

Morscher, Edgar. 2013. How to Treat Naturalistic Fallacies. In *Aktuelle Probleme und Grundlagenfragen der medizinischen Ethik*, eds. Heinrich Ganthaler, Christian R. Menzel, and Edgar Morscher, 203–232. St. Augustin: Academia.

Paglieri, Fabio, and John Woods. 2011. Enthymematic Parsimony. *Synthese* 178: 461–501.

Pollock, John L. 1987. Defeasible Reasoning. *Cognitive Science* 11: 481–518.

Rawls, John. 1999. *A Theory of Justice. Revised edition.* Cambridge, MA: Belknap Press.

Reinmuth, Friedrich. 2014. Hermeneutics, Logic and Reconstruction. *Logical Analysis and History of Philosophy* 17: 152–90.

Rescher, Nicholas. 2001. *Philosophical Reasoning.* Malden: Blackwell.

Rickels, Wilfried, et al. 2011. Large-Scale Intentional Interventions into the Climate System? Assessing the Climate Engineering Debate. Scoping report conducted on behalf of the German Federal Ministry of Education and Research (BMBF). Kiel: Kiel Earth Institute. http://www.kiel-earth-institute.de/scoping-report-climate-engineering.html?file=tl_files/media/downloads/scoping_reportCE.pdf. Accessed 22.07.2015.

Savage, Leonard J. 1954. *The Foundation of Statistics*. New York: Wiley.

Sather, Trevor. 1999. *Pros and Cons. A Debater's Handbook. 18th ed.* London: Routledge.

Schefczyk, Michael. 2016. Financial markets: the stabilisation task. In *The argumentative turn in policy analysis. Reasoning about uncertainty*, eds. Sven Ove Hansson, and Gertrude Hirsch Hadorn xx-xx. Dordrecht: Springer.

Singer, Peter. 1988. Ethical Experts in a Democracy. In *Applied Ethics and Ethical Theory*, eds. David M. Rosenthal, and Fadlou Shehadi, 149–161. Salt Lake City: University of Utah Press.

Singer, Peter. 2002. *Animal Liberation. 3rd ed.* New York: Harper Collins.

Skyrms, Brian. 2000. *Choice and Chance. An Introduction to Inductive Logic. 4th ed.* Belmont, CA: Wadsworth.

Snoeck Henkemans, A. Francisca. 2001. Argumentation Structures. In *Crucial Concepts in Argumentation Theory*, ed. Frans H. van Eemeren, 101–134. Amsterdam: Amsterdam University Press.

Spohn, Wolfgang. 2012. *The Laws of Belief*. Oxford: Oxford University Press.

Steele, Katie. 2006. The Precautionary Principle: a New Approach to Public Decision-Making? *Law, Probability, and Risk* 5: 19–31.

Walton, Douglas N. 1996. *Argument Structure. A Pragmatic Theory.* Toronto: University of Toronto Press.

Walton, Douglas N., Chris A. Reed, and Fabrizio Macagno. 2008. *Argumentation Schemes.* Cambridge: Cambridge University Press.